NREL
NATIONAL RENEWABLE ENERGY LABORATORY

# Beyond the Inventory: An Interagency Collaboration to Reduce Greenhouse Gas Emissions in the Greater Yellowstone Area


Alicen Kandt and Eliza Hotchkiss
*National Renewable Energy Laboratory*

Mike Fiebig
*U.S. Forest Service*



**NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.**

**Technical Report**
NREL/TP-7A20-49291
October 2010

Contract No. DE-AC36-08GO28308

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

# Beyond the Inventory: An Interagency Collaboration to Reduce Greenhouse Gas Emissions in the Greater Yellowstone Area

Alicen Kandt and Eliza Hotchkiss
*National Renewable Energy Laboratory*

Mike Fiebig
*U.S. Forest Service*

Prepared under Task No. FE10.R110



National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401
303-275-3000 • www.nrel.gov

**Technical Report**
NREL/TP-7A20-49291
October 2010

Contract No. DE-AC36-08GO28308

**NOTICE**



Available electronically at http://www.osti.gov/bridge

Available for a processing fee to U.S. Department of Energy
and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information

P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865.576.8401
fax: 865.576.5728
email: mailto:reports@adonis.osti.gov

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800.553.6847
fax: 703.605.6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/help/ordermethods.aspx

Cover Photos: (left to right) PIX 16416, PIX 17423, PIX 16560, PIX 17613, PIX 17436, PIX 17721

Printed on paper containing at least 50% wastepaper, including 10% post consumer waste.

# Contacts


**Authors**

Alicen Kandt
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-384-7518
Alicen.Kandt@nrel.gov

Eliza Hotchkiss
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-384-7309
Eliza.Hotchkiss@nrel.gov

Mike Fiebig
U.S. Forest Service
10 E. Babcock
Bozeman, MT 59715
406-587-6755
mtfiebig@fs.fed.us

**Contributing Authors**

Kristin Day
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-275-4491
Kristin.Day@nrel.gov

John Nangle
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-384-7377
John.Nangle@nrel.gov

Rebecca Butler
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-275-4372
Rebecca.Butler@nrel.gov

Margaret Mann
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-275-2921
Margaret.Mann@nrel.gov

Chuck Kurnik
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
303-275-4374
Chuck.Kurnik@nrel.gov

Heather Davis
U.S. Forest Service
10 E. Babcock
Bozeman, MT 59715
406-587-6729
hadavis@fs.fed.us

Anna Jones-Crabtree
U.S. Forest Service
2880 Skyway Drive
Helena, MT 59601
406-495-3744
ajonescrabtree@fs.fed.us

Trista Patterson
U.S. Forest Service
204 Siginaka Way
Sitka, AK 99835
907-747-4315
tmpatterson@fs.fed.us

## Acknowledgements

The National Renewable Energy Laboratory (NREL) thanks the U.S. Forest Service for its interest in securing NREL's assessment expertise. In particular, NREL is grateful to Mike Fiebig and Anna Jones-Crabtree for their generous assistance and cooperation.

Technical assistance conducted and outlined in this report was funded by the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP) and awarded to the U.S. Forest Service (USFS), unless otherwise noted.

## Abbreviations and Acronyms

| | |
|---|---|
| CFL | Compact fluorescent lighting |
| CFP | Climate Friendly Parks |
| $CH_4$ | Methane |
| CLIP | Climate Leaders in Parks |
| $CO_2$ | Carbon dioxide |
| DOE | U.S. Department of Energy |
| ECM | Energy conservation measure |
| EISA | Energy Independence and Security Act of 2007 |
| E.O. | Executive order |
| EPA | U.S. Environmental Protection Agency |
| ESPC | Energy savings performance contract |
| EV | Electric vehicles |
| FEMP | Federal Energy Management Program |
| FWS | U.S. Fish and Wildlife Service |
| FY | Fiscal year |
| GHG | Greenhouse gas |
| GSA | U.S. General Services Administration |
| GYA | Greater Yellowstone Area |
| GYCC | Greater Yellowstone Coordinating Committee |
| HFC | Hydrofluorocarbons |
| HVAC | Heating, ventilating, and air conditioning |
| kg $CO_2e$ | Kilograms carbon dioxide equivalent |
| LED | Light-emitting diode |
| LEED | Leadership in Energy and Environmental Design |
| M&V | Monitoring and verification |
| MPG | Miles per gallon |
| MPH | Miles per hour |
| $MTCO_2e$ | Million tons carbon dioxide equivalent |
| $N_2O$ | Nitrous oxide |
| NPS | U.S. National Park Service |
| NREL | National Renewable Energy Laboratory |
| O&M | Operations and maintenance |
| PFC | Perfluorocarbons |
| PIH | Plug-in hybrid |
| PPA | Power purchase agreement |
| REC | Renewable energy certificate |
| ROA | Reductions Options Analysis |
| $SF_6$ | Sulfur hexafluoride |
| USFS | U.S. Forest Service |
| UTV | Utility terrain vehicles |
| VMT | Vehicle miles traveled |
| VOC | Volatile organic compound |
| VTC | Video teleconferencing |
| WCF | Working Capital Fund |

## Executive Summary

As one of the largest, intact ecosystems in the continental United States, land managers within the Greater Yellowstone Area (GYA) have recognized the importance of compiling and understanding agency greenhouse gas (GHG) emissions. The 10 Federal units within the GYA have taken an active role in compiling GHG inventories on a unit- and ecosystem-wide level, setting goals for GHG mitigation, and identifying mitigation strategies for achieving those goals.

This paper details the processes, methodologies, challenges, solutions, and lessons learned by the 10 Federal units within the GYA throughout this ongoing effort.

Within the United States, there are vast areas of land under Federal management with multiple resources to control, and this management occurs across the jurisdiction of many agencies performing work under agency-specific mandates. Yet, there are few to no other case studies on record that have taken such a quantitative and collaborative approach to environmental emissions management across so many Federal agencies, or across such a large land base. As such, this case study of the GYA represents a unique opportunity to examine a broad, complex, social-ecological system that shares characteristics, advantages, and limitations with many other land-based cross-agency efforts. We can expect this knowledge and experience to become increasingly sought and valuable as Federal agencies seek unifying principles, criteria, and approaches to the intensifying environmental management pressures on national lands. The inventory approach, documentation of the project over time, and high degree of collaboration all contribute to the unique value of the information in this case study, which can be leveraged for future advancement in broad-scale environmental management efforts.

# Table of Contents

# List of Figures



# List of Tables

# 1 Introduction

The GYA is one of the largest intact ecosystems in the contiguous United States. This region encompasses 18 million acres across three states and contains six national forests, two national parks, and two fish and wildlife refuges. The GYA is one of the most highly visited natural regions in the United States, with more than 4 million visitors each year.

The multiple land-management agencies that operate within the GYA have a long history of working together to reduce the environmental impact of their operations. In 1964, the U.S. National Park Service (NPS) and the U.S. Forest Service (USFS) formed the Greater Yellowstone Coordinating Committee (GYCC), which was joined by the U.S. Fish and Wildlife Service (FWS) in 1999. The goal of the GYCC is to allow representatives from the three agencies to pursue opportunities of mutual cooperation and coordination in the management of core Federal lands in the GYA.[1]

In 2007, the USFS was the first Federal land management agency to join the U.S. Environmental Protection Agency (EPA) Climate Leaders program. As part of this affiliation, USFS agreed to develop a GHG emissions inventory for seven pilot projects, including inventories for the six national forests in the GYA. USFS staff also applied the EPA Climate Leaders protocol to the two FWS refuges. NPS compiled its own agency inventories and in 2008 and 2009, the National Renewable Energy Laboratory (NREL) consolidated the three agency inventories. The consolidated GYA GHG inventory captures emissions associated with anthropogenic activities on all Federal lands in the GYA.

In 2010, the GYA again worked with NREL to create a collaborative process to determine actions to reduce GHG emissions associated with the agency activities. The three Federal agencies used the inventory and action planning process to collaboratively set comprehensive emission reduction goals for the 18-million-acre ecosystem. This project is one of many actions the agencies are taking to understand and reduce their environmental footprint and to satisfy the requirements of Executive Orders (E.O.) 13423, 13514, and the Energy Independence and Security Act (EISA) of 2007 to lower petroleum, energy, and water consumption and to reduce GHG emissions.

This project serves as a model for how GHG accounting and reduction planning can be done across geographic and agency boundaries. This process is especially applicable to other land management agencies. Although the relative emissions from the GYA are comparatively small, this process and documentation, when replicated by other agencies and entities, can have a huge impact on both the public and private sectors. This process can also be replicated for other footprint areas (water, sustainable purchasing, etc.) within the GYA and in other agencies.

[1] GYCC Web site: http://fedgycc.org/

The documentation of this process is particularly important in light of the many benefits (such as cultural, procedural, and economic) that extend far beyond the scope of the quantified elements of the study. The challenges of leveraging these benefits to greater success represent systemic challenges. As such, this case study represents a unique opportunity to examine a broad, complex system (that shares many characteristics, advantages, and limitations with any land-based cross-agency effort) with the benefit of highly collaborative, quantitative documentation. This project could not have had the success it did without the very supportive and proactive project contacts and staff within each agency.

# 2 Project Background

As one of the largest intact ecosystems in the continental United States, land managers within the GYA have recognized the importance of compiling and understanding agency GHG emissions. The GYA is fortunate to have a group to focus on sustainability in the form of a subcommittee of the GYCC, which consists of supervisors from the forests, parks, and refuges to support ongoing efforts across the agencies in a collaborative manner.

In 2008, USFS entered into an interagency agreement with NREL through the USFS Rocky Mountain Region. The agreement was to develop a strategy toward achieving agency and Federal energy reduction goals specifically related to GHG emissions. The GYA ecosystem is comprised of three different Federal land management agencies and these agencies use different GHG accounting tools. NREL provided technical assistance to USFS in consolidating and analyzing GHG emissions inventories of Federal activities within the GYA from the different accounting tools. The USFS Rocky Mountain Region was the lead for this multi-agency partnership.

Following the completion of this agreement, USFS was awarded technical assistance support from the U.S. Department of Energy (DOE), to be provided by NREL for the Federal units within the GYA and led by USFS. This assistance was to guide the agencies through a unique, bottom-up approach to setting reduction targets through conservation measures.

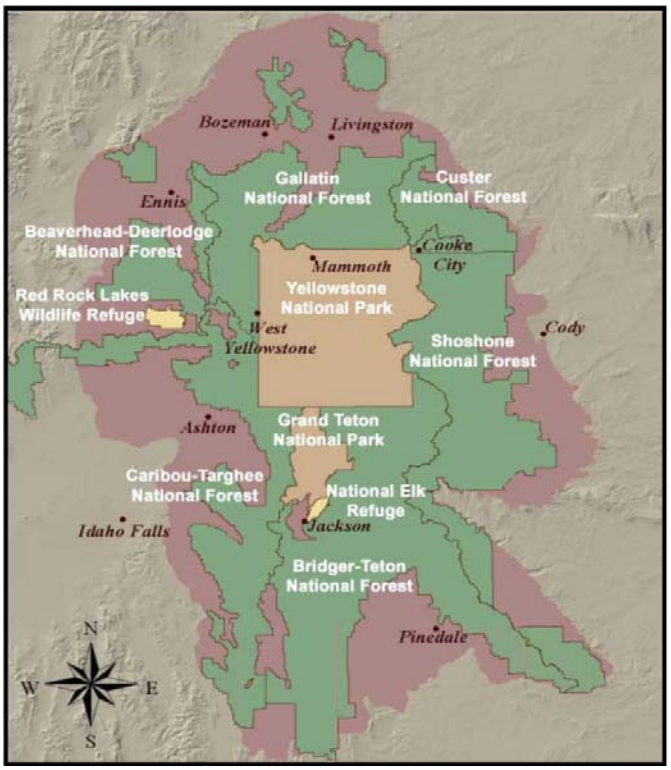



**Figure 1. Map of national forests within the Greater Yellowstone Area (Courtesy of the Greater Yellowstone Coordinating Committee)**

## 2.1 Geographic Scope

The GYA ecosystem is comprised of six national forests, two national parks, and two wildlife refuges, as shown in Figure 1. The six national forests within the GYA cover more than 13 million acres in Wyoming, Montana, and Idaho in Forest Regions 1, 2, and 4. Some of the forests are entirely encompassed by the GYA, while some include land areas that fall slightly outside of the boundaries of the GYA. National forests fully included in this study are the entire acreage of Bridger-Teton, Gallatin, and Shoshone. Only the sections of Beaverhead-Deerlodge, Caribou-Targhee, and Custer National Forests that fell within the GYA boundary were included.

The remaining 5 million acres of the GYA ecosystem are encompassed in the national parks and wildlife refuges. The national parks included in the GYA are Yellowstone and Grand Teton National Parks, with Yellowstone at the heart of the ecosystem. Yellowstone National Park was the country's first national park, and in 2000 it received close to 3 million visitors.

Red Rocks Lakes National Wildlife Refuge and the National Elk Refuge are the two FWS units that are included in the GYA. These are the smallest agency units within the GYA; however, they do have an impact on the GHG emissions of the GYA as a whole, as presented further in this document. The National Elk Refuge is of particular significance as it hosts the world's largest wintering concentration of elk, along with winter range for the largest bison herd of more than 800 bison in the National Wildlife Refuge System, shared with Yellowstone National Park.

These forests, parks, and refuges fall under three different Federal agencies and have national significance for managing lands and natural resources within a particularly sensitive and highly visited area of the country. While there are non-Federal lands associated with this area, the only emissions accounted for within the GYA inventories were those attributed to the operations of the Federal agencies

## 2.2 Greenhouse Gas Inventories and Emissions Sources

GHG inventories are intended to reflect an organization's activities that result in the direct or indirect emission of GHGs. They provide a snapshot of areas where efficiencies might be applied to reduce these emissions. GHG emissions are naturally occurring and man-made chemical compounds, which are being produced excessively by human (or anthropogenic) activities, such as burning of fossil fuels. GHGs are named as such due to their contribution to the greenhouse effect, which traps heat in the atmosphere and causes temperatures on the Earth's surface to rise. The pressing concern of reducing GHGs is an international phenomenon. Since the GYA ecosystem is of particular significance due to its unique natural characteristics, the agencies in the GYA are emphasizing the importance of reducing GHG emissions within agency activities and at an interagency level to further protect the ecosystem.

GHGs include carbon dioxide ($CO_2$), sulfur hexafluoride ($SF_6$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Table 1 shows these gases, as well as how they are most commonly produced or released into the atmosphere.

**Table 1. Greenhouse Gases[2]**

| Gas | Source Areas |
|---|---|
| Carbon Dioxide ($CO_2$) | Burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and other chemical reactions (e.g., cement manufacturing). |
| Sulfur Hexafluoride ($SF_6$) | Magnesium casting, transformers, and electrical switches. |
| Methane ($CH_4$) | Emitted during the production and transport of coal, natural gas, and oil, as well as livestock and agricultural practices, and by the decay of organic waste in municipal solid waste landfills, mulch piles, and peat bogs. Thawing permafrost and deep lakes are also significant sources of methane emissions. |
| Nitrous Oxide ($N_2O$) | Emitted during agricultural and industrial activities and during combustion of fossil fuels and solid waste. |
| Hydrofluorocarbons (HFCs) | Refrigerant leaks, fire extinguishers, and solvents. |
| Perfluorocarbons (PFCs) | Aluminum production, semiconductors, and health imaging. |

Different inventory types capture different GHGs. The most commonly reported gases are $CO_2$, $CH_4$, and $N_2O$. Often, inventories will report units in terms of carbon dioxide equivalent since a chemical's global warming potential (or the efficacy of chemicals to contribute to the greenhouse effect) is measured against $CO_2$. The unit is often written as $CO_2e$ (within the United States it is metric tons of $CO_2e$) or $CO_2$ equivalent.

GHG emissions are generally separated into three categories: Scope 1, Scope 2, and Scope 3. An image of these GHG emission scopes and their sources is shown in Figure 2. These three categories are defined as follows:

**Scope 1—Direct emissions sources** originate from equipment owned and/or operated by an organization at the time of emission. This includes emissions from on-site fuel use, such as oil burning in a heating furnace or gasoline combustion in a vehicle. This also includes fugitive emission sources, such as refrigerators and air conditioning units, which emit GHGs through equipment leaks, maintenance, or other less direct means.

**Scope 2—Indirect emission sources**, such as those generated from purchased electricity use, occur as a result of activities within an organization (e.g., office electricity use), but originate from sources located outside the organization (e.g., electric power plant).

**Scope 3—Optional emission sources** include emissions generated by miscellaneous sources for which emissions have not been traditionally estimated and over which organizations may not have direct control, such as off-site waste disposal, product transport, employee commuting, and business travel. They are often called "optional" because they have not been historically required for reporting purposes.

[2] EPA: http://epa.gov/climatechange/emissions/index.html

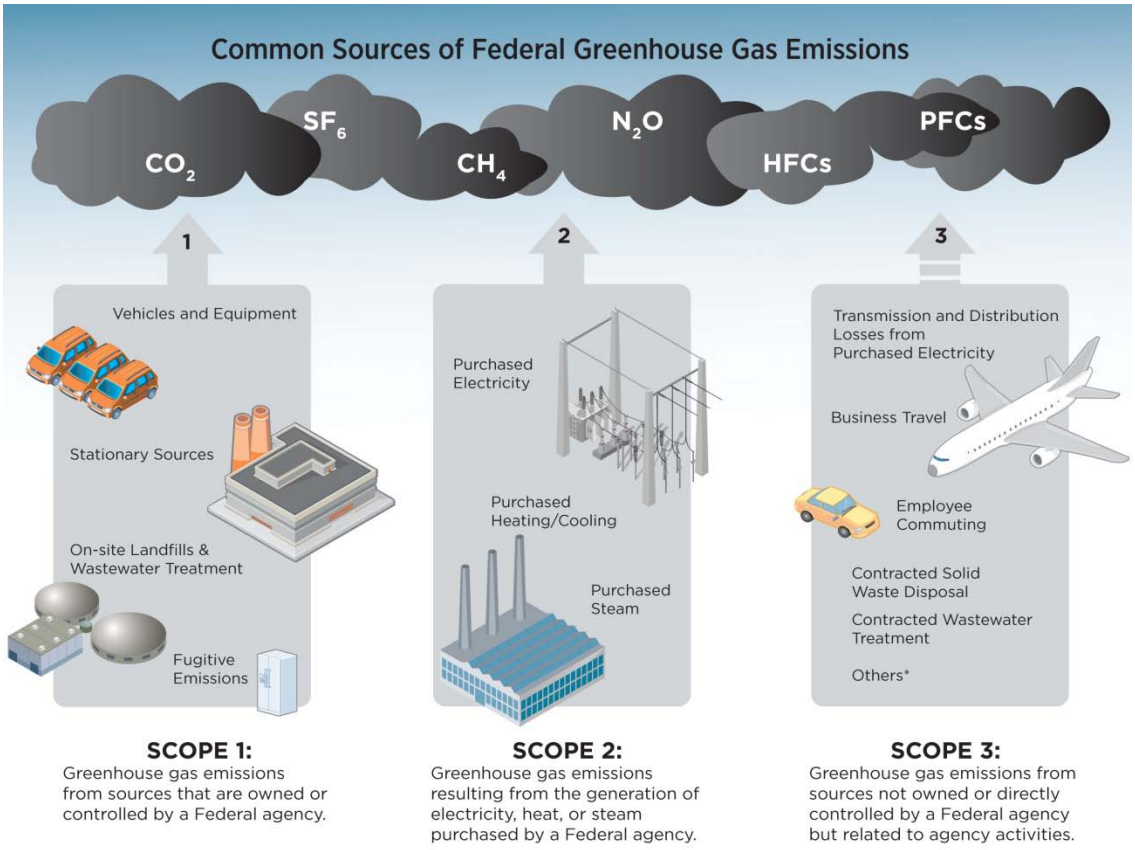



**Figure 2. Scopes of GHG emissions (Credit: NREL)**

## 2.3 Legislation

The GYA inventory was compiled before legislative requirements for agencies to report their GHG emissions. The GYCC felt it imperative to act on creating a GHG inventory and begin creating action plans to reduce emissions before legislation was issued.

The crosswalk in Appendix 4 summarizes the most recent executive orders, as well as the existing statutes, that require improvements in energy efficiency, fleet fuel consumption, increased use of renewable energy technologies, etc. The major legislative forces are E.O. 13423 and E.O. 13514, EISA 2007, and the Energy Policy Act (EPAct) of 2005.

# 3 Setting a Baseline

## 3.1 GYA Unit GHG Inventories

In 2007, USFS agreed to develop a GHG inventory for the six national forests in the GYA. The study was conducted to better understand the consequences of their operations and to meet a requirement to become affiliated with the EPA's Climate Leaders program.[3] The baseline inventory was established for fiscal year (FY) 2007 in order to set and track credible GHG emissions reduction goals for six national forests and the wildlife refuges within the GYA, to be updated annually pursuant to the EPA Climate Leaders protocol. Accordingly, the forest and refuge inventories were completed using the EPA Climate Leaders GHG tool.

The EPA Climate Leaders GHG Calculator Tool (Version 2.8) was used to estimate $CO_2$, $CH_4$, and $N_2O$ emissions within the forest and refuge units in the GYA. The Climate Leaders tool is a Microsoft Excel–based workbook designed to help small businesses and other low emitters estimate their GHG emissions. All methodologies and default values in the tool are based on the most current Climate Leaders Greenhouse Gas Inventory Protocol guidance.

Noted above, the two wildlife refuges are the smallest agency units in the GYA, with very little personnel capacity available to complete a complicated GHG inventory for their operations. As such, USFS staff volunteered to complete the refuge's GHG inventories along with those of six national forests.

For the forest service and refuge inventories, the data for each emissions scope (Scopes 1, 2, and 3) was further divided into source categories, such as mobile sources and electricity that could be evaluated separately. Five emissions sources were included in the inventory: stationary, mobile, purchased electricity, employee commuting, and business air travel.

In the late 1990s, the Climate Friendly Parks (CFP) program also began to address the need for GHG inventories. NPS created a Climate Leaders in Parks (CLIP) tool, which is being used nationally by NPS. The CFP program is a collaboration between NPS and EPA to provide national parks with management tools to impact decisions relating to climate change. Parks need to apply to participate in the CFP program, which includes measuring the park's GHG emissions, developing strategies to mitigate emissions, and educating the public about the park's reduction efforts.

NPS used the CLIP tool for their GHG inventories at Yellowstone and Grand Teton National Parks. The Microsoft Excel based tool is broken into two distinct modules that have their own separate function: the Emission Inventory Module and the Action Planning Module. The Emission Inventory Module is designed to help park staff inventory and estimate emissions resulting from activities within the park. The purpose is to identify the impact of employees, concessionaires, and visitors on climate change and air pollution. The Action Planning Module is

[3] The Climate Leaders program is an EPA industry-government partnership that works with companies to develop comprehensive climate change strategies. Participating companies commit to reduce their impact on the global environment by completing a corporate-wide inventory of their greenhouse gas emissions based on a quality management system, setting aggressive reduction goals, and annually reporting their progress to EPA. Through program participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders.

designed to assist park staff in identifying actions to reduce emissions of GHGs and criteria pollutants, and to target specific emissions reductions associated with those actions. The culmination of the Action Planning Module is the development of an action plan that a park can use to establish the emission mitigation actions identified as goals for the park.[4]

The inventory created within the CLIP tool requires data associated with Scopes 1, 2, and 3 emissions. In 2008 Yellowstone and Grand Teton had inventories completed, using the CLIP tool, for their parks.

The differences between the EPA and CLIP tools are specified further in Appendix 2.

## 3.2 GYA Inventory Compilation

In 2008 and 2009, NREL was funded by USFS to compile the 10 individual unit GHG inventories into one comprehensive inventory. The consolidated GYA GHG inventory captures emissions associated with anthropogenic activities on all Federal lands in the GYA. The inventories were conducted with baseline years between 2006 and 2008, with only slight variations expected from year to year.

As mentioned in the previous section, various calculator tools are available to Federal agencies for estimating emissions from agency activities. USFS and FWS units used the EPA Climate Leaders GHG Calculator Tool, whereas NPS used the CLIP tool. These tools have a variety of different assumptions and calculation methodologies, making it inaccurate to simply combine all of the inventories. A summary of these differences is available in Appendix 2.

NREL studied each inventory and worked with the units and the people who had compiled the unit inventories to better understand common assumptions and differences in operations and purpose across the 10 units. The inventory data for the units was compiled into one comprehensive, GYA-wide inventory through the development of a Reductions Options Analysis (ROA) Tool.

The results of the GYA inventory revealed that the largest emitters were from Scope 2 purchased electricity, contributing 25,536 million tons $CO_2e$ ($MTCO_2e$)—more than half of the total emissions. Stationary combustion (Scope 1) was equivalent to 12,626 $MTCO_2e$ and mobile combustion emissions from unit-owned vehicles and generators (Scope 1) were over 10,557 $MTCO_2e$.

The largest emitting agency is NPS, whose total purchased combustion emissions were 91% of the total GYA-wide emissions; stationary combustion was 89% and mobile combustion was just over half. The chart in Figure 3 indicates the breakdown of emissions in terms of $MTCO_2e$ by agency.

[4] Climate Friendly Parks (CFP): www.nps.gov/climatefriendlyparks/CLIPtool/index.html

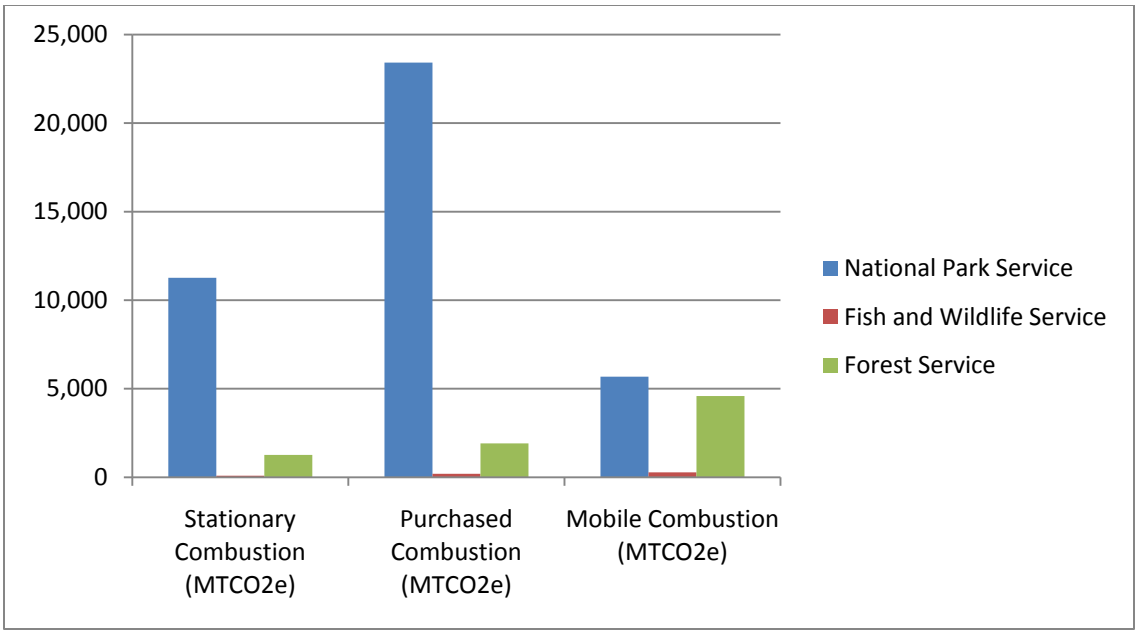



**Figure 3. Total GYA emissions by Federal agency**

Broken down even further, at a unit-level, it is easier to determine which units have the opportunity for emissions reduction programs. Figure 4 shows that the largest emitter within the NPS is purchased combustion (electricity) by Yellowstone National Park, whose emissions are far greater than those of Grand Teton National Park.

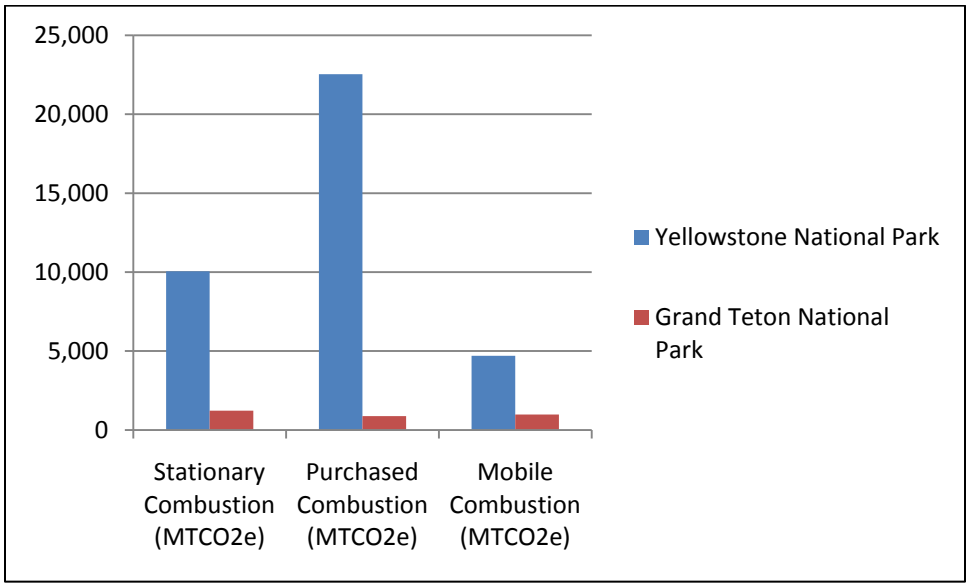



**Figure 4. Emissions by national parks**

Figure 5 summarizes the emissions from the two wildlife refuges in the GYA. It is interesting to note that the largest emitter, unlike the NPS units, is mobile combustion, particularly from the National Elk Refuge.

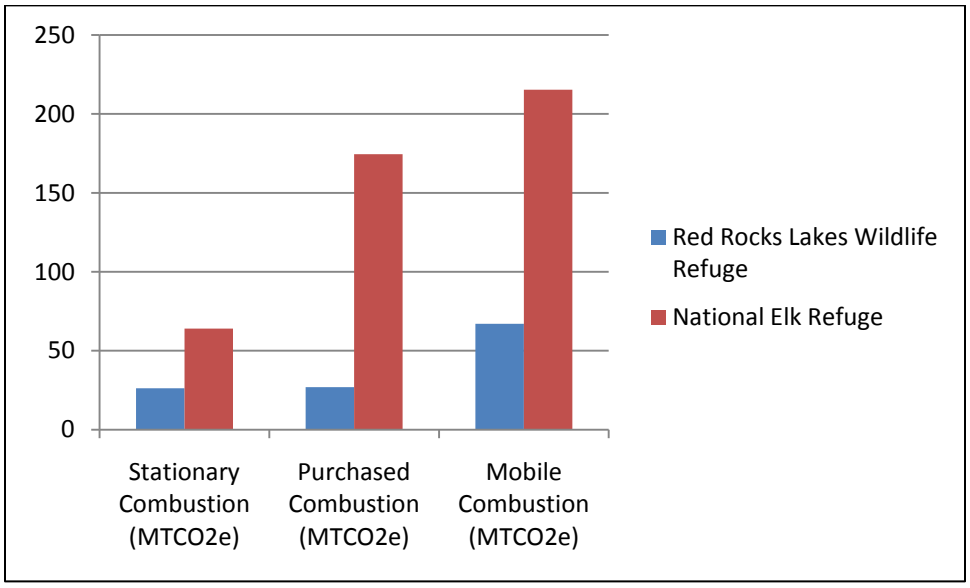



**Figure 5. Emissions by U.S. Fish and Wildlife Service**

Figure 6 represents the emissions from the six national forests within the GYA. The largest emitter, similar to FWS, is mobile combustion sources. The Caribou-Targhee National Forest had the largest emissions, with over 1,200 $MTCO_2e$. The total emissions from mobile sources across the forests were 4,590 $MTCO_2e$, which is comparable to Yellowstone National Park's mobile emissions. The difference comes from the territory that the forests cover, which is equivalent to 13 million acres of the total 18 million that the GYA ecosystem encompasses.

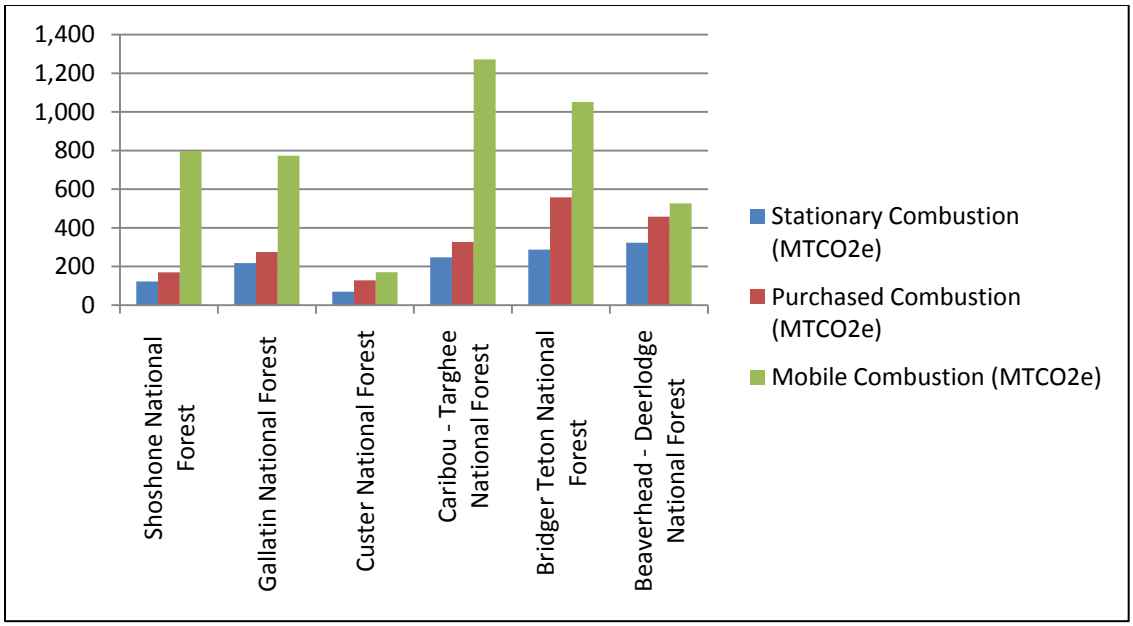



**Figure 6. Emissions by U.S. Forest Service**

The results of the inventory were used to encourage participants during the action planning process, discussed in Sections 4, 5, and 6 of this document.

# 4 Defining Success: Goal Setting and Action Planning Strategy

Following the compilation of the GYA GHG emissions inventory in April 2009, the GYCC wanted to create a GHG emissions reduction action plan (or Climate Action Plan) that would be tiered to both the individual agency unit and the ecosystem as a whole. This cross-agency approach taken by the GYCC was unique. Most organizations or agencies do not collaborate on GHG accounting and reduction, but this method builds upon years of successful ecosystem-wide coordination by the GYCC, and would result in more unified, attainable, and transferrable goals. In order to help GYCC staff create a methodology that engaged all GYA land management agency units and significantly reduce GHG emissions, the GYCC created a "Definition of Success" to guide the process. This definition contains three parts:

- Set and meet a credible, realistic, and ecosystem-wide GHG emissions reduction goal
- Ensure the capacity and leadership intent to meet that goal once it is set
- Develop and document the methodology used for GHG accounting and reduction to serve as a model for other footprint areas, other agencies, and the public.

The interagency and collaborative nature of land management in the GYA, combined with the distributed leadership structure of USFS (which manages six of the ten agency units in the ecosystem), pointed to the creation of a "bottom-up" methodology for climate action planning. Bottom-up meant that GHG emissions reduction action plan goals would be created first by each agency unit, then built into ecosystem-wide emissions reduction goals (e.g., grassroots organizing is a common "bottom-up" system). By contrast, a "top-down" method would have meant that emissions reduction goals would be created by the leadership—in this case, the GYCC. Using the bottom-up methodology, staff engaged each agency unit individually, recording emissions reduction actions that units had completed since the GHG inventory baseline year (FY 2007), emissions reduction actions that are ongoing or already planned, and future actions that might be particularly suited to the agency unit. All actions have a 2020 target date as dictated by E.O. 13514.

The strength of this approach lies in the collaborative formulation of goals that will be attainable by the units, as well as encourage GHG emissions reduction action plans to be as ambitious as possible for each unit. This method was also chosen in order to maximize the ownership that each agency unit had over their climate action plan. This was critical to the process, considering that the action plans would not only have to be implemented by agency personnel at each unit, but also that this would primarily be an additional duty outside of most staff's regular position description. Another benefit to using this methodology is that the ultimate ecosystem-wide GHG emissions reduction goal will be created from the unit goals, which in turn will be based upon each unit's capabilities. This will give the ecosystem-wide goal a high probability of being met since the individual unit plans will act as roadmaps to meet that ecosystem-wide emissions reduction goal.

The biggest challenge of implementing this methodology was meeting the second part of the Definition of Success, "ensuring the capacity and leadership intent to meet that goal." Barriers included a general lack of understanding about GHGs and climate change, a low feeling of empowerment and buy-in to create GHG reduction action plans due to primary duty workloads,

and a perception of insufficient time and resources to accomplish this goal. To address these barriers, GYCC staff used a $250,000 Federal Energy Management Program (FEMP) technical assistance grant with NREL to host a GYA-wide working session, preceded by an eight-part Webinar series and proceeded by a three-part Webinar series. The goals of the Webinars and the workshop were threefold:

- Educate and empower employees around climate change response and action planning.
- Create a rough climate action plan for each unit and the ecosystem as a whole.
- Create a leadership and project management cohort across the GYA agencies.

This strategy was immensely successful, resulting in roughly 60 attendees from across the ecosystem, including representatives from eight out of 10 GYCC member units. Attendees completed draft action plans for the 10 agency units, as well as a prioritized list of GYA-wide projects. In addition, three interagency implementation teams are currently working on GYA-wide projects in fleet, facilities, and Scope 3 footprint areas. The workshop helped to create the agency staff empowerment and ownership of the GYA Climate Action Plan critical to the methodology chosen.

Prior to the working session, the GYCC member from each agency unit pledged a minimum 20% GHG emissions reduction by 2020 in order to help motivate unit personnel to meet a minimum GHG reduction threshold (especially in those units that were not engaging as much in the process), and meet what was then a draft goal of E.O. 13514 (later omitted in the final version). It is believed by staff that this goal will be exceeded, likely resulting in a roughly 25% GHG emissions reduction ecosystem-wide, but this top-down decision by managers to designate a minimum reduction goal was a critical step of showing leadership's dedication to the cause. In this way, one could say that bottom-up and top-down methods actually met in the middle.

As of September 2010, GYA agency units were working with staff to add detail to their action plans. Staff members aim to complete a detailed draft Interagency Climate Action Plan for the GYA using this methodology by October 2010.

# 5 Education, Empowerment, and Building of Capacity

Through the FEMP technical assistance grant, NREL was tasked by GYA staff with creating and hosting a working session that would educate participants within the GYA about GHG impacts and reduction strategies, empower them to identify areas of GHG mitigation opportunities, and carry on the GHG reductions work from a unit level. Planning and implementation of the resulting working session was accomplished collaboratively with GYA staff members. NREL analyzed data from the 2007 inventories and where gaps were identified, further data was requested. The goal in acquiring additional, updated data was to identify areas where there are challenges in data collection, as well as target the subject matter during the educational aspects of the working session.

The working session was organized into pre-work (which included Webinars), a week-long working session, and post-working session Webinars. Webinars held before the working session were designed and delivered to GYA participants to begin discussions relating to GHG emissions and their scopes. Webinars held after the working session provided GYA participants a chance to ask questions and receive guidance as they prepared unit-level action plans for detailing GHG mitigation strategies.

It was decided that for the Webinars, working session, and action planning, emissions would be organized into three functional areas: facilities, fleet, and Scope 3 (or other), in order to better represent the GYA staff structure. Typically, emissions are divided into Scope 1, 2, and 3; however, maintaining this organization would have cut across functional areas. This structure made the most sense when organizing GYA agency personnel into tracks for the working session and for coordinated implementation of projects, but it highlights an ongoing difficulty that agencies will face with upward reporting. These difficulties are further detailed in Section 7.2 of this document.

The facilities group covered stationary emissions and purchased electricity from buildings and water consumption within buildings; the fleet group addressed emissions generated from unit-owned and leased vehicles; and the Scope 3 group included procurement, water, and waste emissions. Each emissions group was designated a point of contact and a subject lead at NREL, to provide participants with some continuity through the pre-work, working session, and action planning process. These subject leads were also present during the working session to present subject-related material and provide answers to technical questions that arose.

## 5.1 Pre-Work

The main goal of the GHG emissions inventory and action planning process was to educate the unit participants. In order to accomplish this, Webinars and pre-work were created. Pre-work was prepared to introduce the data collection process to unit participants and to engage them in the project. The first Webinars covered material relating to GHG emissions and climate change, the science of climate change, and how daily activities impact the environment. The Webinars offered a platform to set the stage, put the project into the climate change context, and helped gauge the state of understanding of individual scopes before the working session. Webinars are posted at http://fedgycc.org/SOSGHG.htm.

Data was collected, where possible, and analyzed within each of the track areas (fleet, facilities, Scope 3), to determine where there were changes from the previous inventory, as well as to determine the focus of the working session.

- **To supplement the 2007 inventory data, recent facilities data was requested from each of the units to determine the energy and water consumption associated with the buildings in each unit.** The NREL facilities lead taught unit facility representatives how to calculate energy intensity and to identify the highest consuming buildings based on this metric. Participants were asked to collect annual energy and water use data—including use and cost data for electricity, natural gas, propane, and water—on the five highest consumers within each unit. Following the initial data call, units were asked to submit detailed data on the building's equipment and systems in the five highest-consuming buildings. Data was difficult to obtain due to busy workloads, as well as a lack of knowing how to access or collect the data requested. The data that was submitted indicated that space heating was the highest-consuming end-use within most buildings, followed by lighting and equipment loads. A few unique systems (such as underground heating of sidewalks where the control system was not completely understood by maintenance staff) were identified that highlighted greater issues with design and funding streams within the GYA. Knowledge of participants was also assessed based on the responses submitted in the data collection sheets, which helped to tailor the working session subject material to raise the knowledge levels.
- **Fleet data outlining usage or vehicle changes following the inventory was requested from each of the units.** This was a difficult task due to heavy workloads and the absence of an efficient means to gather source data such as engine type, mileage, and fuel usage for Working Capital Fund (WCF), the U.S. General Services Administration (GSA), and agency-owned vehicles. The data provided by each unit ranged from a qualitative assessment of planned and implemented fleet changes and daily use to detailed vehicle replacement and usage values for FY 2009. Referencing records from the past inventory and the unit-level data that was received, baseline mobile source emissions at both the unit level and ecosystem-wide were defined by the NREL fleet lead. Yellowstone National Park was the largest emitter, accounting for 45% of the total ecosystem-wide mobile source emissions. Conversely, Red Rock Lakes Wildlife Refuge accounted for only 0.6%.

  In an effort to further define the mobile sources, a distribution by vehicle type was created. Ecosystem-wide, the analysis indicated that 39% of the mobile source emissions were due to the operation of gasoline light-duty trucks. Diesel heavy-duty vehicles and gasoline passenger cars rounded out the top three emitters at 15% and 14% respectively. The same analysis was completed at the unit-level. Considering the data in this form allowed each unit—no matter size or mission—to understand their specific baseline emissions sources. With that awareness, they were prepared to evaluate how the greatest emitting vehicles were being used and identify possible areas for reduction during the working session.

- **The available data for the Scope 3 analysis was limited to the inventory data from 2007, compiled into the GYA-wide inventory in 2008 and 2009 with the assistance of NREL.** The inventory categories that fell under Scope 3 were limited to employee commuting and business travel. Data associated with Scope 3 emissions was difficult to collect due to the limited ownership of these sources by agencies. Therefore, the pre-work for Scope 3 included a spreadsheet calculator tool, created by NREL, to assist in calculating specific emissions for each unit within the GYA. The tool was designed to be user-friendly and make the data gathering process for different emissions sources fairly straightforward. The goal was to show the relative emissions of different sources with limited data inputs. The tool is available in Appendix 5.

  The calculator was designed to collect information pertaining to GHG emissions associated with business air travel, employee commuting, wastewater and municipal solid waste, supply chain, and other areas. Data collection proved difficult; however, the information that was available from the 2007 inventory indicated that the highest Scope 3 GHG emitter was Yellowstone National Park**.**

## 5.2 Pre-Working-Session Webinars

Following the data collection and analysis, NREL designed Webinars to educate unit participants and raise the level of knowledge prior to the working session. The intent was to make the most of the time while the participants were available.

Prior to the NREL Webinars focusing on each functional track, GYA staff hosted two "GHG 101" Webinars in order to ensure that working session participants started with equal background knowledge. Topics covered included the science behind anthropogenic GHG emissions, their relation to global climate change, basic GHG accounting principles like emissions scopes and $CO_2$ equivalents, GHG inventories in general and the results of the GYA GHG inventory, planning for GHG emissions reductions and the GYA Climate Action Plan process, and finally an overview of the working session and forthcoming pre-work.

- **The facilities Webinars** focused primarily on energy legislation; increasing energy awareness within the units; the importance of metering and data collection, monitoring data, and setting targets through a robust program; incorporating efficiency into operations and maintenance programs; and preparing for the working session. The Webinars also explained the data collection sheets and the required information, and showed where to find the information and how to complete the forms. Energy efficient technologies were discussed briefly and discussions were held to determine the current activities of emissions reduction projects at each unit.

  Discussions related to where to find data and where to draw the boundaries of what's included in the data collection process also took place. Many units were concerned about the differentiation between unit-owned buildings and those that were leased from the GSA. The energy efficiency measures that can be implemented in leased buildings are limited due to the lack of control over ownership. The participants were directed to focus on unit-owned facilities as it was felt by the units that more measures could be implemented, and thus more GHG emissions reductions could be

realized, in the owned buildings. Leased facilities were noted as an important topic of discussion for the working session.

- **The fleet Webinars** served not only as a means to request further data from participants, but also to allow for open discussion between interagency colleagues and the NREL fleet leads. After reviewing the inventory data and available updates, and defining the mobile source baseline, participants discussed unit-level reduction goals and how they fit in with the goals of the ecosystem as a whole. Once reduction targets were identified, methods that could be employed to meet them were reviewed. Current and emerging vehicle and fuel technologies offering reduced GHG emissions were presented and their feasibility of use within the individual units was discussed. Identifying improvements in mobile planning and operations to avoid unnecessary emissions were also considered.

  Discussions often centered on roadblocks the participants envisioned they would experience when attempting to reduce mobile source emissions and how those may be overcome. These largely included the following: overcoming the behavior and culture of staff; the lack of alternative fueling infrastructure; encountering ineffective and contradictory policies; high vehicle capital costs; and the absence of efficient GHG emissions tracking methodology.

- **The Scope 3 Webinars** were designed to provide education on Scope 3 emissions sources and provide some ideas for emissions reductions to help seed the discussion for the working session. Discussions during and after the Webinars focused on education about the basics of Scope 3 emissions, sources, and accounting for the associated GHGs. Due to the lack of available data for Scope 3 emissions, the spreadsheet calculator was not used. The discussions focused on emissions mitigation strategies for various Scope 3 emissions sources. Some units had environmental plans in place that included Scope 3 emissions, and members from those units were asked to present on their work at the working session to provide a GYA context for other units. The material presented included waste stream diversion to recycling and using videoconferencing capabilities instead of travel.

Using the Webinars as a forum to educate, set goals, and identify participant interests and concerns proved to be advantageous for the creation of a meaningful agenda for the working session. The exercise also allowed for communication and idea sharing across interagency lines that may not have taken place otherwise.

### 5.3 Working Session

Bozeman, Montana, was deemed a good central location for the working session. Although it would require all participants to travel, the distance of travel was not excessive. Efforts were taken to ensure that the working session was held in an environmentally responsible manner; participants were encouraged to use green hotels, bring their own coffee cups, use nametags from previous conferences, and walk to and from the meetings when possible. Public transit was also provided for field trips and commuting to the different venues throughout the week.

The working session was held during one week in April 2010, beginning on a Monday afternoon and ending by Thursday evening to accommodate busy schedules. On Monday afternoon a

general session was held for all participants, with introductions and background information, as well as a presentation on what to expect for the rest of the week. Each of the remaining days (Tuesday, Wednesday, and Thursday) began with a general topic presentation for all participants covering water, renewable energy certificates (RECs) and power purchase agreements (PPAs), and an overview of resources on DOE's FEMP Web site. The rest of the time on Tuesday and Wednesday was spent in break-out groups, divided by track area, with each group focused on furthering the education relevant to each track area. Field trips to inspire participants, and brainstorming actions for reducing GHG emissions also took place. On Thursday the participants were organized by units and spent time compiling the action plans for their unit and then presenting the action plans to all of the GYCC unit supervisors. That afternoon, participants brainstormed and created lists of potential GYA-wide/interagency actions for each track area. Throughout the week, project participants were interviewed by an independent researcher to capture elements, advantages, and challenges to applying the approach and methodology more broadly to other regions or to other impact categories.

At the end of the working session, three interagency actions were chosen—one in each track area—by the supervisors and participants to implement across all units. GYA staff had secured $30,000 from grants and awards to help implement these first three GYA-wide actions, with the idea that more will follow over the next decade (building from lessons learned while implementing these first three projects). Agendas for the working session are available in Appendix 1; presentations are available at: http://fedgycc.org/SOSGHG.htm.

**Figure 7. Participants of the GYA working session, Bozeman, Montana (Courtesy of Trista Patterson, USFS)**

During the subject tracks on Tuesday and Wednesday, the participants focused on their specific subject areas: facilities, fleet and Scope 3.

### *5.3.1 The Facilities Track*

The facilities track was comprised predominantly of facilities managers with experience and knowledge of energy and water efficiency topics. The focus of the track was to present existing and new technologies for energy and water efficiency and renewable energy pertaining specifically to buildings. The sessions covered areas of energy and water consumption within buildings such as lighting, heating and ventilation, building envelope losses and gains, plug loads, toilets and faucets, and landscaping water use. After providing an overview of energy and water use in buildings, the measures that are most frequently recommended, or are considered easy and inexpensive to implement, were detailed. These measures could be used within a variety of buildings across the agencies with a relatively short payback period. Technologies that were covered included light-emitting diode (LED) and fluorescent lighting and occupancy sensors for lighting and office equipment at desks; variable speed drives; low-flow toilets; porous pavement; and xeriscaping, just to name a few. Additionally, in order to balance the discussions between culture change and available technologies, measures such as energy awareness campaigns and utility data cleanup projects were discussed. The Shoshone National Forest had already undertaken a utility data cleanup and this was used as a case study for energy and monetary savings.

Renewable energy technologies were discussed, along with tools available for determining the technical and economic potential of solar, wind, biomass, and geothermal technologies at a particular location. Alternative financing and incentives were also presented to provide guidance on overcoming the initial capital cost of installing renewable energy systems. Some units had already installed solar photovoltaic (PV) systems successfully, or were in the process of installing systems during new construction projects.

To inspire participants to achieve sustainability within renovations and new construction, two tours and a presentation were arranged. One tour took place at the Bozeman Library, a U.S. Green Building Council Leadership in Energy and Environmental Design (LEED®) certified building, and was conducted by architect Mark Headley and LEED project manager Kath Williams. The library is an example of how energy efficient strategies, such as daylighting, natural ventilation, nighttime cooling, low volatile organic compound (VOC) construction materials, and solar PV can be integrated into a new construction project with the goal of achieving LEED certification.

A presentation entitled, “Innovation within the GYA: An Example of LEED Renovation at the Grand Teton National Park” was presented by Chris Finlay of Grand Teton National Park. Within the presentation, Mr. Finlay described the processes that the park undertakes to ensure that renovations and new construction meet LEED certification. A second tour was offered of the Montana State University (MSU) steam plant and the campus steam tunnels. This tour was conducted by Dan Stevenson, facilities manager at MSU. Dan was able to identify areas where improvements to the efficiency of the steam plant had been made and indicated the amount of savings the campus had realized since the upgrades.

Also presented during the facilities track was the Shoshone National Forest Net Zero Analysis, which was intended to inspire participants. This project was a separate task between the Shoshone National Forest and NREL; however, the results were presented as an example of a

goal that can be established across different agencies. The Shoshone National Forest Net Zero Analysis project is still on-going and the report is currently being drafted.

The greatest challenge to the facilities track was providing information to those with little knowledge of the subject areas while trying to engage those who had experience with energy efficiency, water conservation, and renewable energy technologies. During the educational presentations, participants were asked to note projects that they had implemented or believed they could implement at their units. During the brainstorming session for potential actions to reduce GHG emissions within facilities, the participants wrote possible energy and water conservation measures on note-boards and then each measure was discussed. The discussions of the measures were helpful to share ideas across the agencies and determine which measures might be applicable on a GYA-wide level. These brainstorming sessions were instrumental in providing guidance during the unit- and GYA-wide action planning process later in the week.


**Figure 8. Tour of the Bozeman Public Library, LEED (Courtesy of Mike Fiebig, USFS)**

### *5.3.2 The Fleet Track*

The intent of the fleet track was to support the GHG reduction objectives of the GYA ecosystem by focusing on ways to reduce its mobile source emissions. To achieve this and empower its participants, the fleet track was aimed at reviewing baseline data, identifying future goals, and sharing knowledge. The participants were further educated on GHG emissions and methods for reduction. Resource availability and potential partnerships within the ecosystem and beyond were also presented. A review of Federal guidance and legislation as they relate to Federal fleets was given as well.


**Figure 9. Eco Auto demonstration, Bozeman, Montana (Credit: Kristin Day, NREL)**

Additionally, the pre-work and discussions held during the Webinars identified a need to supply information to the participants regarding alternative fuels and infrastructure availability, GHG emissions calculation tools, and fleet optimization software. Time was also spent identifying and brainstorming solutions to behavioral and cultural challenges. The participants felt strongly that overcoming these challenges would be essential if fleet-related GHG reduction actions were to be implemented successfully.

To further inspire the fleet participants, a hands-on demonstration was given by Eco Auto, Incorporated, a Bozeman, Montana, company specializing in green personal transportation alternatives (see Figure 9). Participants learned about Eco Auto's vehicle utility and energy efficiency, and brainstormed ideas on how these vehicles could be used within their unit's fleets.

At the conclusion of the fleet breakout session, the participants felt educated, empowered, and inspired. By pulling from what they had learned, each participant was able to identify unit-level mobile source reduction actions they felt could be successfully implemented within their unit.

### *5.3.3 The Scope 3 Track*

During the Scope 3 track, the track lead reviewed the Scope 3 emissions and source material that had been introduced in the Webinars. Material was also presented covering E.O. 13514 and Federal GHG Accounting and Reporting Guidance. Presentations were also given by members from GYA units that had enacted environmental plans that included Scope 3 emission sources.

Educating the participants was a major focus; however, debates about boundary and control over certain emissions sources dominated the working session. As with the Scope 3 emissions sources, the conversations covered multiple topics and opportunities for reductions. The major topics included waste reduction, recycling, and composting.

# 6 Action Planning

Typically during an action planning process, an organization begins with data analysis, baseline compilation, and audits of current performance, and then establishes areas of reduction based on the current performance. As this was a bottom-up approach, which was intended to motivate on-the-ground staff, GYCC staff determined that actions should come from the staff that will be instrumental in the implementation process. By asking staff for their suggestions they have more of an investment in the projects and are motivated to participate in the implementation process to ensure its success.

The first step in the action planning process was to educate the participants through Webinars and the working session. During the brainstorming session within each track participants were able to generate their own conservation measures, while gaining ideas from other participants. Ecosystem-wide actions were also discussed and decided upon during these sessions. An effort was made to integrate solutions that involved culture change (e.g., behavior change programs), as well as technologies (e.g., alternative fuels for fleet). Participants were also encouraged to think of solutions that crossed over the scope boundaries, such as the linkage between fleet and stationary energy generation and use. Lists of all of the brainstormed solutions were generated and shared among the participants after the working session, which assisted a few units with revising and further defining their unit-specific actions.

Each unit was asked to compile an action plan with conservation measures across the three emissions scopes. The units were required to submit their draft plans to GYCC staff and plans are being finalized for an October 2010 deadline. These action plans are intended to identify a minimum 20% reduction within each unit by 2020.

Some of the unit actions that were identified by participants either during or after the working session are listed below by working session subject track.

**Figure 10. Action planning (Courtesy of Trista Patterson, USFS)**

Facilities track action items:

- Building Envelope
  - Improve insulation in buildings
  - Install window blinds to reduce heat gains and losses
  - Replace windows in need of improvement
- Lighting
  - Install motion/daylight sensors on lighting
  - Upgrade lighting and exit lights
- HVAC
  - Convert current furnace to run off biodiesel
  - Regularly inspect heating, ventilating, and air conditioning (HVAC) systems
  - Upgrade boilers
  - Upgrade thermostatic controls and lower the temperature in the winter
- Metering and Utility Bill Cleanup
  - Begin utility bill tracking, cleanup, and water metering
  - Install meters on all buildings
- Water Conservation
  - Install gravity-fed irrigation systems
  - Leak detection (water) inspections
  - Install low-flow products in bathrooms and kitchens
  - Winterize water systems through pipe insulation measures
  - Implement water catchment projects
  - Implement xeriscaping projects to reduce potable water use for landscaping
  - Install on-demand hot water systems
- Plug Loads
  - Consider limiting/eliminating personal appliances in offices
  - Replace appliances with more energy efficient products
  - Turn computers off at night and on the weekends
- Renewable Energy
  - Explore micro-hydro, wind, solar PV, and solar hot water projects
  - Purchase 100% green power

- Cultural, Behavioral and Other
  - Create conservation education campaigns and "green teams"
  - Conduct energy audits on buildings
  - Consider energy savings performance contracts (ESPCs)
  - Incorporate LEED criteria into new construction and renovations
  - Incorporate energy efficiency criteria into new leases and remodels
  - Winterize buildings when not in use in the winter

Fleet track action items:

- Fuel Switching
  - Use biodiesel fuel
  - Use Ethanol-10 fuel
- Vehicle Purchasing
  - Purchase electric vehicles (EVs) and electric utility terrain vehicles (UTV)
  - Purchase hybrid vehicles
  - Replace low mpg with high mpg vehicles
- Cultural, Behavioral and Other
  - Implement cultural and behavioral education programs
  - Downsize and rightsize vehicles within the fleet
  - Initiate a fuel tracking system
  - Create an idle reduction program
  - Create colored key tags to indicate vehicle fuel efficiency (e.g., green = best mpg)
  - Install low-friction tires
  - Collect real-time data through granular analysis with scan gauges
  - Reduce unit vehicle speed by 5 mph of posted speed
  - Initiate a program to encourage staff to cycle in town, as opposed to driving
  - Begin tire pressure education and place tire gauges in all vehicles
  - Encourage public transportation to meetings when possible
  - Use re-refined oil
  - Implement video teleconferencing (VTC) to reduce mileage for meetings

Scope 3 track action items:

- Water Conservation
  - Install composting toilets
  - Install low-flow water products
  - Replace sprinklers with conservation technologies
- Waste Minimization
  - Set printer settings to default as double-sided printing
  - Begin a "less computer upgrade" (hardware)
  - Increase recycling
  - Continue recycling program of propane cylinders
  - Implement a waste reduction program
  - Begin a water bottle initiative to reduce plastic water bottle waste
- Commuter and Business Travel
  - Begin an employee shuttle (carpool)
  - Initiate a flexible work schedule program
  - Implement live-feed teleconferencing/Webinars (long distance travel reduction)
  - Create a travel education program with staff for business travel mileage reduction
- Visitor Emissions Reduction
  - Implement a visitor idle reduction program
  - Install bulletin boards in visitor centers informing public about sustainable operations at each unit
- Transmission and Distribution Loss Reduction
  - Determine how to decrease transmission losses

**Figure 11. Action planning process (Courtesy of Trista Patterson, USFS)**

The participants convened on the final day of the working session to share their action items across scope areas within each unit. The units then created the aforementioned draft unit action plan. In the afternoon of the final day of the working session the units presented their action plans to a supervisor or representative from the GYCC. The reason for this presentation was to communicate the actions in a bottom-up approach to a representative with more authority to support and assist with implementing the actions.

After the presentations, the most frequently listed or most popular actions were listed on note-boards and participants and supervisors were asked to place a sticker next to their top three favorite actions. The actions with the greatest number of votes (i.e., stickers) were selected as the actions to implement on a GYA-wide effort.

GYA-wide actions were chosen for each of the scopes and volunteers were asked to work on each of the projects, as well as being assigned a technical lead from NREL for any additional technology or area specific questions. These actions are as follows:

1. Xeriscaping (Facilities)
2. Idling reduction program (Fleet)
3. GHG tracking software (Scope 3)

Additionally, low-cost or motivating projects were also selected as follows:

1. LED exit signs (Facilities)
2. Color-coded key card holders (Fleet)
3. GYA travel calculator (Scope 3)

## 6.1 Post-Working-Session Webinars

Following the working session, NREL track leads hosted one Webinar for each track. These Webinars provided attendees with an opportunity to ask specific questions related to measures in their action plans. Questions dealt with how to determine appropriate costs of measures, estimate the energy savings, or emission savings associated with the measures identified in the action planning process of the working session.

Also in the Webinars, initial discussions began surrounding the GYA-wide action specific to that track. Attendees were able to brainstorm next steps in the implementation of the project and develop a path forward for implementation without NREL involvement.

# 7 Implementation and Next Steps

Implementation of both the unit-level climate action plans and the GYA-wide emissions reduction projects will be led by GYA unit-level staff members, either in volunteer teams or under existing scopes of work and organizational structures. GYCC staff will also continue to help with planning, vision, and technical assistance needs. This will be an ongoing process, and one that is still in the development stage. Each GHG emissions reduction action contained in the 10 GYA unit Climate Action Plans has a designated project manager, responsible position, or implementation team attached to it. An implementation plan will also be included in the final version of the GYA Climate Action Plan, to be completed in early 2011.

## 7.1 Next Steps

Technical assistance from NREL was provided through the end of August 2010. Each unit within the GYA is expected to finalize their action plans; to seek out financial opportunities for implementing the conservation and renewable energy measures, along with targets; and to continue progress toward their emissions reduction goals. The GYCC will need to approve and amend, if necessary, the unit and GYA-wide action plans, during their annual meeting in October 2010. If implemented, the draft GYA-wide action plan is estimated to reduce GHG emissions by 36% to 39% from a 2007 baseline. The savings associated with each action will need to be justified by unit staff and adjustments will need to be made before the action plans are finalized and published or reported.

One of the challenges to the GYA will be to continue the momentum that led up to and continued through the working session. The action plans are in progress and the next steps are to gain approval, find resources, and determine the best approach to implementing each action. The bottom-up approach is an ongoing process, which will be tested as Federal guidance is released on emissions reporting. It will be interesting to compare how the bottom-up approach aligns with reporting requirements and whether the GYA is able to make progress on reducing emissions compared to other agencies who have yet to begin the accounting, reporting, and reduction process.

There is no doubt that if the GYA units are able to implement the measures they've identified, GHG emission reductions will be achieved. It will be important to closely monitor and record energy, water, and fuel reductions in order to determine the actual reduction of source emissions; monitoring, tracking, and reporting have been a challenge for staff to address during the GHG projects mentioned in this document. One solution is to identify an easier way to manage carbon accounting within the GYA so as to measure progress toward GHG reduction goals. If recording and reporting isn't the sole responsibility of one person within each unit, then it is an additional role for already overloaded staff. Therefore, the system could be improved to alleviate the additional workload of employees and to assist with ease of data collection, monitoring, and reporting.

## 7.2 Challenges, Solutions, and Lessons Learned

The challenges identified during the GYA project were mostly related to busy schedules and full workloads. It was difficult for participants to find the time to collect additional data during their already busy workdays, as well as to free up time to complete the pre-work and attend the Webinars and working session. To work around these challenges NREL attempted to design the

data collection materials to be straightforward and easy to use. The working session was originally scheduled over an entire week; however, it was reduced to allow participants to juggle other responsibilities during the week. The Webinars were designed to cover the most information in a shorter amount of time, which would free up time during the working session to identify opportunities and brainstorm actions that each unit could implement to reduce GHG emissions.

Participants from each track area were invited to represent their unit, but in some instances the units have very small staffing capabilities and only one staff member was sent to represent the entire unit. Only two units were not represented during the working session. Where one staff member was present at the working session, NREL and other GYA participants assisted with completing the action plans in the areas where there was no representation (e.g., if a participant attended to represent the facilities session, assistance was provided in Scope 3 and fleet measures on the action plan).

The most difficult challenge for NREL was determining the complexity of the material to be covered in the Webinars and during the working session as the knowledge base of the participants was unknown. The fleet managers, for example, were interested in learning about available resources and partnerships that could assist them in meeting their mobile source reduction goals. Most were quite knowledgeable of mobile source GHG reduction methods, but needed guidance on how to measure their impacts and overcome the challenges of implementing them. Scope 3 discussions centered around waste and recycling, as well as procurement of goods. Guidance was required mostly on defining the boundaries and determining where the GYA members could have the most impact. Facilities managers were well versed in energy efficiency and were more interested in cutting edge technologies; however there were a couple participants who needed to know more about the basics of energy efficiency.

It was challenging to create a curriculum that would meet the needs and knowledge levels of all participants equally in a short amount of time. A questionnaire was designed prior to the working session to target the working session areas within each scope; however, in some instances this did not provide the information that NREL required. One solution for similar sessions may be to have different levels of information presented on different days and those participants with more knowledge can attend the working session later in the week once the basic information has been discussed with less experienced participants.

The GYCC and GYA were ambitious in their efforts attempting a new, bottom-up approach to the goal setting and action planning process. The main challenge with this approach is balancing the technical analysis with the actions that are felt by on-the-ground staff as being feasible actions. Analytical results may indicate that the best action is to reduce demands on HVAC systems within a building; however, the most feasible action may be to install compact fluorescent lighting (CFL) fixtures. The savings associated with these different measures requires calculation, which can only be accurately completed with accurate baseline data and supporting information from current practices. The detail of the initial data collection process was at a higher level than was required for measure-specific savings calculations, thus a percentage of anticipated savings was estimated based on industry standards and from the participants themselves, based on knowledge of the unit-level activities, infrastructure, and staff culture or

awareness. Estimates can be improved through a monitoring and verification (M&V) program or through more robust data collection.

Action planning staff organized the working session into three functional areas in order to better represent the GYA staff structure than if the session was organized into Scopes 1, 2, and 3 (which cut across functional areas). These groups were:

- Fleet
- Facilities
- Scope 3 emissions.

This structure was the most practical when organizing GYA agency personnel into like tracks for the working session (and for coordinated implementation of projects), but it highlights an ongoing difficulty that agencies will face with upward reporting. While many GHG emissions reduction projects fall into only one emissions scope (e.g., right-sizing of vehicles is a Scope 1 reduction), many more emissions reduction projects cut across all three emissions scopes (e.g., the GYA idling reduction project). Crosswalking these two areas (functional grouping and emissions scope) presents some real GHG accounting challenges. From the standpoint of getting collaborative actions planned and implemented on the ground, functional grouping is essential. Once this occurs though, breaking functionally grouped emissions reduction projects into emissions scopes for GHG tracking and accounting purposes forces staff members to estimate the percentage reduction in each emissions scope that an action will result in. This works for planning purposes, but contains some inaccuracies and best-estimates due to the granularity of the data.

## 7.3 Insights from a Third Party Observer

This section documents challenges, insights, and opportunities gained from interviews conducted with project participants. Interviews were conducted by Dr. Trista Patterson (USFS Pacific Northwest Research Station) in open-question format during the working session. These outside observations were collected to synthesize respondents' impressions and capture qualitative data on the benefits and drawbacks of inventory not otherwise captured in the quantitative study results. Commentary summarized here pertains to 1) challenges, 2) hidden benefits of project execution, 3) accuracy and relation of data collected to anticipated ability to control related emissions, and 4) future needs, suggestions, and applications.

### *7.3.1 Challenges*

- **Challenge 1: Upfront cost of compiling inventory and cost to implement GHG mitigation strategies.**

  The principal challenge cited by project participants is the up-front cost of the inventory compilation itself in terms of staff time, as well as the eventual costs of implementing recommended actions. Principally, because capital budgeting for Federal entities works on an annual fiscal year, decision-support is often ambiguous as to when to invest in changes that will result in benefits over a longer time period. Possible solutions to this are 1) reporting and budgeting that can extend over several years to absorb high up-front costs of infrastructure installation, 2) adjusting the decision-support system and leeway given to managers to make decisions over longer

payback periods, 3) looking at the future dates of scheduling for infrastructure replacement to allow a manager to anticipate future costs, 4) understanding the factors affecting whether or not something is affordable to facilitate future changes when the price of those inputs change (e.g., fuel costs may reach a certain point, justifying shifts to biobased fuels), and 5) prioritizing and "shelving" fully developed plans so that when a manager receives unexpected funds (for example at the end of a fiscal year), the plan can be executed on very short timelines.

- **Challenge 2: Lack of feedback to incentivize savings.**

  Implementing the GHG mitigation strategies often represents a budgetary cost in terms of staff-time, maintenance, or infrastructure. The savings accrued are often not reported back to the manager charged with making those decisions. For example, budgetary savings may result in less funding being allocated to an agency in the next fiscal year. Possible solutions may be nationwide accounting mechanisms that allow savings to be accrued by the managing entity's budget. The emerging market in carbon is an example that has sparked some imagination among respondents in an accounting and credit mechanism by which credit could be attributed to managers who best manage for emissions reduction.

- **Challenge 3: Personnel investment in inventory compilation.**

  Staff time and personnel resources required to compile an inventory are not fully recognized. Often the staff drawn upon to do this work must drop other tasks to accomplish data collection, reporting, collaboration, and resolution. The innovation required to design and implement technical changes often requires going beyond position descriptions, which encumbers staff to take on the risk that the suggested fix might not work. Suggested changes may induce push-back from coworkers and involve what is viewed as "extra work." Respondents suggested that the rewards for accomplishment may be personal, but may also be short-lived or unsustainable in light of other on-the-job pressures. Additionally, managers themselves do not receive a bonus for making extra efforts or taking extra risk to bring about very large system savings, as would occur in the private sector. Solutions could be to design mechanisms to incentivize those who contribute to emissions or financial savings. These could be monetary or non-monetary. In addition, respondents noted that supervisors can create time in a work plan to allow for experimentation, brainstorming, and collaboration. Respondents noted the importance of verbal, public, and group acknowledgement, especially in regular staff meetings since it tends to reinforce the mindset of the building or facility as a whole, reduce push-back, and encourage future brainstorming among employees.

- **Challenge 4: Accuracy and relation of data collected to anticipated ability to control related emissions.**

  Respondents reported a high degree of certainty in the collected data, but described in detail the time investment, patience, and creativity needed to pursue that level of detail. Scope 3 discussions in particular, focused on the tradeoffs between attaining an additional level of data resolution versus spending time on the recommended fixes. This was referred to as "the rabbit hole" issue in Scope 3 discussions, where respondents exchanged information about what they felt was a reasonable level of

detail in information collection. Group exchange of this sort is invaluable because respondents noted that written inventory protocol can have a high intimidation factor for someone new to inventories. Doubts in the study purpose, uncertainty in project support, unawareness of what the data will be used for, and especially time limitations were all cited as possible contributors to reasons why this extra effort for good numbers may not be put in. One possible solution to this is regular discussion of the rabbit hole, assuring inventory staff that this is a common challenge. Early elicitation and comparison of data among inventory staff were also cited as possible solutions.

### *7.3.2 Benefits*

- **Benefit 1: Understanding what is "normal."**

  An inventory requires scrutiny of a system both at an unusual level of detail, over time, and (in this case) across various management units. One unsung advantage of compiling an inventory is that those who perform them develop a sense for what is normal. In this way, inefficiencies, errors, and system changes can be noticed, monitored, and adjusted. Respondents noted that one critical element of this was the satisfaction they received in understanding why a number was particularly different, reporting both satisfaction from better system understanding, communication with various factions of management (for example a fleet manager speaking with a hydrologist), and satisfaction received from an ultimate fix to what may have been prior system oversight.

- **Benefit 2: Problem resolution to technical and hidden problems.**

  One advantage of compiling an inventory over many management units is that common inefficiencies may be revealed and resolved through shared learning and/or resources. One example can be seen in the incidental learning that comes along with the inventory compilation itself. In this case, an inventory compilation process required the procurement of a series of billing statements, only to reveal a series of late-charges or mis-billings because computerized or centralized systems were not aligned. Because an individual management unit may not be able to afford a specialist or staff time to resolve the problem, cooperation or shared specialists may help introduce fixes across several management entities, with least cost.

- **Benefit 3: Staff identification of solutions.**

  On-the-ground staff were able to identify potential solutions to problems they faced. These included, but were not limited to 1) service providers or contractors to work at this scale, 2) understanding of input factors affecting price breaks, 3) a calculator to help calculate payback periods of implementation measures, and 4) quantitative information and comparison of life-cycle analysis for several common pieces of infrastructure.

# 8 Summary and Conclusions

This is the first effort where Federal parks, forests, and wildlife refuges have worked across agency boundaries to compile and execute emissions reduction plans for an entire ecosystem. The use of an ecosystem as a boundary is also unique but very appropriate; the effects of GHG emissions are likely going to be felt beyond organizational bounds, and probably at an ecosystem level. However, working across agency bounds can also be logistically challenging. Each agency has different policies and processes, and modifying these is inherently difficult. Through this project it was demonstrated that cross-agency leadership and coordination—as clearly demonstrated for many years through the GYCC—is essential for project success regardless of agency constraints. On-the-ground cross fertilization of ideas, as experienced during the Webinars and working session, enabled unit staff to learn from each other, share experiences, and plan for future GHG reductions together.

While the process that was undertaken was not void of challenges, it was an important part of the process to understand where the barriers lie in order to address these and improve upon future projects. By fully understanding the constraints and limitations of agencies and what issues are unique to a particular agency, a project can be more successful in the long term.

The steps, methodologies, and lessons learned throughout this process have been summarized in order to serve as a template for Federal agencies and private entities as they work to reduce their impact on the environment through emissions reductions. By sharing the experiences of three agencies spread across a unique ecosystem, it is hoped that these efforts will fuel a dialogue and other similar projects.

# Appendix 1. Working Session Agendas

## Fleet Track Agenda

**Greater Yellowstone Interagency Climate Action Plan Working Session**

April 19 – 22, 2010

### Day 1 – Monday, April 19th, 2010: *Setting the Stage* – Weaver Room, the Emerson Center

| | |
|---|---|
| 1:00 PM – 1:30 PM | Introductions and Overview of the Week<br>*Mike Fiebig and Anna Jones-Crabtree* |
| 1:30 PM – 2:30 PM | GYCC Keynote Address and Panel Discussion<br>*Rebecca Aus, Mary Erickson and Suzanne Lewis, GYCC Members* |
| 2:30 PM – 2:45 PM | *Break* |
| 2:45 PM – 3:45 PM | Presentation: "Foot-Printing for Futurists: Using 'Hard' Numbers to Firm-up 'Fuzzy' Future Vision."<br>*Trista Patterson, USFS Pacific Northwest Research Station* |
| 3:45 PM – 5:00 PM | Overview of each Footprint Track, Current Data, and GHG Tracking<br>*Kristin Day, Eliza Hotchkiss, John Nangle, NREL* |
| Evening | Optional Social Hour – location and time TBA |

### Day 2 – Tuesday, April 20th, 2010: *Identifying Actions* – Room 233, Strand Union Building, MSU

| | |
|---|---|
| 8:30 AM – 9:00 AM | Large-Group Presentation: Guest speaker from the Department of Energy's Federal Energy Management Program (FEMP)<br>*Joe Konrade, FEMP* |
| | *Split into Footprint Tracks - Rooms 232, 233, 234* |

| | |
|---|---|
| 9:00 AM – 9:45 AM | Fleet Track Introduction<br>*Kristin Day & Ryan Daley, NREL*<br>• Purpose and overview<br>• Review of federal guidance and legislation<br>• Visioning Exercise 1: Where do you see your fleet in 10 years? |
| 9:45 AM – 10:15 AM | Review of Past GYA Inventory Data & Results<br>*Kristin Day, NREL*<br>• FY 2007 inventory overview & background<br>• Presentation of data & analysis results<br>• Next steps, opportunities and challenges |
| 10:15 AM – 10:30 AM | *Break* |
| 10:30 AM – 11:30 AM | Greenhouse Gas Emissions: Calculations & Management<br>*Kristin Day, NREL*<br>• How to calculate your GHG emissions<br>• Assess unit-level GHG emissions changes from FY 2007 baseline<br>• Fleet Selection & Management Game: Who can reduce their GHG emissions the most while still fulfilling their mission and meeting federal mandates? |
| 11:30 AM – 12:30 PM | Indentifying Resources and Potential Partnerships<br>*Andrew Hudgins, NREL*<br>• Federal partnerships<br>*U.S. Department of Energy's Clean Cities*<br>• Regional partnerships<br>*Yellowstone Business Partnership*<br>• Industry partnerships |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 2:15 PM | Behavior and Cultural Changes<br>*Heather Davis, USFS*<br>• Review of small changes that can have a big affect on GHG emissions |
| 2:15 PM – 3:00 PM | Emerging Fleet Technologies<br>*Ryan Daley, NREL*<br>• Overview of advanced vehicle technologies, their benefits and drawbacks<br>• Alternative Fuel Vehicles (AFV) in the federal fleet<br>• Hybrid Electric Vehicles (HEV)<br>• Plug-in Hybrids (PHEV) and Electric Vehicles (EV) |

| | |
|---|---|
| 3:00 PM – 4:45 PM | Eco Auto Inc. Introduction & Demonstration, at MSU<br>*Kristin Day & Andrew Hudgins, NREL* |
| 4:45 PM – 5:15 PM | Fleet Track Day 1 Wrap-Up<br>*All* |
| Evening | Optional Social Hour – location and time TBA |

## Day 3 – Wednesday, April 21st, 2010: *From Actions to Climate Action Plans*
## Room 233, Strand Union Building, MSU

| | |
|---|---|
| 8:30 AM – 9:00 AM | Large-Group Presentation: Renewable Energy Credits (RECs) and Power Purchase Agreements (PPAs)<br>*Alicen Kandt, NREL*<br><br>*Split into Footprint Tracks - Rooms 232, Ballroom B, 234* |
| 9:00 AM – 10:15 AM | Fleet Optimization Tools<br><br>*Heather Davis, USFS & Ryan Daley, NREL*<br>• Tools Overview<br>*USFS Fleet Lifecycle Costing Tool*<br>*NREL Fleet Optimization Tool*<br>• Fleet Atlas/Optimization Tool demonstration |
| 10:15 AM – 10:30 AM | *Break* |
| 10:30 AM – 11:30 AM | GSA Fleet Vehicles<br>*Speaker, TBD*<br>• GHG ratings and things to come… |
| 11:30 PM – 12:30 PM | Alternative Fuels & Infrastructure<br>*Kristin Day, NREL*<br>• Overview of alternative fuels, their benefits and drawbacks<br>• Review of alternative fuel vehicles and infrastructures in GYA<br>• Identify opportunities and potential roadblocks |
| 12:30 PM – 1:30 PM | *Lunch* |

| | |
|---|---|
| 1:30 PM – 5:30 PM | Compiling an Action Plan for GYA Fleets<br>*All*<br>♦ Visioning Exercise 2: Where do you see your fleet in 10 years? Do you have the tools to get there? What else is needed?<br>♦ GYA-Wide Project Visioning Session – brainstorm on flip chart<br>♦ Identifying and Prioritizing actions<br>*Unit level*<br>*GYA-wide*<br>♦ Creating an implementation strategy<br>*Unit level*<br>*GYA-wide*<br>♦ Further Needs, Measurement & Verification<br>♦ Hand-off resource packs<br>♦ Feedback, Review & Adjournment |
| Evening | Optional Social Hour – location and time TBA |

## Day 4 – Thursday, April 22nd, 2010: *Planning for 2020 and Beyond* – Weaver Room, Emerson Center

| | |
|---|---|
| 8:30 AM – 9:15 AM | Happy Earth Day! Introduction to Break-out Sessions<br>*Anna Jones-Crabtree and Mike Fiebig* |
| 9:15 AM – 9:45 PM | Moving Forward: Water in the GYA<br>*Alicen Kandt, NREL* |
| 9:45 AM – 10:00 AM | *Break* |
| 10:00 AM – 11:00 AM | GYA Unit Breakout Sessions. Smaller Units can Team-up with A Larger Unit<br>*Mike Fiebig, Anna Jones-Crabtree and NREL Staff*<br>♦ Share identified actions from footprint tracks; complete your unit template; talk about what things you need to do as a unit to implement those projects such as barriers, opportunities, timing, and leadership.<br>♦ Commit to the next things that you want to do.<br>♦ Be ready to share those actions with your GYCC member after lunch.<br>♦ Some Ideas: Where do you want things to go on your unit? Identify what unit-level activities can we connect GYA-wide? What things are you most excited about? What are more easily implemented if we do them on GYA-wide basis? What will your biggest hurdles will be? What are the next steps for your particular unit? |

| | |
|---|---|
| 11:00 AM – 12:30 PM | Collective Discussion and Feedback, *Anna, Mike and NREL Staff*<br>♦ Brief sharing of individual unit action plans and anything that has emerged as a new GYA-wide project (45 min).<br>♦ Open conversation and feedback (30 min).<br>♦ Finish up preparing to present to, and work with, your GYCC Member. |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 1:45 PM | Introductions and Overview of the Afternoon<br>*Mike Fiebig and Anna Jones-Crabtree* |
| 1:45 PM – 2:30 PM | Moving Out on your Unit, *Mike Fiebig and Anna Jones-Crabtree*<br>♦ Briefing your Line Officer.<br>♦ Discussion of your action plan against the definition of success; update and amend as needed.<br>♦ Large-group discussion space for feedback, questions, and problem-solving. Opportunities? Challenges? Get feedback on your plan again. |
| 2:30 PM – 3:30 PM | Coordinated Implementation and Funding<br>*Mike Fiebig, Anna Jones-Crabtree, NREL*<br>♦ Each footprint track will present their 2-3 overarching projects from the day before (short description, cost, timeline, project champions) on flip charts.<br>♦ Question and Answer Space: Present anything extra that emerged (add to voting options)<br>♦ Discussion of criteria for project selection and "voting" procedures. |
| 3:30 PM – 3:45 PM | *Break and Vote*<br>♦ Choice of one coordinated project to implement GYA-wide ($20,000 from a USFS Sustainable Business Award for FY 2010, and $15,000 from the GYCC for FY 2011). |
| 3:45 PM – 4:30 PM | Resourcing discussion and clarification of funding and timeline<br>*Mike Fiebig, Anna Jones-Crabtree, NREL*<br>♦ Identifying follow-up needs and project champions<br>♦ Climate Action Plan timeline and future iterations |
| 4:30 PM – 5:00 PM | Session Closing<br>*All Participants and Staff*<br>♦ Recap: Definition of Success. Did we meet it? What are we committing to? Prep for close-out of session.<br>♦ Feedback on the Working Session<br>♦ Closing thoughts from participants. Highlights? Lessons? |
| Evening | Optional Social Hour – location and time TBA |

# Facilities Track Agenda

**Greater Yellowstone Interagency Climate Action Plan Working Session**

April 19 – 22, 2010

## Day 1 – Monday, April 19th, 2010: *Setting the Stage* – Weaver Room, the Emerson Center

| | |
|---|---|
| 1:00 PM – 1:30 PM | Introductions and Overview of the Week<br>*Mike Fiebig and Anna Jones-Crabtree* |
| 1:30 PM – 2:30 PM | GYCC Keynote Address and Panel Discussion<br>*Rebecca Aus, Mary Erickson and Suzanne Lewis, GYCC Members* |
| 2:30 PM – 2:45 PM | *Break* |
| 2:45 PM – 3:45 PM | Presentation: "Foot-Printing for Futurists: Using 'Hard' Numbers to Firm-up 'Fuzzy' Future Vision."<br>*Trista Patterson, USFS Pacific Northwest Research Station* |
| 3:45 PM – 5:00 PM | Overview of each Footprint Track, Current Data, and GHG Tracking<br>*Kristin Day, Eliza Hotchkiss, John Nangle, NREL* |
| Evening | Optional Social Hour – location and time TBA |

## Day 2 – Tuesday, April 20th, 2010: *Identifying Actions* – Room 233, Strand Union Building, MSU

| | |
|---|---|
| 8:30 AM – 9:00 AM | Large- Group Presentation: Guest speaker from the Department of Energy's Federal Energy Management Program (FEMP)<br>*Joe Konrade, FEMP* |
| | *Split into Footprint Tracks - Rooms 232, 233, 234* |

| | |
|---|---|
| 9:00 AM – 10:15 AM | COMING TOGETHER<br>• Introduction and Background - *Alicen Kandt & Eliza Hotchkiss, NREL*<br>*Purpose of the training, overview of the working session*<br>*Visioning exercise (2020 and 2050)*<br>*Reviewing Energy Usage Data*<br>▪ Utility Cleanup, *Heather Davis, USFS*<br>▪ Addressing metering concerns - leased and owned spaces |
| 10:15 AM – 10:30 AM | *Break* |
| 10:30 AM – 12:30 PM | UNDERSTANDING ENERGY<br>*Eliza Hotchkiss, NREL*<br>• Energy Use in Buildings<br>*General overview of where/how energy is used in buildings in this climate zone)*<br>*Human physiology*<br>*Building Envelope*<br>• HVAC<br>*Overview of technologies and Opportunities/ECMs*<br>*(12:00) Hands-on walk through, Dan Stevenson, MSU* |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 3:45 PM | UNDERSTANDING ENERGY<br>*Eliza Hotchkiss, NREL*<br>• Lighting<br>*Overview of technologies and Opportunities/ECMs*<br>*Hands-on walk through*<br>• Plug Loads<br>*Overview of technologies and Opportunities/ECMs*<br>*Hands-on walk through*<br><br>*Each participant will need their data collection sheets and a laptop* |
| 4:00 PM – 5:15 PM | Tour of Bozeman Library, LEED Certified |
| Evening | Optional Social Hour – location and time TBA |

**Day 3 – Wednesday, April 21st, 2010: *From Actions to Climate Action Plans***
**Room 233, Strand Union Building, MSU**

| | |
|---|---|
| 8:30 AM – 9:00 AM | Large-Group Presentation: Renewable Energy Credits (RECs) and Power Purchase Agreements (PPAs),<br>*Alicen Kandt, NREL*<br><br>*Split into Footprint Tracks - Rooms 232, Ballroom B, 234* |
| 9:00 AM – 10:15 AM | UNDERSTANDING WATER, *Alicen Kandt & Eliza Hotchkiss, NREL*<br>Overview of technologies and Opportunities/ECMs<br>Hands-on walk through |
| 10:15 AM – 10:30 AM | *Break* |
| 10:30 AM – 12:30 PM | RENEWABLE ENERGY OPPORTUNITIES<br>*Alicen Kandt & Eliza Hotchkiss, NREL*<br>Renewable Energy Technologies<br>RE Flow chart – options and resources<br>Basic overview of renewable resources available to the GYA<br>Incentives for RE installation<br>New Technologies on the Horizon |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 1:45 PM | Examples of Innovation within the GYA |
| 1:45 PM – 5:00 PM | Discussion Groups for Action Planning<br>*Alicen Kandt and Eliza Hotchkiss, NREL*<br>♦ Visioning Exercise 2: Where do you now see your facilities in 2020 and 2050? Do you have the tools to get there? What else is needed?<br>♦ GYA wide project visioning session to brainstorm<br>*Identifying common issues, barriers, challenges (i.e. lease vs. owned facilities)*<br>■ Identifying actions<br>*Unit wide*<br>*GYA wide*<br>■ Creating an implementation strategy<br>*Unit wide*<br>*GYA wide*<br>■ Feedback, Review & Adjournment<br>*Resource packs* |
| Evening | Optional Social Hour – location and time TBA |

## Day 4 – Thursday, April 22nd, 2010: *Planning for 2020 and Beyond* – Weaver Room, Emerson Center

| | |
|---|---|
| 8:30 AM – 9:15 AM | Happy Earth Day! Introduction to Break-out Sessions<br>*Anna Jones-Crabtree and Mike Fiebig* |
| 9:15 AM – 9:45 PM | Moving Forward: Water in the GYA<br>*Alicen Kandt, NREL* |
| 9:45 AM – 10:00 AM | *Break* |
| 10:00 AM – 11:00 AM | GYA Unit Breakout Sessions. Smaller Units can Team-up with a Larger Unit<br>*Anna, Mike and NREL Staff*<br>▪ Share identified actions from footprint tracks; complete your unit template; talk about what things you need to do as a unit to implement those projects such as barriers, opportunities, timing, and leadership.<br>▪ Commit to the next things that you want to do.<br>▪ Be ready to share those actions with your GYCC member after lunch.<br>▪ Some Ideas: Where do you want things to go on your unit? Identify what unit-level activities can we connect GYA-wide? What things are you most excited about? What are more easily implemented if we do them on GYA-wide basis? What will your biggest hurdles will be? What are the next steps for your particular unit? |
| 11:00 AM – 12:30 PM | Collective Discussion and Feedback, *Anna, Mike and NREL Staff*<br>♦ Brief sharing of individual unit action plans and anything that has emerged as a new GYA-wide project (45 min).<br>♦ Open conversation and feedback (30 min).<br>♦ Finish up preparing to present to, and work with, your GYCC Member. |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 1:45 PM | Introductions and Overview of the Afternoon<br>*Mike Fiebig and Anna Jones-Crabtree* |
| 1:45 PM – 2:30 PM | Moving Out on your Unit<br>*Mike Fiebig and Anna Jones-Crabtree*<br>♦ Briefing your Line Officer.<br>♦ Discussion of your action plan against the definition of success; update and amend as needed.<br>♦ Large-group discussion space for feedback, questions, and problem-solving. Opportunities? Challenges? Get feedback on your plan again. |

| | |
|---|---|
| 2:30 PM – 3:30 PM | Coordinated Implementation and Funding<br>*Mike Fiebig, Anna Jones-Crabtree, and NREL*<br>▪ Each footprint track will present their 2-3 overarching projects from the day before (short description, cost, timeline, project champions) on flip charts.<br>▪ Question and Answer Space: Present anything extra that emerged (add to voting options)<br>▪ Discussion of criteria for project selection and "voting" procedures. |
| 3:30 PM – 3:45 PM | *Break and Vote*<br>▪ Choice of one coordinated project to implement GYA-wide ($20,000 from a USFS Sustainable Business Award for FY 2010, and $15,000 from the GYCC for FY 2011). |
| 3:45 PM – 4:30 PM | Resourcing discussion and clarification of funding and timeline<br>*Mike Fiebig, Anna Jones-Crabtree, and NREL*<br>▪ Identifying follow-up needs and project champions<br>▪ Climate Action Plan timeline and future iterations |
| 4:30 PM – 5:00 PM | Session Closing<br>*All Participants and Staff*<br>▪ Recap: Definition of Success. Did we meet it? What are we committing to? Prep for close-out of session.<br>▪ Feedback on the Working Session<br>▪ Closing thoughts from participants. Highlights? Lessons? |
| Evening | Optional Social Hour – location and time TBA |

# Scope 3 Track Agenda

**Greater Yellowstone Interagency Climate Action Plan Working Session**

April 19 – 22, 2010

## Day 1 – Monday, April 19th, 2010: *Setting the Stage* – Weaver Room, the Emerson Center

| | |
|---|---|
| 1:00 PM – 1:30 PM | Introductions and Overview of the Week<br>*Mike Fiebig and Anna Jones-Crabtree* |
| 1:30 PM – 2:30 PM | GYCC Keynote Address and Panel Discussion<br>*Rebecca Aus, Mary Erickson and Suzanne Lewis, GYCC Members* |
| 2:30 PM – 2:45 PM | *Break* |
| 2:45 PM – 3:45 PM | Presentation: "Foot-Printing for Futurists: Using 'Hard' Numbers to Firm-up 'Fuzzy' Future Vision."<br>*Trista Patterson, USFS Pacific Northwest Research Station* |
| 3:45 PM – 5:00 PM | Overview of each Footprint Track, Current Data, and GHG Tracking<br>*Kristin Day, Eliza Hotchkiss, John Nangle, NREL* |
| Evening | Optional Social Hour – location and time TBA |

## Day 2 – Tuesday, April 20th, 2010: *Identifying Actions* – Room 233, Strand Union Building, MSU

| | |
|---|---|
| 8:30 AM – 9:00 AM | Large- Group Presentation: Guest speaker from the Department of Energy's Federal Energy Management Program (FEMP)<br>*Joe Konrade, FEMP* |
| | *Split into Footprint Tracks - Rooms 232, 233, 234* |

| | |
|---|---|
| 9:00 AM – 10:15 AM | Overview of Scope 3 Working Session Schedule<br>• Introduction and Background<br>• Review of Federal Guidance documents<br>• Review of Previous GYA Inventories |
| 10:15 AM – 10:30 AM | *Break* |
| 10:30 AM – 12:30 PM | Ecosystem-wide Scope 3 Emissions<br>*Presentations will serve as illustrative examples and help jumpstart discussions for Ecosystem-wide opportunities*<br>• Visioning Exercise 1: Where do you see Scope 3 emissions for your unit in 10 years? (choose 1-2 footprints)<br><br>• Discussion of Scope 3 Opportunities<br>*Contractor/Vendor/Purchasing*<br>*Concessioner/permittee emissions - Jane Ruchman, Gallatin NF (tentative)*<br>*Visitor Emissions - John Nangle, NREL* |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 4:00 PM | Ecosystem-wide Scope 3 emissions - Continued<br>• Commuting/Travel - *Janet Bean-Dochnal, B-D NF*<br>• GSA TravelTrax - *John Nangle, NREL*<br>• Water/Waste Disposal - *Jim Evanoff, Yellowstone NP*<br>• Choice of top footprint areas to focus on - *John Nangle, NREL* |
| 4:00 PM – 5:15 PM | Site Tour LEED building - Bozeman Public Library<br><br>*If the LEED Building tour is cancelled, we can continue the ecosystem-wide discussion.* |
| Evening | Optional Social Hour – location and time TBA |

## Day 3 – Wednesday, April 21st, 2010: *From Actions to Climate Action Plan*
## Room 233, Strand Union Building, MSU

| | |
|---|---|
| 8:30 AM – 9:00 AM | Large-Group Presentation: Renewable Energy Credits (RECs) and Power Purchase Agreements (PPAs)<br>*Alicen Kandt, NREL*<br><br>*Split into Footprint Tracks - Rooms 232, Ballroom B, 234* |
| 9:00 AM – 10:15 PM | Recap and Unit-specific Scope 3 Emissions Sources<br>*John Nangle, NREL*<br>• Recap from previous day<br>• Identification of common, eco-system wide (EW) Scope 3 emissions (e.g. collective purchasing?) |
| 10:15 AM – 10:30 AM | *Break* |

| | |
|---|---|
| 10:30 AM – 12:30 PM | Site-specific Scope 3 Emissions<br>*John Nangle, NREL*<br>♦ Begin identifying major Scope 3 emissions at individual units<br>♦ Identify emissions reduction opportunities |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 5:00 PM | Compiling an Action Plan for Scope 3 Emissions<br>*John Nangle, NREL*<br>♦ Visioning Exercise 2: Where do you want to see Scope 3 emissions sources for your unit in 10 years (same 1-2 footprints)? Do you have the tools to get there? What else is needed?<br>♦ GYA-Wide Project Visioning Session – brainstorm on flip chart\<br>♦ Identifying and Prioritizing actions (continued from morning)<br>*Unit level*<br>*GYA-wide*<br>♦ Creating an implementation strategy<br>*Unit level*<br>*GYA-wide*<br>♦ Feedback, Review & Adjournment |
| Evening | Optional Social Hour – location and time TBA |

## Day 4 – Thursday, April 22nd, 2010: *Planning for 2020 and Beyond* – Weaver Room, Emerson Center

| | |
|---|---|
| 8:30 AM – 9:15 AM | Happy Earth Day! Introduction to Break-out Sessions<br>*Anna Jones-Crabtree and Mike Fiebig* |
| 9:15 AM – 9:45 PM | Moving Forward: Water in the GYA<br>*Alicen Kandt, NREL* |
| 9:45 AM – 10:00 AM | *Break* |
| 10:00 AM – 11:00 AM | GYA Unit Breakout Sessions. Smaller Units can Team-up with a Larger Unit<br>*Anna Jones-Crabtree, Mike Fiebig and NREL Staff*<br>♦ Share identified actions from footprint tracks; complete your unit template; talk about what things you need to do as a unit to implement those projects such as barriers, opportunities, timing, and leadership.<br>♦ Commit to the next things that you want to do.<br>♦ Be ready to share those actions with your GYCC member after lunch.<br>♦ Some Ideas: Where do you want things to go on your unit? Identify what unit-level activities can we connect GYA-wide? What things are you most excited about? What are more easily implemented if we do them on GYA-wide basis? What will your biggest hurdles will be? What are the next steps for your particular unit? |

| | |
|---|---|
| 11:00 AM – 12:30 PM | Collective Discussion and Feedback, *Anna, Mike and NREL Staff*<br>♦ Brief sharing of individual unit action plans and anything that has emerged as a new GYA-wide project (45 min).<br>♦ Open conversation and feedback (30 min).<br>♦ Finish up preparing to present to, and work with, your GYCC Member. |
| 12:30 PM – 1:30 PM | *Lunch* |
| 1:30 PM – 1:45 PM | Introductions and Overview of the Afternoon<br>*Mike Fiebig and Anna Jones-Crabtree* |
| 1:45 PM – 2:30 PM | Moving Out on your Unit<br>*Mike Fiebig and Anna Jones-Crabtree*<br>♦ Briefing your Line Officer.<br>♦ Discussion of your action plan against the definition of success; update and amend as needed.<br>♦ Large-group discussion space for feedback, questions, and problem-solving. Opportunities? Challenges? Get feedback on your plan again. |
| 2:30 PM – 3:30 PM | Coordinated Implementation and Funding<br>*Mike Fiebig, Anna Jones-Crabtree and NREL Staff*<br>♦ Each footprint track will present their 2-3 overarching projects from the day before (short description, cost, timeline, project champions) on flip charts.<br>♦ Question and Answer Space: Present anything extra that emerged (add to voting options)<br>♦ Discussion of criteria for project selection and "voting" procedures. |
| 3:30 PM – 3:45 PM | *Break and Vote*<br>♦ Choice of one coordinated project to implement GYA-wide ($20,000 from a USFS Sustainable Business Award for FY 2010, and $15,000 from the GYCC for FY 2011). |
| 3:45 PM – 4:30 PM | Resourcing discussion and clarification of funding and timeline<br>*Mike Fiebig, Anna Jones-Crabtree and NREL Staff*<br>♦ Identifying follow-up needs and project champions<br>♦ Climate Action Plan timeline and future iterations |
| 4:30 PM – 5:00 PM | Session Closing<br>*All Participants and Staff*<br>♦ Recap: Definition of Success. Did we meet it? What are we committing to? Prep for close-out of session.<br>♦ Feedback on the Working Session<br>♦ Closing thoughts from participants. Highlights? Lessons? |
| Evening | Optional Social Hour – location and time TBA |

# Appendix 2. Differences Between EPA Climate Leaders and CLIP Tools

***Main Differences:***

- Stationary Combustion:
  - The EPA includes optional inputs for different types of coal and fuel oil and also accounts for land fill gas use.
  - The CLIP tool includes optional inputs for biodiesel and "other" stationary combustion sources whose emission factor is user defined.
  - The two tools use different sources in their methodology section.
- Purchased Electricity:
  - The EPA tool uses data from eGRID2006 (with 2004 data), while the CLIP tool uses eGRID 2002.
  - The CLIP accounts for transmission losses, while the EPA tool does not.
- Mobile Combustion:
  - The EPA tool uses vehicle miles traveled (VMT) and fuel consumption to calculate emissions (Fuel-->$CO_2$; VMT-->$CH_4$ and $N_2O$).
  - The CLIP tool uses VMT -OR- fuel consumption to calculate all emissions. Average miles per gallon (MPG) are used to convert VMT to fuel consumption and vice-versa.
  - Both tools account for non-highway vehicles
  - The tools use slightly different methodologies and coefficients to calculate emissions; these do not seem to dramatically alter the results.

***Additional Details:***

- Stationary Combustion:
  - EPA: Includes optional inputs for different types of coal and fuel oil; also accounts for land fill gas use.
  - CLIP: Includes optional inputs for biodiesel and "other."
  - Sources in methodology appear to be different.
  - EPA: Calculates $CO_2$, $CH_4$, and $N_2O$ by multiplying fuel usage by a constant that is "hard-coded" in the formula.
  - CLIP: Calculates $CO_2$, $CH_4$, and $N_2O$ by multiplying fuel usage by a constant by referring to its "Conversion Factors" sheet.
  - These emission constants may vary slightly due to different methodologies followed by each tool.
- Purchased Electricity:
  - EPA: Kilowatt-hours are multiplied by emission constants contained within the worksheet (eGRID2006 Emission Factors by Sub-region [2004 Data]); calculates $CO_2$, $CH_4$, and $N_2O$ emissions.
  - EPA: Does not appear to account for transmission losses.
  - CLIP: Multiply park electricity consumption by pounds of carbon per megawatt hours. Then multiply by the amount of energy lost during transmission and distribution.
  - CLIP: $CO_2$ is the only pollutant calculated; $CH_4$ and $N_2O$ are considered to be negligible (eGRID 2002, http://www.epa.gov/cleanenergy/egrid/index.htm).
- Mobile Combustion:

- EPA: Information for unit's entire fleet is hand-entered (includes source ID, source description, vehicle type, vehicle year, fuel used, units, VMT, or hours of operation).
- EPA: Fuel usage is summed by fuel type (the total fuel consumption of each fuel type is not sorted by vehicle type).
- EPA: $CO_2$ emissions are calculated by total fuel consumption (emission factors vary by fuel type and are hard-coded into the formula bar).
- EPA: $CH_4$ and $N_2O$ emissions are calculated by multiplying an emissions factor with VMT, which are summed by vehicle type and vehicle year.
- EPA uses both VMT and fuel consumption to calculate emissions as opposed to one or the other.
- EPA: Provides optional inputs for non-highway vehicles including ships and boats, trains, aircraft, and agricultural equipment (these are often populated and therefore omitted from the ROA tools).
- CLIP: Calculates $CO_2$, $CH_4$, and $N_2O$ emissions using VMT or fuel consumption. Average MPG is used to convert to and from VMT or fuel consumption.
- CLIP: Also has inputs for non-highway vehicles that are omitted from ROA tools.

# Appendix 3. Overview of Inventory Compilation

The agencies within the GYA conducted assessments of their activities and completed GHG emissions inventories for each of the 10 units. In 2008, NREL was funded by USFS to compile the 10 individual unit GHG inventories into a suite of inventories that can be analyzed together. The consolidated suite of GYA GHG inventories captures emissions associated with anthropogenic activities on all Federal lands in the GYA. The inventories were conducted between 2006 and 2008, with only slight variations expected from year to year.

The boundary for the combined inventory was that of the GYA, depicted below in Figure 12 by the purple boundary. While some of the 10 units are entirely contained within the GYA, some fall outside of its bounds. These include: Beaverhead-Deerlodge National Forest, Custer National Forest, and Caribou-Targhee National Forest. The six forests associated with the GYA cover over 15 million acres in Wyoming, Montana, and Idaho. Thirteen million acres of these national forests are inside the GYA boundary.[5] In some cases the inventories represent activities for the entire area of each unit, as activities are not distinguished as being within or outside of the GYA boundaries. Because GHG reduction opportunities target modifications to operations for entire units, emissions that may fall outside of the GYA boundary were, in some cases, not able to be excluded from the analysis.

The methodology the USFS used to account for the fact that portions of these three forests, and associated activities and GHG emissions, are outside of the GYA is described in the USFS paper, "Greenhouse Gas Inventory for the National Forests in the GYA."[6]

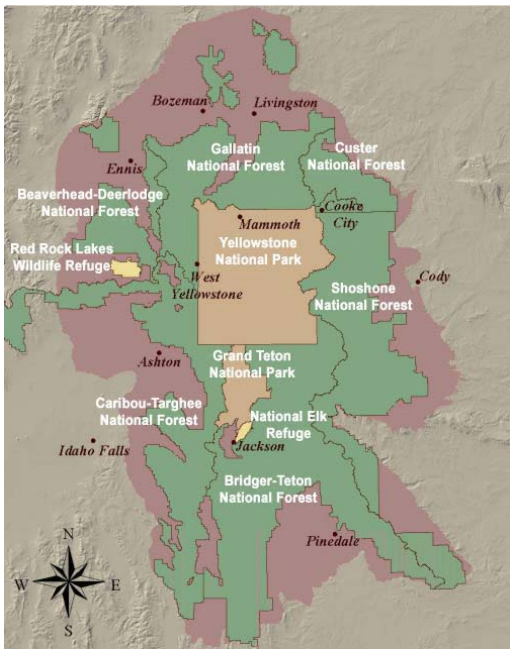



**Figure 12. Greater Yellowstone Area boundary**

[5] USFS Sustainable Operations: www.fs.fed.us/sustainableoperations/documents/GHG-Report6NatlForestsInGYA.pdf, page 7.
[6] USFS Greenhouse Gas Inventory for the National Forests in the GYA: www.fs.fed.us/sustainableoperations/documents/GHG-Report6NatlForestsInGYA.pdf

As described in Section 3 (Setting a Baseline) and highlighted in Appendix 2 (Differences between EPA Climate Leaders and CLIP Tools), two different GHG accounting tools were used to compile the unit inventories; USFS and FWS units used the EPA Climate Leaders GHG Calculator Tool, whereas NPS used the CLIP tool. See Table 2 for an overview of the data and tools used for each unit inventory.

**Table 2. Data and Tools Used for Unit Inventories**

| GYA Unit | Abbreviation | Tool Used | Data Year[7] |
|---|---|---|---|
| Grand Teton National Park | GTNP | CLIP (Climate Leadership in Parks) Tool | 2007 data |
| Yellowstone National Park | YNP | | 2006 data |
| National Elk Refuge | Elk | EPA Climate Leaders GHG Emissions Calculator (SGEC) | 2008 data |
| Red Rock Lakes Refuge | Red | | |
| Beaverhead-Deerlodge National Forest | BHDF | | FY 2007 data[8] |
| Bridger-Teton National Forest | BTF | | |
| Caribou-Targhee National Forest | CTF | | |
| Custer National Forest | CF | | |
| Gallatin National Forest | GF | | |
| Shoshone National Forest | SF | | |

NREL studied each inventory and worked with the units and the people who had compiled the unit inventories to better understand common assumptions and differences in operations and purpose across the 10 units. The inventory data for the units was compiled into one comprehensive, GYA-wide inventory through the development of an ROA Tool. Figure 13 shows total GHG emissions per unit. Yellowstone National Park has the greatest quantity of GHG emissions, due to the nature of its visitor services operations. Grand Teton National Park produces the second-highest level of emissions, although in aggregate, the USFS units (Beaverhead-Deerlodge, Bridger-Teton, Caribou-Targhee, Custer, Gallatin, and Shoshone) rank higher. The FWS units (National Elk and Red Rock Lakes) emit the smallest quantity of GHGs.

Graphs show GHG emissions for the individual units, as well as the individual totals for USFS units and FWS units. Grand Teton National Park and Yellowstone National Park are not

[7] Calendar year unless otherwise noted
[8] Based on FY 2007, defined here as October 1, 2006 through September 30, 2007

presented as summed, as their operating modes are quite different from one another. The USFS unit operations are consistent and can thus be analyzed together. Similarly, both FWS units are operated in the same manner and for the same purpose.

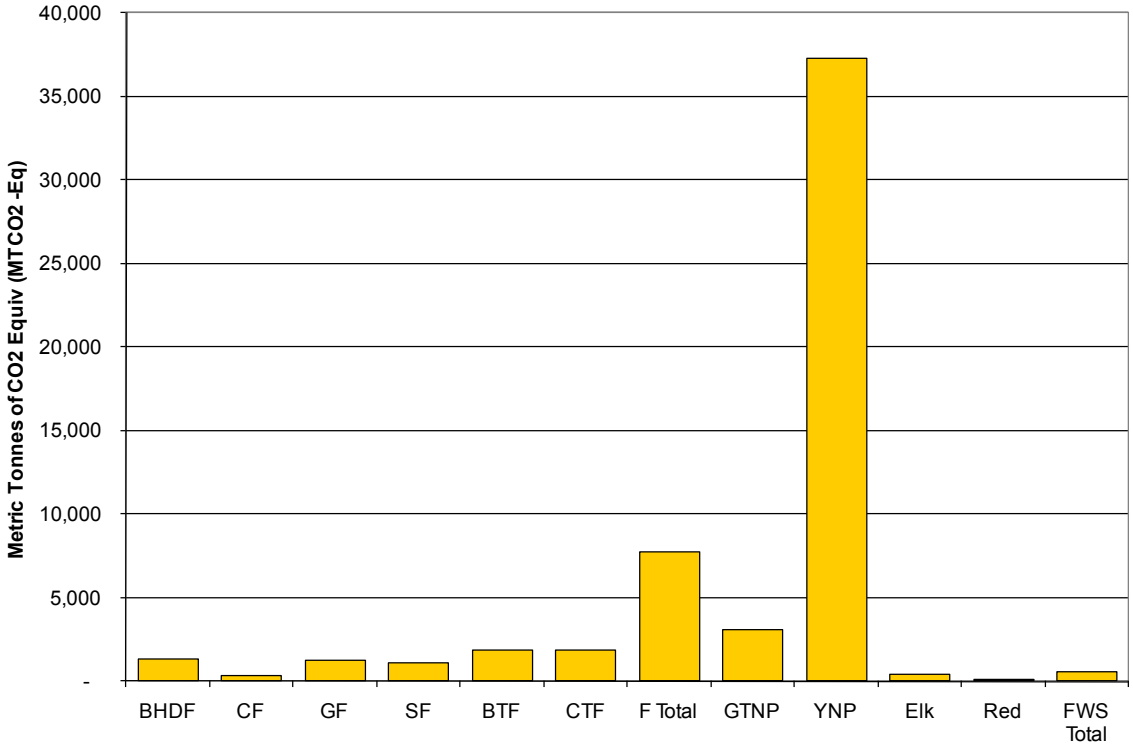



**Figure 13. Total greenhouse gas emissions per Greater Yellowstone Area unit**

NREL examined each unit's inventory to detect trends and outliers in an attempt to identify opportunities for GHG reduction. To identify these outliers, the inventory data was first evaluated by demographics, including land area, number of employees or visitors, and miles of roads. Accurate demographic data was difficult to procure for each unit, and therefore the results of this analysis were only marginally useful.

Two examples are below. The first, Figure 14, displays emissions (in kg $CO_2e$) per acre of land in each unit. One can clearly observe that the National Elk Refuge is the highest emitter per acre, which is interesting since it is a relatively small unit in terms of total emissions, land area, visitors, and employees. Reasons for the large amount of emissions per acre include extra driving required to cover the unit area, use of heavy vehicles and four-wheel-drive vehicles for transport across unpaved roads in the winter, and heating of temporary and remote buildings. The second, Figure 15, shows total GHG emissions per visitor. From this graphic one can see that the unit with substantially higher GHG emissions per visitor is Yellowstone National Park. These emissions can be attributed to its purpose, which is to provide opportunities for citizens to visit and experience the park. Thus, the hotel, restaurant, and visitor services that are an integral part of the operations result in significantly more emissions than produced from the other units.

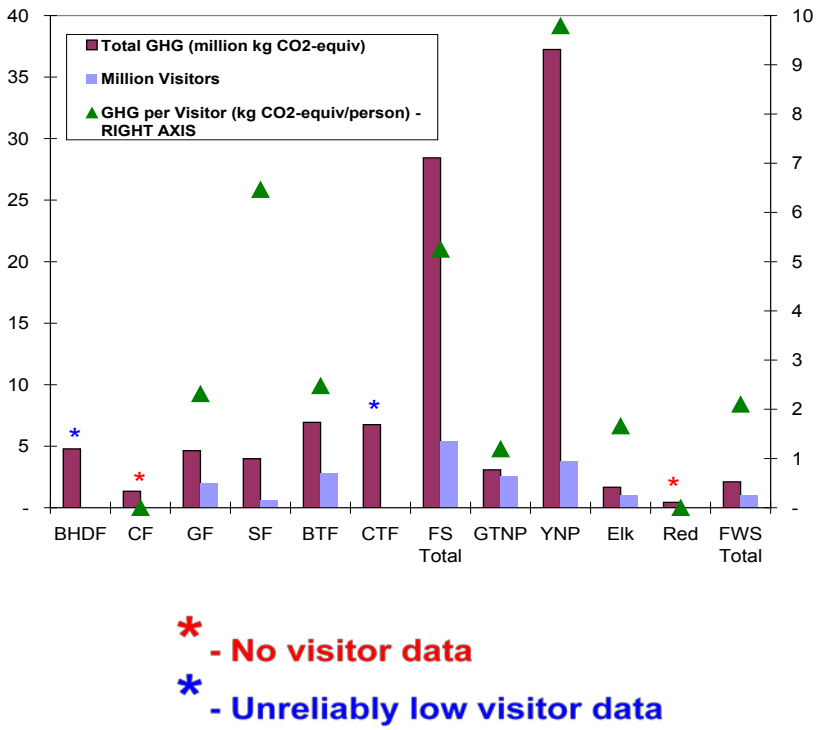



**Figure 14. Emissions per acre of land per unit**

After attempting to sort emissions by demographics, NREL disaggregated them by major emissions categories: mobile combustion, stationary combustion, and purchased electricity. Figure 16 shows emissions by source category for each unit within the GYA. The results of the combined inventory revealed that the largest source of emissions for the entire GYA was purchased combustion sources, mostly electricity, contributing 25,500 $MTCO_2e$, greater than half of the total emissions. Stationary combustion was equivalent to 12,600 $MTCO_2e$ and mobile combustion 10,600 $MTCO_2e$.

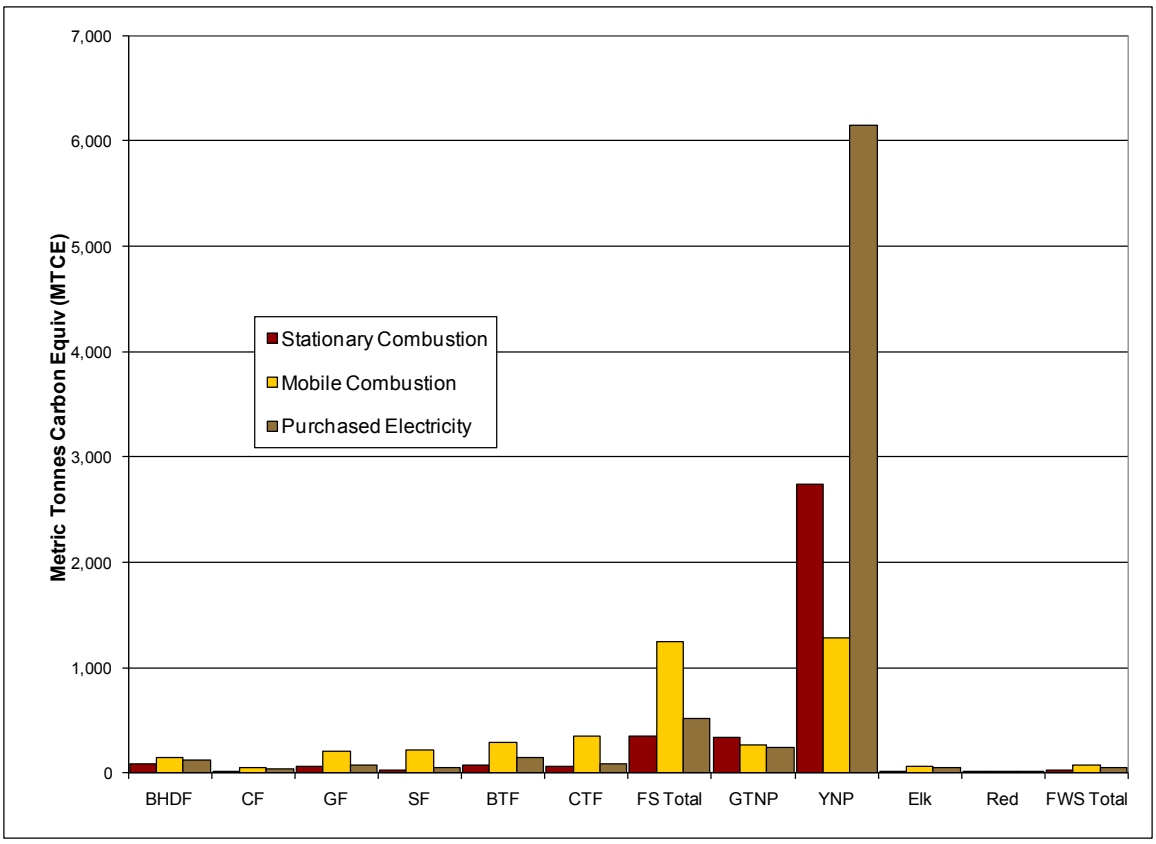



**Figure 15. GHG emissions per visitor per unit**

In comparing across the units, it became apparent that the primary emissions category varied by unit. For example, mobile sources are the largest contributor for the forest units, but the smallest for Yellowstone National Park, contributing only 13% to the total GHGs. Stationary combustion sources account for more emissions than purchased electricity or mobile combustion for both of the national parks. See Figure 16, below.

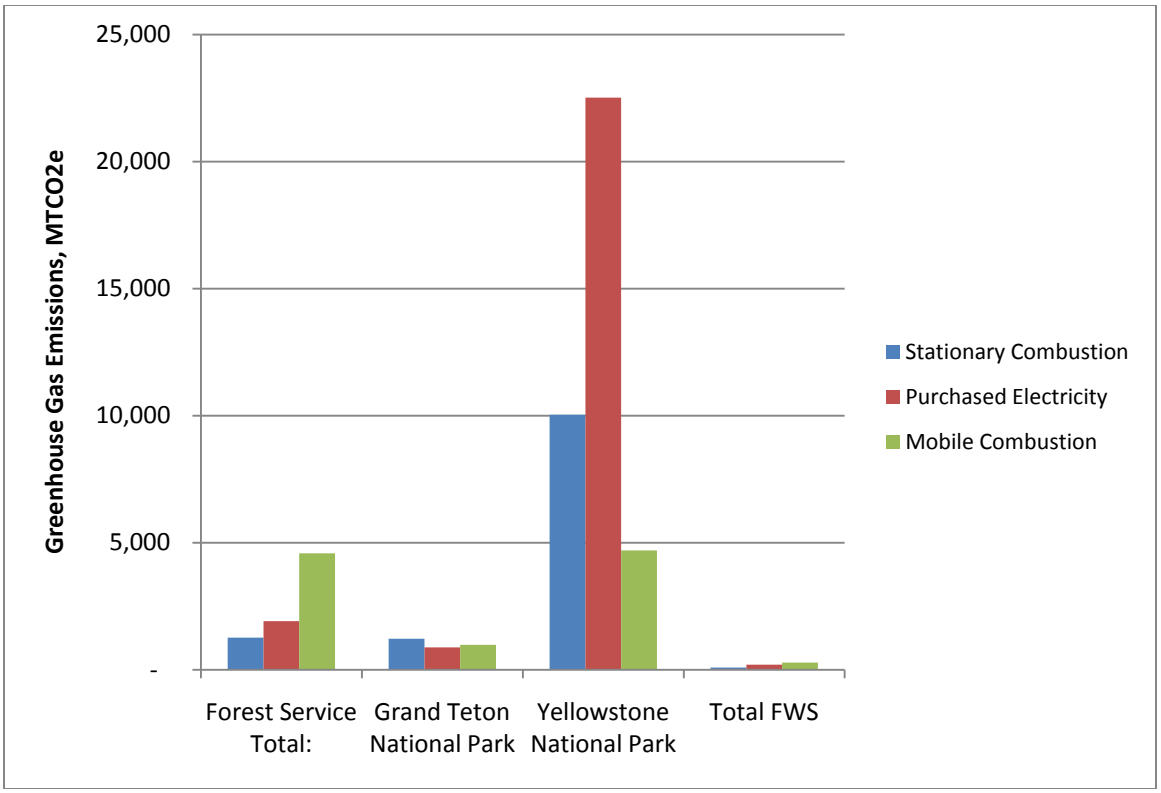



**Figure 16. Emissions broken out by emission categories**

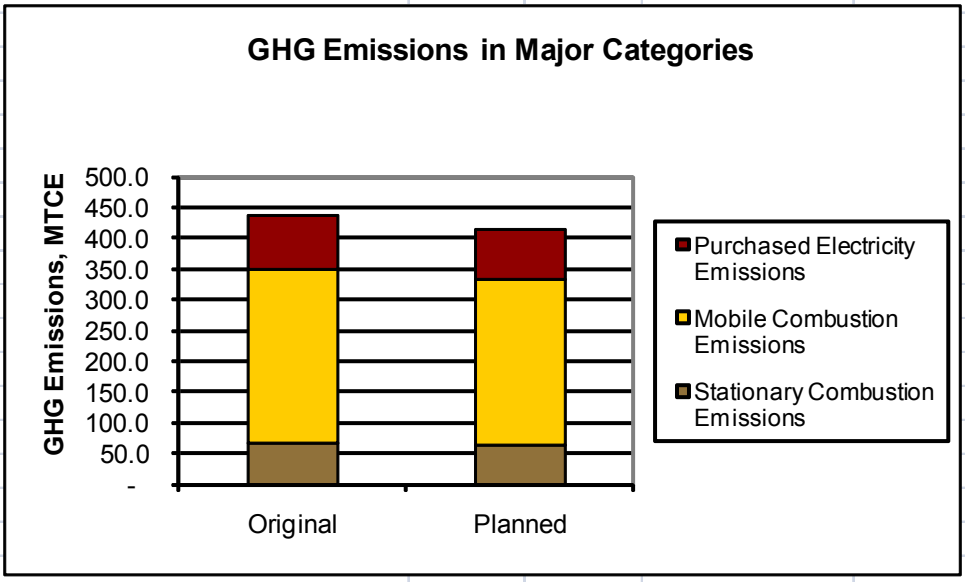
The ROA tool developed by NREL was a first-cut at providing units information on where to focus their emissions-reductions efforts. Using the tool, reduction levels within each of the source categories can be tested for their impact on the total emissions for that unit, as well as the impact such reductions would have on total GYA emissions. Examples of the tool tailored for Caribou-Targhee National Forest are shown below. The targeted emissions reductions are not illustrative of the plans that the units are making to alter activities, but meant to illustrate how the ROA tool works. An ROA tool was constructed for each unit.

# Greater Yellowstone Area Greenhouse Gas Emissions Reduction Options Analysis Tool

## *Caribou-Targhee National Forest*

### SUMMARY OF CURRENT AND PLANNED EMISSIONS REDUCTIONS

| | MTCE | | TOTAL for UNIT |
|---|---|---|---|
| | Original | Planned | % Reduction |
| Stationary Combustion Emissions | 67.3 | 64.2 | 4.7% |
| Mobile Combustion Emissions | 281.0 | 267.6 | 4.8% |
| Purchased Electricity Emissions | 89.0 | 81.5 | 8.5% |
| ***TOTAL*** | ***437.4*** | ***413.2*** | ***5.5%*** |




### PURCHASED ELECTRICITY EMISSIONS REDUCTION OPTIONS

**Change only those values in the GREEN cells**

**PURCHASED ELECTRICITY**

| Electricity Purchased | Reduction Planned | Current Emissions (MTCE) | | | | Planned Emissions (MTCE) | | | |
|---|---|---|---|---|---|---|---|---|---|
| kWh/year | % | CO2 | CH4 | N2O | Total GHG | CO2 | CH4 | N2O | Total GHG |
| 776,834 | 8% | 89 | 0 | 0 | 89 | 81 | 0 | 0 | 81 |

**Total % Reduction in GHG Emissions for This Unit 6%**

## MOBILE COMBUSTION EMISSIONS REDUCTION OPTIONS

Change only those values in the GREEN cells

| Total % Reduction in Mobile Combustion Emissions | 4.8% |
|---|---|
| Total % Reduction in GHG Emissions for This Unit | 6% |

| | | | CURRENT EMISSIONS | | | | | | | % PLANNED CHANGE | | PLANNED EMISSIONS | | | | | TOTAL REDUCTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Metric Tons of Carbon Equivalent (MTCE) | | | | | | | Reduction | Increase | Carbon Equivalent (MTCE) | | | | | |
| Type "FUEL" or "VMT">>> | VMT | | AVG MPG | | $CO_2$ | $CH_4$ | $N_2O$ | Total | | MILES | AVG MPG | $CO_2$ | $CH_4$ | $N_2O$ | Total | | |
| **Gasoline** | | | | | | | | | | | | | | | | | |
| Car | 26,150 | mi | 22.15 | mpg | 2.9 | 0.0 | 0.1 | **2.9** | | **4.0%** | | 2.7 | 0.0 | 0.1 | **2.8** | | **4.0%** |
| Light Truck, SUV, Minivan | 976,056 | mi | 17.69 | mpg | 133.3 | 0.3 | 4.9 | **138.5** | | | **8.0%** | 123.4 | 0.2 | 4.5 | **128.2** | | **7.4%** |
| Bus | 0 | mi | 6.90 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 229,572 | mi | 7.61 | mpg | 72.2 | 0.2 | 2.4 | **74.8** | | | | 72.2 | 0.2 | 2.4 | **74.8** | | |
| Motorcycle | 0 | mi | 50.00 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Diesel** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 19.52 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Light Truck, SUV, Minivan | 0 | mi | 15.59 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 6.90 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 172,024 | mi | 7.23 | mpg | 64.7 | 0.0 | 0.1 | **64.8** | | | **5.0%** | 61.7 | 0.0 | 0.1 | **61.7** | | **4.8%** |
| **Liquefied Petroleum Gas** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 15.96 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Trucks and SUVs | 0 | mi | 15.96 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 5.24 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 0 | mi | 5.24 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Compressed Natural Gas** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 21.98 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Trucks and SUVs | 0 | mi | 21.98 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 4.19 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 0 | mi | 7.22 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Methanol** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 15.89 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Trucks and SUVs | 0 | mi | 15.89 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 2.61 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 0 | mi | 4.50 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Ethanol** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 15.89 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Trucks and SUVs | 0 | mi | 15.89 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 2.35 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 0 | mi | 4.04 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Hybrid** | | | | | | | | | | | | | | | | | |
| Gasoline Car | 0 | mi | 56.00 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Gasoline Truck | 0 | mi | 26.00 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Diesel Bus | 0 | mi | 15.00 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Biodiesel (20%)** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 19.52 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Trucks and SUVs | 0 | mi | 15.59 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 6.90 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 0 | mi | 5.24 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Biodiesel (100%)** | | | | | | | | | | | | | | | | | |
| Car | 0 | mi | 19.52 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Trucks and SUVs | 0 | mi | 15.59 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Bus | 0 | mi | 6.90 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| Heavy Duty Vehicle | 0 | mi | 5.24 | mpg | 0.0 | 0.0 | 0.0 | **0.0** | | | | 0.0 | 0.0 | 0.0 | **0.0** | | |
| **Highway Vehicles Total** | | | | | **273.1** | **0.5** | **7.4** | **281.0** | | | | **260.0** | **0.5** | **7.1** | **267.6** | | **4.8%** |

## STATIONARY COMBUSTION EMISSIONS REDUCTION OPTIONS

Change only those values in the GREEN cells

| | | | | Current Emissions (MTCE) | | | | | Planned Emissions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel Type | Current Amount Consumed | Unit | % Reduction in Use Planned | CO2 | CH4 | N2O | Total GHG | % of Total | CO2 | CH4 | N2O | Total GHG | % of Total |
| Natural Gas | 1,743,886 | cubic feet | 5% | 26.0 | 0.05 | 0.02 | 26.1 | 39% | 24.7 | 0.05 | 0.01 | 24.8 | 39% |
| Diesel Fuel | 2,402 | gallons | 6% | 6.7 | 0.02 | 0.02 | 6.7 | 10% | 6.3 | 0.02 | 0.02 | 6.3 | 10% |
| Propane | 15,145 | gallons | 2% | 23.7 | 0.09 | 0.07 | 23.9 | 35% | 23.3 | 0.09 | 0.07 | 23.4 | 36% |
| Biodiesel | - | gallons | 3% | 0.0 | 0.00 | 0.00 | 0.0 | 0% | 0.0 | 0.00 | 0.00 | 0.0 | 0% |
| Kerosene | - | gallons | 4% | 0.0 | 0.00 | 0.00 | 0.0 | 0% | 0.0 | 0.00 | 0.00 | 0.0 | 0% |
| Wood | 25 | short tons | 9% | 9.9 | 0.70 | 0.14 | 10.7 | 16% | 9.0 | 0.63 | 0.12 | 9.7 | 15% |
| Coal | - | short tons | 12% | 0.0 | 0.00 | 0.00 | 0.0 | 0% | 0.0 | 0.00 | 0.00 | 0.0 | 0% |
| Total | | | | 66.2 | 0.86 | 0.24 | 67.3 | 100% | 63.2 | 0.79 | 0.22 | 64.2 | 100% |

| Total % Reduction in Stationary Combustion Emissions | 5% |
|---|---|
| Total % Reduction in GHG Emissions for This Unit | 6% |

# Appendix 4. Crosswalk of Sustainability Goals and Targets in Executive Orders and Statutes

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***GHG Baseline*** | | Prepare baseline of GHG emissions for scope 1 and 2 emissions for FY 2008 by January 3, 2010 for scope 3 GHG emissions by June 2, 2010 [§7((b)(i)]. (Headquarters Lead). | |
| ***HG Emission Reductions*** | Reduce GHG emissions through reduction of energy intensity by (1) 3% annually through FY 2015 or (2) 30% by FY 2015 (baseline 2003). [§2(a)] | Establish agency-wide GHG emission percentage reduction targets by FY 2020 (baseline FY 2008) for:<br>• Scope 1 and scope 2 GHG emissions by FY 2020 (due January 4, 2010).<br>• Scope 3 GHG emissions (due June 2, 2010).<br>[§2(a) and (b)] | |
| ***GHG Emission Reporting*** | | Report comprehensive GHG emission inventory for FY 2010 by January 5, 2011, and annually thereafter by the end of January. [§2(c)] | [EISA §527]: Each Federal agency must issue an annual report that describes the status of initiatives to improve energy efficiency, reduce energy costs, and reduce GHG emissions.<br>[EPA MGGRR]: Facilities and suppliers of fossil fuels or industrial GHGs that emit more than 25,000 metric tons of $CO_2$-e per year must report their emissions by March 31, 2011, for 2010 emissions. Reports submitted annually thereafter. |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Building Energy*** | Reduce building energy intensity 3% annually through FY 2015, or 30% total reduction by FY 2015 (baseline FY 2003). [§2(a)] | Reduce energy intensity in buildings to achieve GHG reductions. [§2(a)(i)] | [EISA §431]: Reduce building energy intensity 3% annually through 2015, or 30% total reduction by 2015 (baseline 2003). |
| ***Renewable Energy Consumption*** | Ensure that 50% of statutorily required renewables comes from "new" (as of 1999) sources. [§2(b)] | Increase use of renewable energy. [§2(a)(ii)] | [EPAct 2005 §203]: Defines “renewable energy.”<br>[EPAct 2005 §203]: Increase renewables 3% in FY 2007–2009;<br>• Increasing to 5% in FY 2010–2012.<br>• Increasing to 7.5% in FY 2013 and beyond.<br>[EISA §523]: 30% of hot water demand in new Federal buildings and major renovations must be met with solar hot water if life-cycle cost effective. |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Fleet Petroleum Use*** | Reduce by 2% vehicle petroleum annually through FY 2015 (baseline FY 2005). [§2(g)]<br><br>Achieve 10% increase in non-petroleum fuel consumption annually (baseline FY 2005). [§2(g)]<br><br>Use plug-in hybrids when PIH are commercially available at a life-cycle cost reasonably comparable to non-PIH vehicles. [§2(g)] | Reduce fleet's consumption of petroleum products 2% annually through end of FY 2020 (baseline FY 2005). [§2(a)(iii)(C)]<br><br>Use low-GHG-emitting vehicles. [§2(a)(iii)(A)]<br><br>Optimize number of vehicles in fleet. [§2(a)(iii)(B)] | [EISA §142]: Reduce vehicle petroleum reduction 20% by FY 2015 (baseline FY 2005).<br><br>[EISA §142]: Achieve 10% increase in non-petroleum fuel use annually by 2015 (baseline 2005).<br><br>[EISA §246]: Install at least one renewable fuel pump at each Federal fleet fueling center by 2010.<br><br>[EISA §141]: Federal agencies are prohibited from acquiring any light-duty motor vehicle or medium-duty passenger vehicle that is not a "low greenhouse gas emitting vehicle." Alternatively, an agency may demonstrate that it has adopted cost-effective policies to reduce petroleum consumption to achieve a comparable reduction in GHGs.<br><br>[EPAct 2005 §701]: Dual-fueled vehicles to be operated on alternative fuel unless waivered. |
| ***Renewable Energy Generation*** | Implement new renewable energy generation projects on agency property for agency use. [§2(b)] | Implement renewable energy generation projects on agency property. [§2(a)(ii)] | [EPAct 2005 §203]: Double count renewable energy produced on Federal or Indian lands and used on-site at Federal facilities. |
| ***Supply Chain GHG Emissions*** | [Indirect] In agency acquisition of goods and services, use of sustainable environmental practices, including energy-efficient products, is encouraged. [§2(d)] | Pursue opportunities with vendors and contractors to reduce GHG emissions. (§2(b)(i)) | [EISA §526]: Federal agencies are prohibited from procuring synfuel unless its life-cycle GHG emissions are less than those for conventional petroleum sources. |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Scope 3 Emissions*** | | Implement transit, travel, training, and conferencing strategies to support low-carbon commuting and travel. [§2(b)(ii)]<br><br>Implement innovative policies to address scope 3 emissions unique to agency operations. [§2(b)(iv)] | |
| ***Potable Water Consumption*** | Reduce water consumption intensity 2% annually through FY 2015 or 16% total reduction by the end of FY 2015 (baseline FY 2007). [§2(c)] | Reduce 2% annually potable water consumption intensity through FY 2020 or 26% by the end of FY 2020 (baseline FY 2007 water consumption). [§2(d)(i)] | |
| ***Industrial, Landscaping, and Agricultural Water Consumption*** | Reduce water consumption intensity 2% annually through FY 2015 or 16% total reduction by the end of FY 2015 (baseline FY 2007). [§2(c)] | Reduce industrial, landscaping, and agricultural water consumption by 2% annually or 20% by the end of FY 2020 (baseline FY 2010 industrial, landscaping, and agricultural consumption). [§2(d)(ii)] | |
| ***Water Reuse*** | | Identify, promote, and implement water reuse strategies that reduce potable water consumption. [§2(d)(iii)] | |
| ***Storm-water Management*** | | Achieve EPA's storm-water management objectives. [§2(d)(iv)] [EPA is to provide guidance on this requirement by December 4, 2009.] | [EISA §438]: Maintain or restore, for Federal properties over 5,000 square feet, the property's pre-development hydrology as to temperature, rate, volume, and duration of flow. |
| ***Pollution Prevention*** | Maintain cost effective waste prevention and recycling programs. [§2(e)] | Minimize generation of waste and pollutants through source reduction. [§2(e)(i)] | Source reduction is required through SARA Title III and waste minimization is required through RCRA generator requirements. |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Solid Waste Diversion*** | Increase diversion of solid waste as appropriate. [§2(e)] | Divert 50% of non-hazardous solid waste from disposal by the end of FY 2015. [§2(e)(ii)] Does not include diversion to waste-to-energy plants. [§7]<br>Divert 50% of construction and demolition materials and debris from disposal by the end of FY 2015. [§2(e)(iii)] | [Sites: Check state and local laws and regulations related to solid waste diversion.] |
| ***Paper*** | Use paper containing at least 30% postconsumer fiber content. [§2(d)] | Acquire uncoated printing and writing paper containing at least 30% postconsumer fiber.<br>Reduce printing paper use. [§2(e)(iv)] | [Solid Waste Disposal Act, § 6002 and 40 CFR Part 247]: Purchase paper with the highest amount of postconsumer fiber practicable. |
| ***Toxic Materials and Chemicals*** | Reduce acquisition, use, and disposal of toxic materials and chemicals. [§2(e)] | Reduce and minimize the quantity of toxic and hazardous chemicals and materials acquired, used, and disposed FY 2015. [§2(e)(v)] | [Pollution Prevention Act]: Federal facilities are required to deploy pollution prevention as the first choice in environmental management. |
| ***Compostable and Organic Material*** | | Increase diversion of compostable and organic material from waste streams. [§2(e)(vi)] | |
| ***Landscaping Management*** | | Implement pest management and other landscaping management practices. [§2(e)(vii)] | |
| ***Chemical Use*** | Reduce acquisition, use, and disposal of toxic materials and chemicals. [§2(e)] | Increase use of acceptable alternative chemicals and processes. [2(e)(viii)] Decrease chemical use to assist in achieving GHG reduction targets. [§2(e)(ix)] | [Montreal Protocol]: The reduction of most ozone-depleting substances also leads to a reduction in GHGs released. |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Sustainable Communities*** | | Participate in regional transportation planning and recognize existing community transportation infrastructure. [§2(f)(i)]<br><br>Align Federal policies to increase the effectiveness of local planning for energy choices such as locally-generated renewable energy. [§2(f)(ii)]<br><br>Ensure planning for new facilities/leases considers pedestrian-friendly sites near existing employment centers and accessible to public transit. [§2(f)(iii)]<br><br>Identify and analyze impacts from energy use and alternative energy sources in EAs and EISs for new or expanded facilities. [§2(f)(iv)]<br><br>Coordinate with regional programs for Federal, tribal, state, and local ecosystem, watershed, and environmental management. [§2(f)(v)] | |
| ***Energy Efficiency in New Construction and Major Renovations*** | | Achieve by 2030 zero-net-energy in buildings entering the planning process after 2020. [§2(g)(i)] | [EPAct 2005 §109]: Achieve energy performance 30% beyond ASHRAE 90.1-2004.<br><br>[EISA §433]: New Federal buildings and Federal buildings undergoing major renovations shall reduce their fossil fuel-generated energy consumption (baseline 2003) by 55% (2010), 65% (2015), 80% (20202), 90% (2025), and 100% (2030). |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***High Performance Sustainable Buildings*** | Ensure all new agency construction and renovation complies with the *Guiding Principles*. [§2(f)]<br><br>Ensure 15% of existing Federal building inventory incorporate the *Guiding Principles* by 2015. [§2(f)] | Ensure all new construction, major renovation, or repair and alteration complies with the *Guiding Principles*. [§2(g)(ii)]<br><br>Ensure 15% of existing facilities and building leases (above 5,000 gross square feet) meet the *Guiding Principles* by FY 2015. [§2(g)(iii)]<br><br>Make annual progress towards 100% conformance with the *Guiding Principles.* [§2(g)(iii)] | [EISA §433]: Requires sustainable design principles be applied to the siting, design, and construction of buildings subject to the standards.<br><br>[EISA §434]: Ensure major replacements of installed equipment, renovation, or expansion of existing space employ the most energy-efficient designs, systems, equipment, and controls life-cycle cost effective.<br><br>[EISA §435]: As of December 19, 2010, Federal agencies are prohibited from leasing buildings that have not earned the ENERGY STAR® label (some exemptions apply).<br><br>[EPAct 2005 §109]: Includes application of sustainable design principles for new buildings. |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Advanced Metering and Measurement*** | | | [EPAct 2005 §103]: Federal buildings must be metered by October 1, 2012 with data provided at least daily and electricity consumption measured hourly.<br><br>[EISA §432]: Identify "covered facilities" constituting at least 75% of the agency's facility energy use. Each covered facility must have an energy manager designated and meet additional requirements. Energy and water evaluations must be completed every 4 years for each facility. Facility energy managers are also responsible for commissioning equipment and establishing O&M plans for measuring, verifying, and reporting energy and water savings.<br><br>[EISA §434(b)]: By October 16, 2016, each agency shall provide for equivalent metering of natural gas and steam. |
| ***Green Roofs*** | | Minimize consumption of energy, water, and materials through cost-effective, innovative strategies, such as highly reflective and vegetated roofs. [§2(g)(iv)] | |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Building Portfolio Management*** | | Manage existing building systems to reduce consumption of energy, water, and materials. [§2(g)(v)]<br><br>Identify alternatives to renovation that reduce existing assets' deferred maintenance costs. [§2(g)(v)]<br><br>Identify opportunities to consolidate and dispose of existing assets, optimize real property portfolio performance, and reduce environmental impacts. [§2(g)(vi)] | |
| ***Historic Buildings*** | | Promote long-term viability of agency-owned historic buildings by ensuring that rehabilitation utilizes best practices and technologies in retrofitting. [§2(g)(vii)] | |
| ***Sustainable Acquisition*** | Purchase products that are:<br>• Recycled,<br>• Biopreferred<br>• ENERGY STAR<br>• FEMP-designated,<br>• EPEAT<br>• WaterSense (and other water-efficient)<br>[§2(d)] | Ensure 95% of new contract actions for products and services are:<br>• Energy efficient<br>• Water efficient<br>• Biobased-content<br>• Environmentally preferable<br>• Non-ozone depleting,<br>• Recycled-content<br>• Non-toxic or less-toxic than alternatives [§2(h)(i)] | [EPAct 2005 §104]: Requires Federal agencies to incorporate energy efficiency criteria consistent with ENERGY STAR and FEMP-designated products for all procurements involving energy-consuming products and services.<br><br>[EISA §525]: Requires procurement to focus on ENERGY STAR and FEMP-designated products.<br><br>[EISA §524]: Encourages agencies to minimize standby energy use in purchases of energy-using equipment.<br><br>*NOTE: Preferences in RCRA 6002, FSRIA 9002, and EPCRA not included.* |

| Goal/Target | E.O. 13423 | E.O. 13514 | Existing Statute |
|---|---|---|---|
| ***Electronics Stewardship*** | Ensure that 95% of agency electronic product acquisitions are EPEAT registered. [§2(h)]<br><br>Enable the ENERGY STAR feature on agency computers and monitors. (§2(h))<br><br>Establish and implement policies to extend the useful life of agency electronic equipment. (§2(h))<br><br>Use environmentally sound disposal practices for electronics. (§2(h)) | Ensure procurement preference for EPEAT-registered electronic products. [§2(i)(i)]<br><br>Enable power management, duplex printing, and other energy-efficient or environmentally preferable features on all eligible DOE electronic products. [§2(i)(ii)]<br><br>Employ environmentally sound disposition of excess or surplus electronic products. [§2(i)(iii)]<br><br>Ensure procurement of ENERGY STAR and FEMP-designated electronic equipment. [§2(i)(iv)]<br><br>Implement best management practices in energy-efficient management of servers and Federal data centers. [§2(i)(v)] | [EISA §431]: Reduce building energy intensity 3% annually through 2015, or 30% total reduction by 2015 (baseline 2003). |
| ***Environmental Management Systems*** | Implement EMSs to support goals of EO. [§3(b)] [See also CEQ *Instructions* 3/28/2007] | Continue implementation of EMSs; ensure they are maintained to achieve the goals of the EO. [§2(j)] | |

Prepared by DOE's Office of Environmental Policy and Assistance (HS-22) with assistance from the Federal Energy Management Program, 12-02-09.

# Appendix 5. Scope 3 Calculator Tool

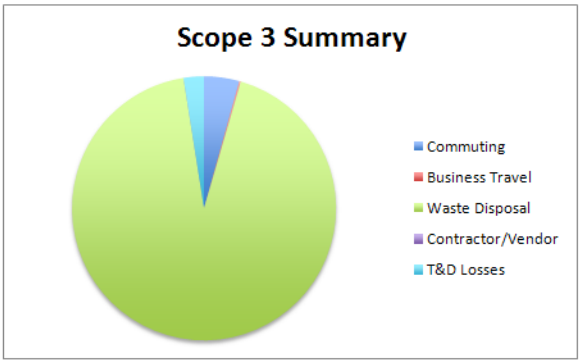
National Renewable Energy Laboratory
Innovation for Our Energy Future

Scope 3 GHG
Summary

| Contact Information | | | |
|---|---|---|---|
| **Name** | | **Title** | |
| **Phone Number** | | **Unit** | |
| **Email** | | | |

**Scope 3 Summary**

| Category | MT CO2e |
|---|---|
| Commuting | 609.72 |
| Business Travel | 26.41 |
| Waste Disposal | 13,141.88 |
| Contractor/Vendor | 0.00 |
| T&D Losses | 353.47 |
| Leased Space | 209.72 |




**Key**

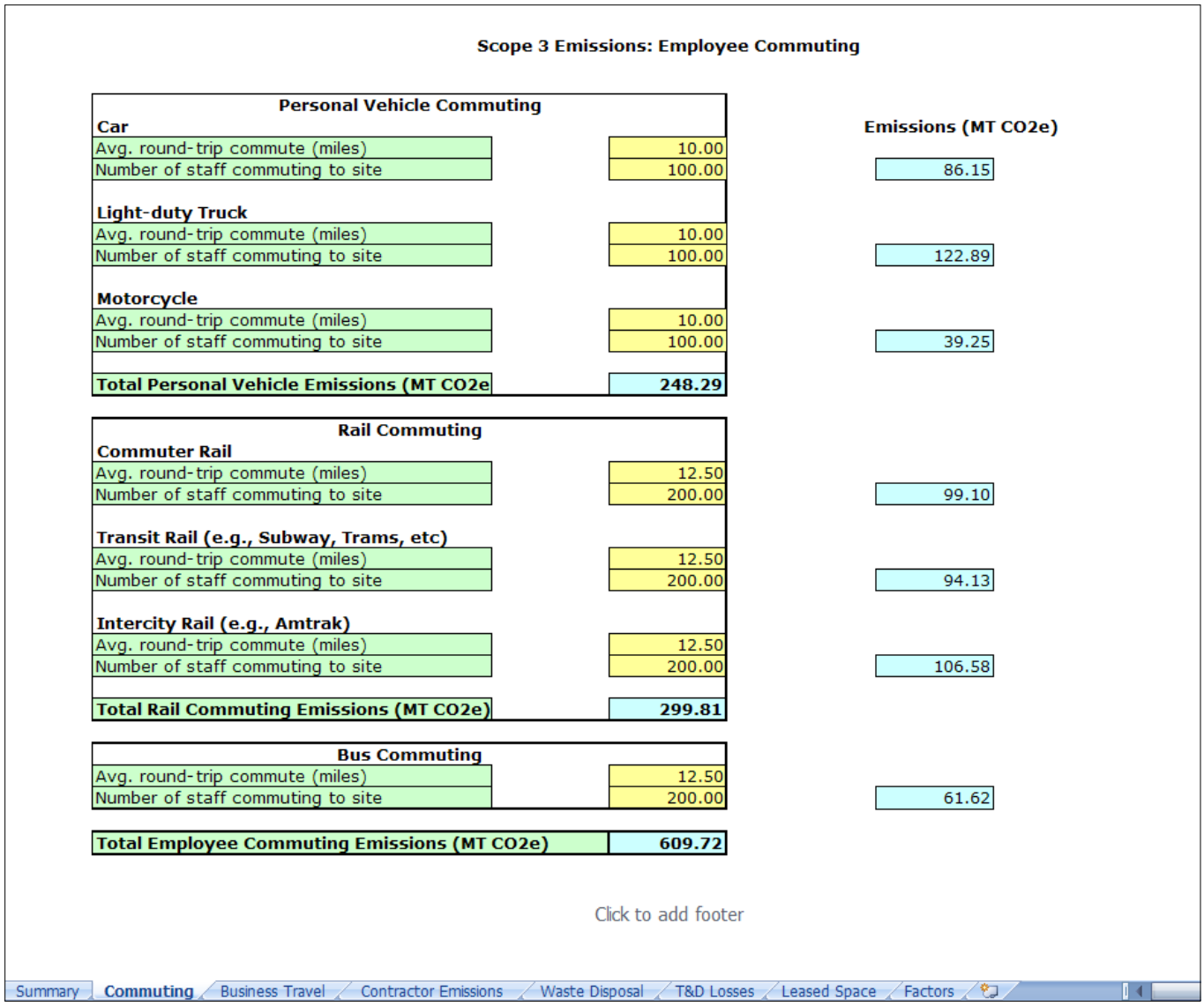
| | |
|---|---|
| Label | |
| Input Field | |
| Calculated Field | |
| Factor Field | |

This calcuator tool will help you get an idea of your Scope 3 GHG emissions and help you decide where to begin planning for emissions reductions. It was built with the idea that data gathering is the most difficult task in developing a GHG inventory, so the data requirements are fairly minimal. Of course, this means that the calculations are broad strokes, but at the very least, should give you an order-of-magnitude comparison in the various emissions categories.
To use the calculator, fill in the yellow boxes on the different data tabs along the bottom of the calculator. The tool will do the calculations and create the graph automatically. For transparency, calculations, calculation factors, and information sources are documented throughout the tool. If you have any questions, my contact info is in the lower right corner, so please feel free to contact me.

Version 3

John Nangle
john.nangle@nrel.gov
(303) 384-7377

Summary | Commuting | Business Travel | Contractor Emissions | Waste Disposal | T&D Losses | Leased Space | Factors



## Scope 3 Emissions: Employee Commuting

| Personal Vehicle Commuting | | Emissions (MT CO2e) |
|---|---|---|
| **Car** | | |
| Avg. round-trip commute (miles) | 10.00 | |
| Number of staff commuting to site | 100.00 | 86.15 |
| **Light-duty Truck** | | |
| Avg. round-trip commute (miles) | 10.00 | |
| Number of staff commuting to site | 100.00 | 122.89 |
| **Motorcycle** | | |
| Avg. round-trip commute (miles) | 10.00 | |
| Number of staff commuting to site | 100.00 | 39.25 |
| **Total Personal Vehicle Emissions (MT CO2e** | **248.29** | |

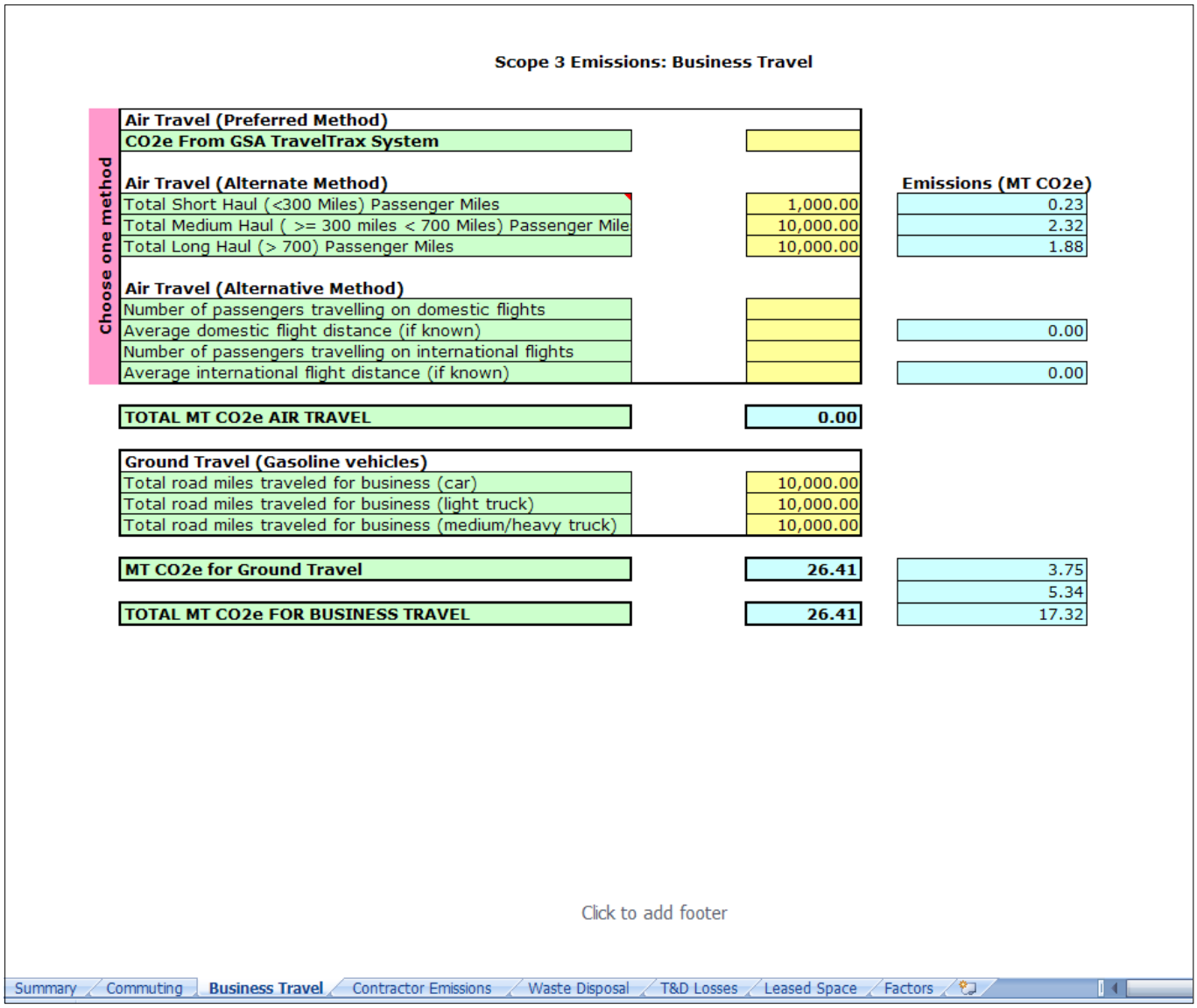
| Rail Commuting | | |
|---|---|---|
| **Commuter Rail** | | |
| Avg. round-trip commute (miles) | 12.50 | |
| Number of staff commuting to site | 200.00 | 99.10 |
| **Transit Rail (e.g., Subway, Trams, etc)** | | |
| Avg. round-trip commute (miles) | 12.50 | |
| Number of staff commuting to site | 200.00 | 94.13 |
| **Intercity Rail (e.g., Amtrak)** | | |
| Avg. round-trip commute (miles) | 12.50 | |
| Number of staff commuting to site | 200.00 | 106.58 |
| **Total Rail Commuting Emissions (MT CO2e)** | **299.81** | |

| Bus Commuting | | |
|---|---|---|
| Avg. round-trip commute (miles) | 12.50 | |
| Number of staff commuting to site | 200.00 | 61.62 |

| | |
|---|---|
| **Total Employee Commuting Emissions (MT CO2e)** | **609.72** |

Click to add footer

Summary | Commuting | Business Travel | Contractor Emissions | Waste Disposal | T&D Losses | Leased Space | Factors



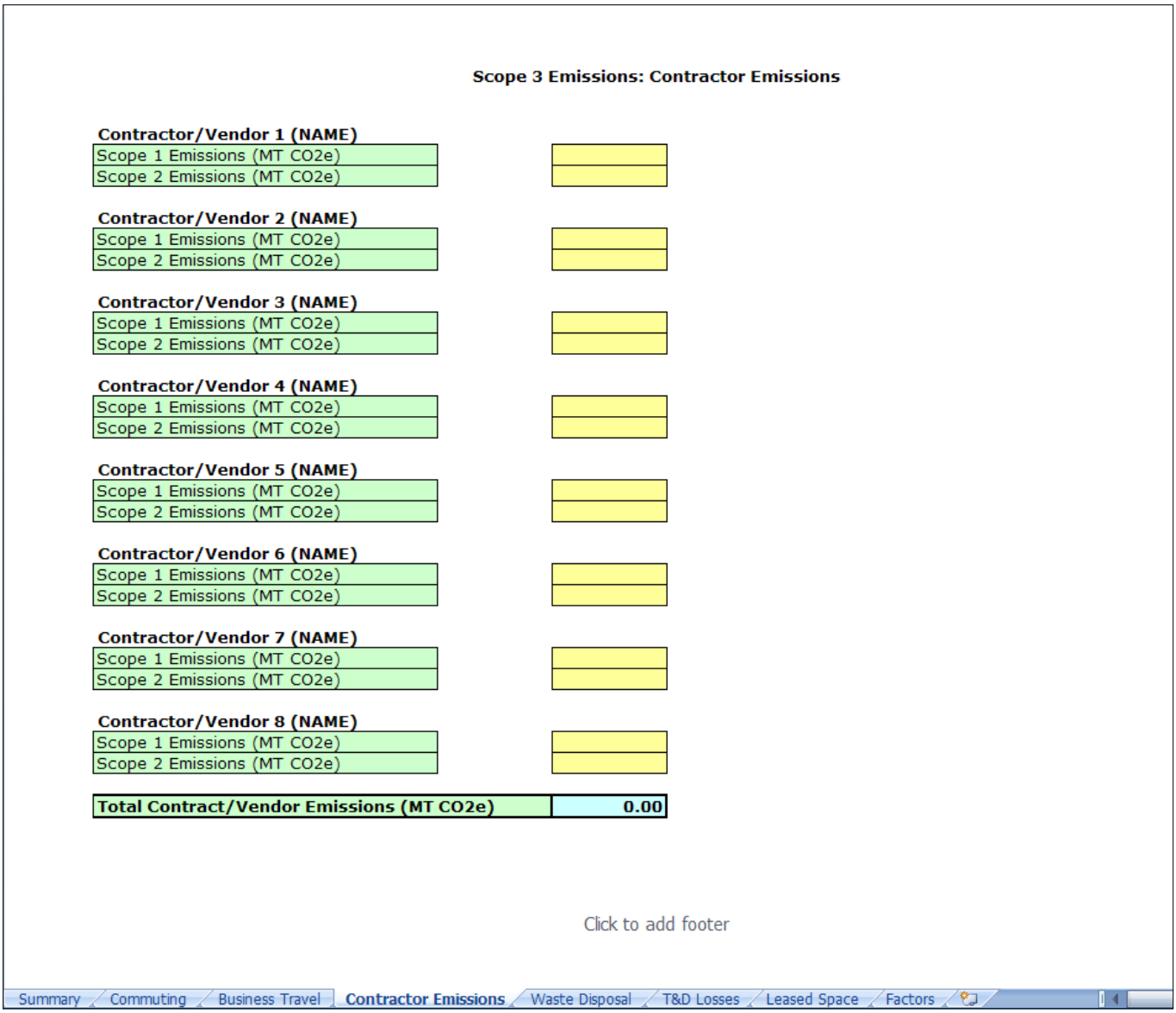
Scope 3 Emissions: Business Travel

Choose one method

| | | Emissions (MT CO2e) |
|---|---|---|
| **Air Travel (Preferred Method)** | | |
| **CO2e From GSA TravelTrax System** | | |
| **Air Travel (Alternate Method)** | | |
| Total Short Haul (<300 Miles) Passenger Miles | 1,000.00 | 0.23 |
| Total Medium Haul ( >= 300 miles < 700 Miles) Passenger Mile | 10,000.00 | 2.32 |
| Total Long Haul (> 700) Passenger Miles | 10,000.00 | 1.88 |
| **Air Travel (Alternative Method)** | | |
| Number of passengers travelling on domestic flights | | |
| Average domestic flight distance (if known) | | 0.00 |
| Number of passengers travelling on international flights | | |
| Average international flight distance (if known) | | 0.00 |
| **TOTAL MT CO2e AIR TRAVEL** | **0.00** | |
| **Ground Travel (Gasoline vehicles)** | | |
| Total road miles traveled for business (car) | 10,000.00 | |
| Total road miles traveled for business (light truck) | 10,000.00 | |
| Total road miles traveled for business (medium/heavy truck) | 10,000.00 | |
| **MT CO2e for Ground Travel** | **26.41** | 3.75 |
| | | 5.34 |
| **TOTAL MT CO2e FOR BUSINESS TRAVEL** | **26.41** | 17.32 |

Click to add footer

Summary | Commuting | **Business Travel** | Contractor Emissions | Waste Disposal | T&D Losses | Leased Space | Factors

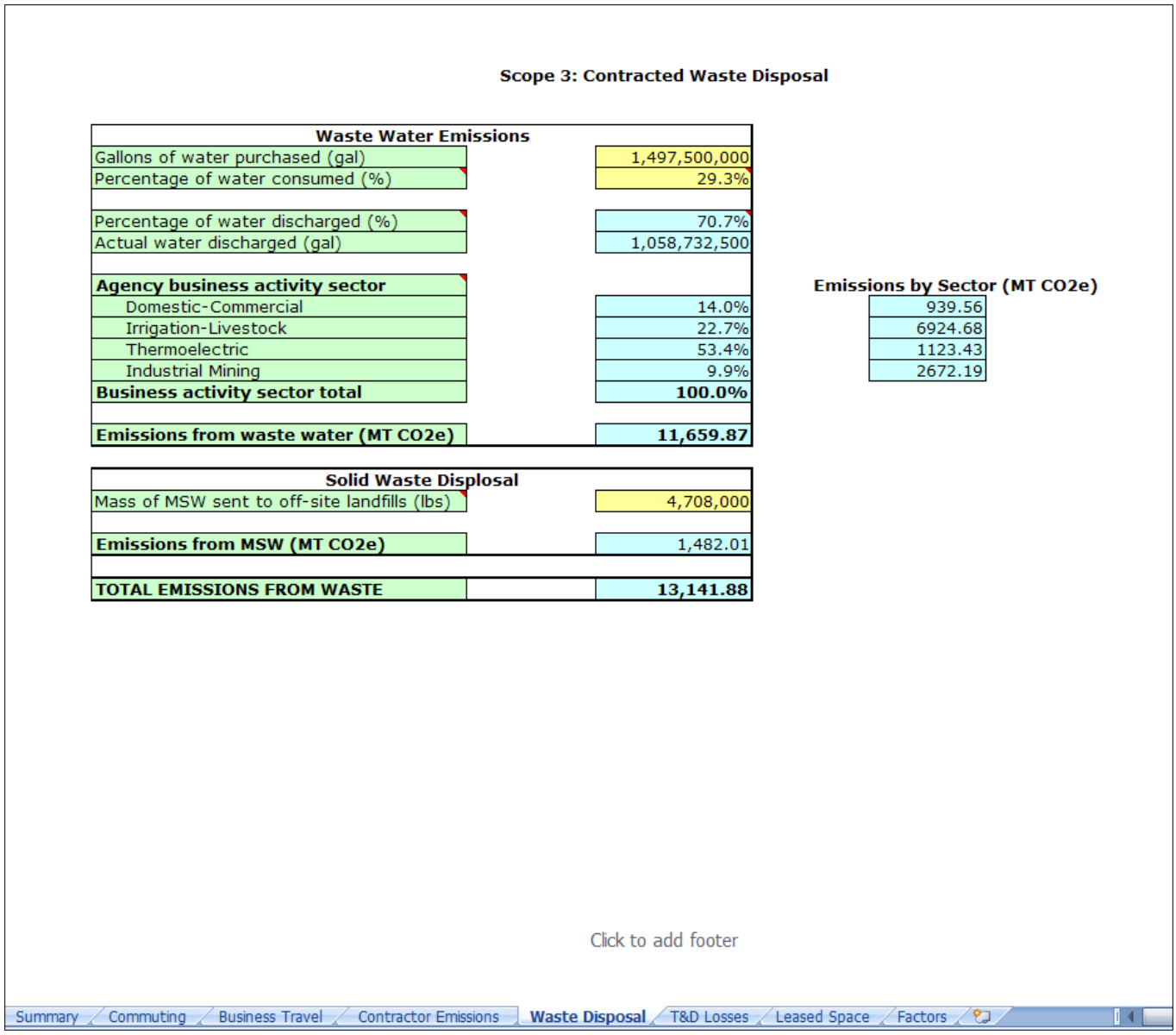


**Scope 3 Emissions: Contractor Emissions**

| | |
|---|---|
| **Contractor/Vendor 1 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 2 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 3 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 4 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 5 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 6 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 7 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Contractor/Vendor 8 (NAME)** | |
| Scope 1 Emissions (MT CO2e) | |
| Scope 2 Emissions (MT CO2e) | |
| **Total Contract/Vendor Emissions (MT CO2e)** | **0.00** |

Click to add footer

Summary | Commuting | Business Travel | **Contractor Emissions** | Waste Disposal | T&D Losses | Leased Space | Factors



**Scope 3: Contracted Waste Disposal**

| Waste Water Emissions | |
|---|---|
| Gallons of water purchased (gal) | 1,497,500,000 |
| Percentage of water consumed (%) | 29.3% |
| | |
| Percentage of water discharged (%) | 70.7% |
| Actual water discharged (gal) | 1,058,732,500 |
| | |
| **Agency business activity sector** | |
| Domestic-Commercial | 14.0% |
| Irrigation-Livestock | 22.7% |
| Thermoelectric | 53.4% |
| Industrial Mining | 9.9% |
| **Business activity sector total** | **100.0%** |
| | |
| **Emissions from waste water (MT CO2e)** | **11,659.87** |

| Solid Waste Displosal | |
|---|---|
| Mass of MSW sent to off-site landfills (lbs) | 4,708,000 |
| | |
| **Emissions from MSW (MT CO2e)** | 1,482.01 |
| | |
| **TOTAL EMISSIONS FROM WASTE** | **13,141.88** |

| Emissions by Sector (MT CO2e) |
|---|
| 939.56 |
| 6924.68 |
| 1123.43 |
| 2672.19 |

**Scope 3 Emissions: Utility Transmission Distribution Losses**

| **Scope 2 Purchased Electricity** | |
|---|---|
| Annual Purchased Electricity (MWh) | 8,388.36 |
| **Total Electric T&D Emissions (MT CO2e)** | **353.47** |

| **TOTAL CO2e EMISSIONS FROM T&D LOSSES (MT CO2E)** | **353.47** |
|---|---|

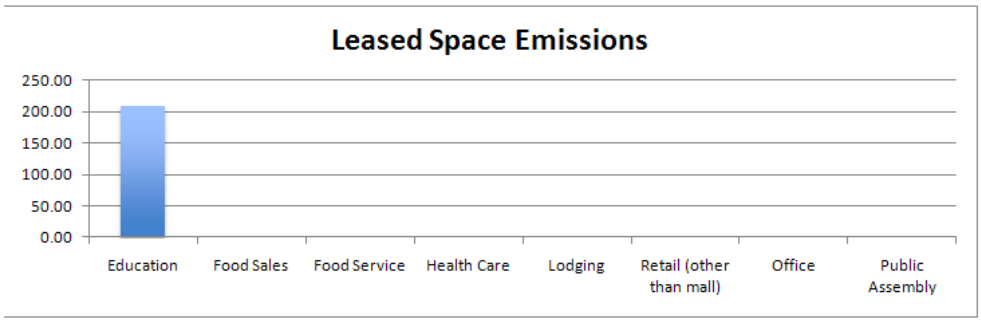
Click to add footer

Summary | Commuting | Business Travel | Contractor Emissions | Waste Disposal | **T&D Losses** | Leased Space | Factors

## Scope 3 Emissions: Leased Space

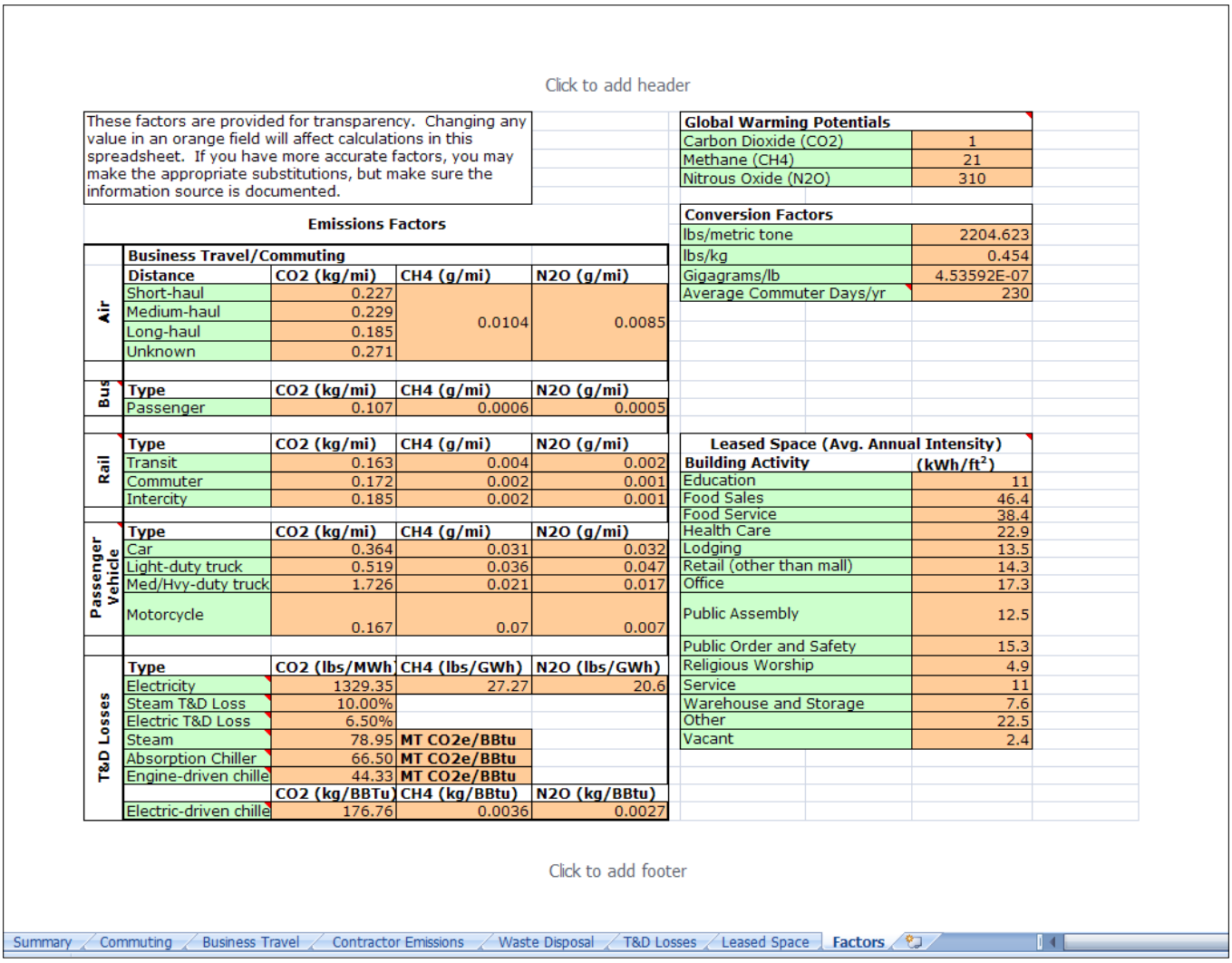
| Type of Leased Space | Leased area (sq. ft.) | Emissions per Leased Space Type (MT CO2e) |
|---|---|---|
| Education | | 0.00 |
| Food Sales | | 0.00 |
| Food Service | | 0.00 |
| Health Care | | 0.00 |
| Lodging | | 0.00 |
| Retail (other than mall) | | 0.00 |
| Office | 20,000 | 209.72 |
| Public Assembly | | 0.00 |
| Public Order and Safety | | 0.00 |
| Religious Worship | | 0.00 |
| Service | | 0.00 |
| Warehouse and Storage | | 0.00 |
| Other | | 0.00 |
| Vacant | | 0.00 |
| **Total Emissions from Leased Space** | | **209.72** |

**Note:** Only include space leased under a fully-serviced lease, i.e. a lease in which the utilities are included in the rent. Emissions from utilities that are paid separately from the rent would be counted as Scope 2




Click to add footer

Summary | Commuting | Business Travel | Contractor Emissions | Waste Disposal | T&D Losses | Leased Space | Factors



Click to add header

These factors are provided for transparency. Changing any value in an orange field will affect calculations in this spreadsheet. If you have more accurate factors, you may make the appropriate substitutions, but make sure the information source is documented.

**Emissions Factors**

| | Business Travel/Commuting | | | |
|---|---|---|---|---|
| Air | **Distance** | **CO2 (kg/mi)** | **CH4 (g/mi)** | **N2O (g/mi)** |
| | Short-haul | 0.227 | 0.0104 | 0.0085 |
| | Medium-haul | 0.229 | | |
| | Long-haul | 0.185 | | |
| | Unknown | 0.271 | | |
| Bus | **Type** | **CO2 (kg/mi)** | **CH4 (g/mi)** | **N2O (g/mi)** |
| | Passenger | 0.107 | 0.0006 | 0.0005 |
| Rail | **Type** | **CO2 (kg/mi)** | **CH4 (g/mi)** | **N2O (g/mi)** |
| | Transit | 0.163 | 0.004 | 0.002 |
| | Commuter | 0.172 | 0.002 | 0.001 |
| | Intercity | 0.185 | 0.002 | 0.001 |
| Passenger Vehicle | **Type** | **CO2 (kg/mi)** | **CH4 (g/mi)** | **N2O (g/mi)** |
| | Car | 0.364 | 0.031 | 0.032 |
| | Light-duty truck | 0.519 | 0.036 | 0.047 |
| | Med/Hvy-duty truck | 1.726 | 0.021 | 0.017 |
| | Motorcycle | 0.167 | 0.07 | 0.007 |
| T&D Losses | **Type** | **CO2 (lbs/MWh** | **CH4 (lbs/GWh)** | **N2O (lbs/GWh)** |
| | Electricity | 1329.35 | 27.27 | 20.6 |
| | Steam T&D Loss | 10.00% | | |
| | Electric T&D Loss | 6.50% | | |
| | Steam | 78.95 | **MT CO2e/BBtu** | |
| | Absorption Chiller | 66.50 | **MT CO2e/BBtu** | |
| | Engine-driven chille | 44.33 | **MT CO2e/BBtu** | |
| | | **CO2 (kg/BBTu)** | **CH4 (kg/BBtu)** | **N2O (kg/BBtu)** |
| | Electric-driven chille | 176.76 | 0.0036 | 0.0027 |

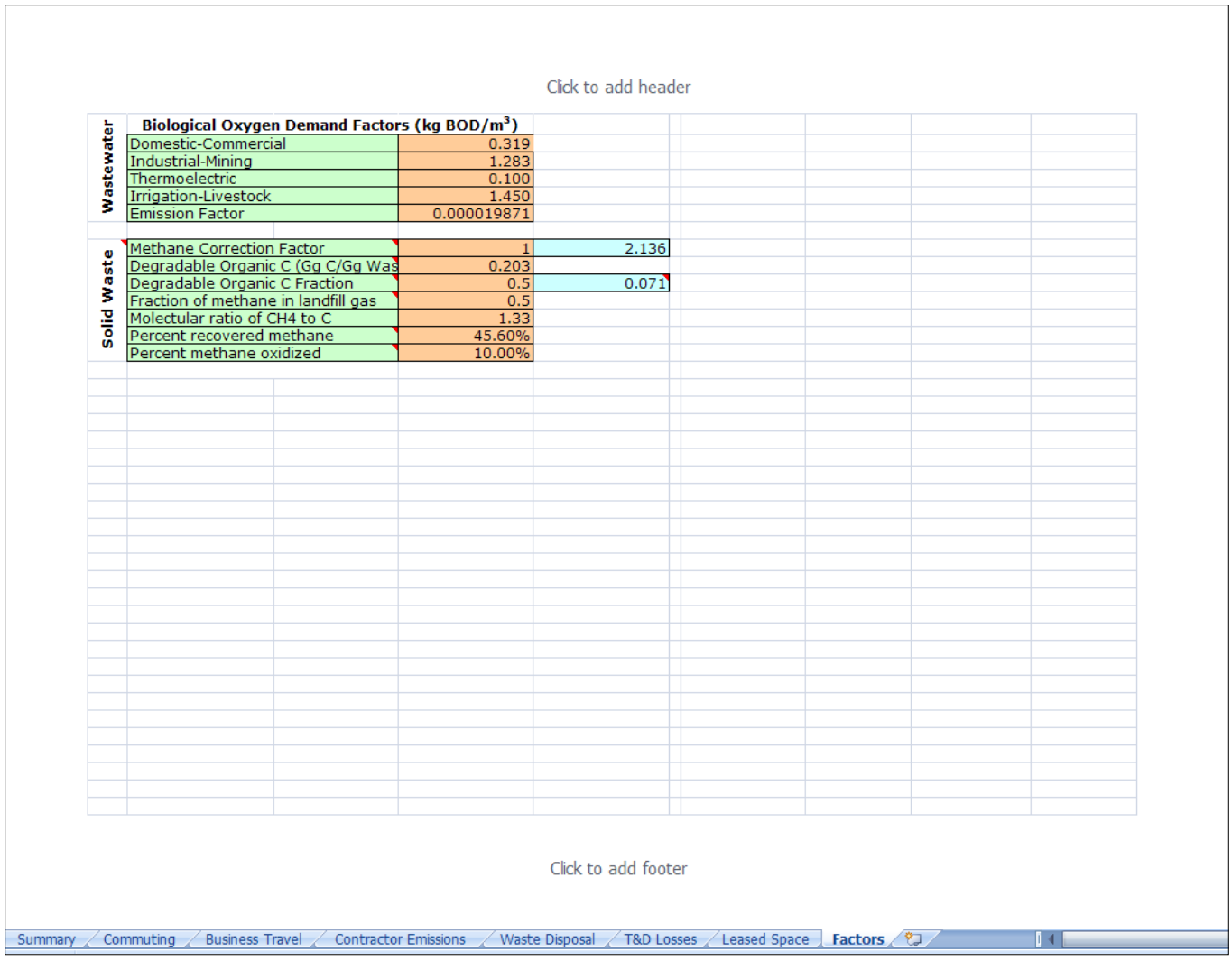
| **Global Warming Potentials** | |
|---|---|
| Carbon Dioxide (CO2) | 1 |
| Methane (CH4) | 21 |
| Nitrous Oxide (N2O) | 310 |

| **Conversion Factors** | |
|---|---|
| lbs/metric tone | 2204.623 |
| lbs/kg | 0.454 |
| Gigagrams/lb | 4.53592E-07 |
| Average Commuter Days/yr | 230 |

| **Leased Space (Avg. Annual Intensity)** | |
|---|---|
| **Building Activity** | **(kWh/ft²)** |
| Education | 11 |
| Food Sales | 46.4 |
| Food Service | 38.4 |
| Health Care | 22.9 |
| Lodging | 13.5 |
| Retail (other than mall) | 14.3 |
| Office | 17.3 |
| Public Assembly | 12.5 |
| Public Order and Safety | 15.3 |
| Religious Worship | 4.9 |
| Service | 11 |
| Warehouse and Storage | 7.6 |
| Other | 22.5 |
| Vacant | 2.4 |

Click to add footer

Summary | Commuting | Business Travel | Contractor Emissions | Waste Disposal | T&D Losses | Leased Space | Factors


Click to add header
Wastewater
Biological Oxygen Demand Factors (kg BOD/m³)
Domestic-Commercial 0.319
Industrial-Mining 1.283
Thermoelectric 0.100
Irrigation-Livestock 1.450
Emission Factor 0.000019871
Solid Waste
Methane Correction Factor 1 2.136
Degradable Organic C (Gg C/Gg Was 0.203
Degradable Organic C Fraction 0.5 0.071
Fraction of methane in landfill gas 0.5
Molectular ratio of CH4 to C 1.33
Percent recovered methane 45.60%
Percent methane oxidized 10.00%
Click to add footer
Summary
Commuting
Business Travel
Contractor Emissions
Waste Disposal
T&D Losses
Leased Space
Factors

# REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 0704-0188*



**PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.**

| 1. REPORT DATE *(DD-MM-YYYY)* | 2. REPORT TYPE | 3. DATES COVERED *(From - To)* |
|---|---|---|
| October 2010 | Technical Report | |

**4. TITLE AND SUBTITLE**
Beyond the Inventory: An Interagency Collaboration to Reduce Greenhouse Gas Emissions in the Greater Yellowstone Area

**5a. CONTRACT NUMBER**
DE-AC36-08GO28308

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**
Alicen Kandt, Eliza Hotchkiss, and Mike Fiebig

**5d. PROJECT NUMBER**
NREL/TP-7A20-49291

**5e. TASK NUMBER**
FE10.R110

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80401-3393

**8. PERFORMING ORGANIZATION REPORT NUMBER**
NREL/TP-7A20-49291

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

**10. SPONSOR/MONITOR'S ACRONYM(S)**
NREL

**11. SPONSORING/MONITORING AGENCY REPORT NUMBER**

**12. DISTRIBUTION AVAILABILITY STATEMENT**
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT** *(Maximum 200 Words)*
As one of the largest, intact ecosystems in the continental United States, land managers within the Greater Yellowstone Area (GYA) have recognized the importance of compiling and understanding agency greenhouse gas (GHG) emissions. The 10 Federal units within the GYA have taken an active role in compiling GHG inventories on a unit- and ecosystem-wide level, setting goals for GHG mitigation, and identifying mitigation strategies for achieving those goals. This paper details the processes, methodologies, challenges, solutions, and lessons learned by the 10 Federal units within the GYA throughout this ongoing effort.

**15. SUBJECT TERMS**
National Renewable Energy Laboratory; NREL; U.S. Department of Energy; DOE; Federal Energy Management Program; FEMP; U.S. Forest Service; USFS; national parks; Greater Yellowstone Area; GYA; greenhouse gas emissions; GHG inventory; GHG mitigation

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | |
| Unclassified | Unclassified | Unclassified | UL | | 19b. TELEPHONE NUMBER (*Include area code*) |

**Standard Form 298** (Rev. 8/98)
Prescribed by ANSI Std. Z39.18