



GREENHOUSE GAS INVENTORY

FOR THE

NATIONAL FORESTS IN THE GREATER YELLOWSTONE AREA



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USDA Forest Service



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COMMON ACRONYMS

A/C	Air Conditioning	GSA	General Services Administration
ASC	Albuquerque Service Center	LPG	Liquefied Petroleum Gas
ATVs	All-Terrain Vehicles	N ₂ O	Nitrous Oxide
B-D	Beaverhead-Deerlodge (National Forest)	NFC	National Finance Center
B-T	Bridger-Teton (National Forest)	NPS	National Park Service
CH ₄	Methane	NREL	National Renewable Energy Lab
CO ₂	Carbon Dioxide	NWPP	Northwest Power Pool
CO _{2e}	Carbon Dioxide Equivalent	R1	Region 1 of the Forest Service (northern Idaho, Montana, North Dakota, and northwest South Dakota)
C-T	Caribou-Targhee (National Forest)	R2	Region 2 of the Forest Service (Colorado, Kansas, Nebraska, South Dakota, and eastern Wyoming)
eGRID	Emissions & Generation Resource Integrated Database (EPA data program)	R4	Region 4 of the Forest Service (lower Idaho, Nevada, Utah, and western Wyoming)
EMIS	Equipment Management Information System	RD	Ranger District
EPA	United States Environmental Protection Agency	RO	Regional Office
FWS	United States Fish and Wildlife Service	SO	Forest Supervisor's Office
FY	Fiscal Year	USDA	United States Department of Agriculture
GHG	Greenhouse Gases	WCF	Working Capital Fund
GYA	Greater Yellowstone Area	WECC	eGRID Subregion code name
HFCs	Hydrofluorocarbons		

EXECUTIVE SUMMARY

In 2007, the Forest Service was the first federal land management agency to join the Environmental Protection Agency (EPA) Climate Leaders program. As part of this affiliation, the Forest Service agreed to develop a greenhouse gas (GHG) emissions inventory (GHG inventory) for seven pilot projects, including this inventory for the National Forests in the Greater Yellowstone Area (GYA). The National Renewable Energy Lab will consolidate this inventory with other GHG inventories associated with the GYA that were developed by the National Park Service and U.S. Fish and Wildlife Service. The consolidated GHG inventory will capture anthropogenic activities on all federal lands in the GYA. The three federal agencies will use this inventory to collaboratively set comprehensive emission reduction goals for the 18 million acre ecosystem. This inventory is one of many actions the Forest Service is taking to understand and reduce its environmental footprint and satisfy the requirements of Executive Order 13423 and the Energy Independence and Security Act of 2007 to lower its petroleum and energy consumption.

This inventory only addresses anthropogenic emissions from the 6 National Forests and does not include carbon sequestration or carbon sinks. This report presents the GHG emissions as metric tons of carbon dioxide equivalents (CO₂e). Carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) emissions are provided in the GHG Calculator Tool that accompanies this report.

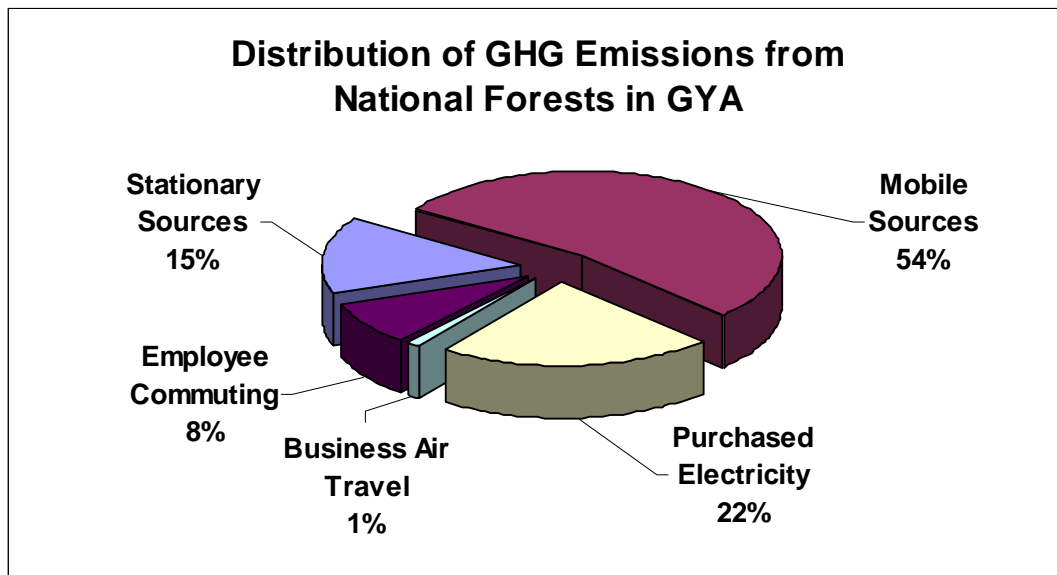
This inventory estimates GHG emissions generated by Forest Service activities in FY 2007 on the following six National Forests in the GYA: Bridger-Teton, Beaverhead-Deerlodge, Caribou-Targhee, Custer, Gallatin, and Shoshone. GHG emissions for each forest were separated by source category and are displayed in Table 1. The distribution of emissions by source for all 6 Forests is shown in Figure 1.

Table 1. Emissions by source category for each forest (metric tons CO₂e).

	Beaver-head-Deerlodge	Bridger-Teton	Caribou-Targhee	Custer	Gallatin	Shoshone	GYA Total
Mobile Sources	526	1,050	1,270	170	772	797	4,586
Purchased Electricity	457	558	326	128	275	170	1,913
Stationary Sources	322	287	247	69	218	123	1,265
Employee Commuting	13	164	245	39	184	91	735
Business Air Travel	13	22	29	11	21	11	106
TOTAL:	1,332	2,080	2,117	417	1,469	1,190	8,605

The geographic scope of this inventory is intended to be the GYA ecosystem boundary. Due to data limitations, some emission sources outside of this boundary were included. Emissions from purchased electricity, stationary sources, and business air travel for the Custer, Caribou-Targhee, and Beaverhead-Deerlodge NFs are overestimated because they include activity outside the GYA boundaries. The electricity, stationary source, and business air travel emissions for the Bridger-Teton, Gallatin, and Shoshone NFs represent activity only within the GYA because these Forests are located entirely within the GYA boundaries. Mobile source and employee commuting emissions for all 6 Forests reflect activity only within the GYA.

Figure 1. Distribution of GHG emissions by source category.



Key inventory findings fall into two categories:

1. Findings that reveal significant GHG reduction opportunities

- ◆ Mobile sources are the largest contributor of GHG emissions.
- ◆ Fleet fuel economy is low.
- ◆ Buildings (electricity and energy use) are the second largest contributor of GHG emissions.

2. Findings that should be carefully evaluated for future inventory efforts:

- ◆ Data provided by Forest staff can play a significant role to ensuring a complete and accurate inventory, but the level of effort to accomplish this can be equally significant.
- ◆ Some Forest Service reporting and data storage systems are outdated and contain inconsistencies and data gaps.
- ◆ GSA mileage data is of poor quality.
- ◆ Wood contributes a disproportionately larger amount of methane and nitrous oxide emissions than fossil fuels.
- ◆ Estimating emissions for a geographic boundary smaller than the administrative boundary can be time consuming and complex.

These findings are explained in more detail in Section VIII (Summary of Inventory Findings) of this report.

Obtaining data for six National Forests in three different Regions proved to be extremely time consuming and revealed differences, shortcomings, and inconsistencies in data management and data retention procedures between regions. See Appendix A for a rating and explanation of the data quality for each source category. Many lessons learned emerged from this process. These lessons will assist future inventory efforts and inform the agency about improvements needed for agency reporting and data storage systems. A more comprehensive “Lessons Learned” document will be forthcoming in spring 2009. This “Lessons Learned” document will be invaluable to anyone embarking on inventory work for our agency.

I. INTRODUCTION

The Forest Service has had a mission of conservation for over 100 years. Today we must rethink how we accomplish our mission on a planet with a changing climate. One of many important activities we are undertaking as part of the Agency's Climate Change Strategy is to better understand our own environmental footprint. Greenhouse gas emissions (GHG) are one component of our total environmental footprint. A GHG emissions inventory helps us identify our major sources of GHGs and reveal inefficiencies in our operations as well as opportunities to reduce emissions and costs. This inventory is one of many actions the Forest Service is taking to satisfy the requirements of Executive Order 13423 and the Energy Independence and Security Act 2007 to lower its petroleum and energy consumption.

In 2007, the Forest Service was the first federal land management agency to join the EPA Climate Leaders program. As part of this affiliation, the Forest Service agreed to develop a GHG inventory for seven pilot projects, including this inventory for the six National Forests in the Greater Yellowstone Area (GYA). The GYA is one of the largest intact ecosystems in the continental United States. GYA land managers and Forest staff worked collectively with the inventory team to develop this first of its kind GHG inventory because they want to better understand the consequences of their operations.

The Forest Service will use this base year inventory to set and track credible GHG emission reduction goals for these six National Forests. The inventory will be updated annually, pursuant to the EPA Climate Leaders protocol, as a means of tracking progress. The National Renewable Energy Lab will consolidate the inventory with other GHG inventories developed by the National Park Service and U.S. Fish and Wildlife Service. Ultimately, the consolidated GHG inventory will capture anthropogenic activities on all federal lands in the GYA. The three federal agencies will use this inventory to collaboratively set comprehensive emission reduction goals for the 18 million acre ecosystem. As a federal land management agency, the Forest Service has the utmost responsibility to be a good steward of the land we manage and the environment that surrounds us. Good stewardship should account for the global environment impacted by our activities, such as global air quality. Conducting a GHG inventory is an important first step to fully understanding our impact.

II. GYA INVENTORY BASICS

This inventory attempts to capture day-to-day anthropogenic Forest Service activities that generate GHG emissions. Though, due to time and resource restraints, this inventory does not capture all GHG emitting activities in the GYA as explained below and in Section V.B of this report. Many assumptions and decisions were made to include or exclude data.

BASE YEAR

This GHG inventory is based on fiscal year 2007 (FY 2007), which is defined as October 1, 2006 through September 30, 2007.

GHG POLLUTANTS

This report presents the GHG emissions as metric tons of carbon dioxide equivalents (CO₂e). CO₂e is a universal standard of measurement against which the global warming potential of different GHGs can be evaluated. The GHG Calculator Tool that accompanies this report presents CO₂e, carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) emissions.

Operational control means activities for which the Forest Service has full authority to implement operating policies.

ORGANIZATIONAL SCOPE OF INVENTORY

The organizational boundary of the inventory is the six NFs for which the Forest Service has operational control. However, there are minor exceptions where activities beyond the agency's full operational control are included in the inventory, such as employee commuting and energy use in government-owned employee residences. On the other hand, when the agency leases buildings with other co-tenants, or utilities are paid as part of the lease, it is often impossible to obtain activity data attributable only to the Forest Service and these activities are unavoidably excluded from the inventory. For the most part, the inventory covers all owned and leased facilities, buildings, and vehicles.

This inventory excludes activities by public visitors, concessionaires, special use permit holders, contractors operating on National Forest land, and permitted facilities, such as oil and gas operations or ski resorts, because they are largely outside of the operational control of the Forest Service.

INVENTORY DATABASE GHG CALCULATOR TOOL

The inventory team used the EPA Climate Leaders "GHG Calculator Tool" (Version 2.8) to estimate the GHG emissions. It is an Excel-based workbook designed to help small businesses and other low emitters estimate their GHG emissions. All methodologies and default values in the GHG Calculator Tool are based on the most current Climate Leaders Greenhouse Gas Inventory Protocol guidance. The populated GHG Calculator Tool used for the inventory accompanies this report.

The GHG Calculator Tool requires the following inputs to calculate GHG emissions: vehicle type, vehicle model year, fuel type, fuel quantity used, and miles traveled (or hours operated). The Tool also asks for the percentage of biofuel and ethanol percentages for any alternative fuels used on the Forests. The inventory team used the Tool's default values of 20% biofuel and 80% ethanol as the make-up of any alternative fuels used by Forest vehicles. These default values only applied to the Shoshone

National Forest mobile estimates, because it was the only Forest to report any bio-based fuel use.

The inventory team modified the GHG Calculator Tool so the information could be organized and presented individually for each Forest and the entire GYA. Then, the team populated the tool with the necessary raw data to allow the tool to calculate the GHG emissions. After initially populating the EPA Calculator Tool, the inventory team discovered errors in some of the calculations that are permanently encoded in the tool. The team discussed these errors with EPA and made the necessary corrections. According to EPA, the EPA Climate Leaders GHG Calculator Tool (Version 2.8) will be phased out in one or two years and replaced by a more user-friendly GHG emissions calculator tool.

DE MINIMIS EMISSIONS

This inventory does not include de minimis emissions. The inventory team determined that emissions from air conditioners, refrigerators, freezers, and fire extinguishers were de minimis and not significant enough to pursue.

De minimis emissions are GHG emissions determined/assumed to be less than 5% of the total inventory emissions.

There are other potential GHG generating activities the inventory team explored to determine whether the emissions were de minimis even though the GHG Calculator Tool does not address these activities. For example, asphalt paving activities have the potential to generate significant amounts of GHGs if large quantities of asphalt are used. Forests reported that they use very little asphalt. Based on this feedback, the inventory team decided not to pursue this emission source any further.

If any contracted activities are substantial, such as asphalt paving or herbicide/fertilizer applications, then these source categories should be explored in future inventories that look at impacts beyond the agency's operational control. This is an example of source categories considered to be de minimis because the inventory is narrowly focused on activities only within the agency's operational control, but these source categories could exceed de minimis levels if the inventory scope goes beyond the agency's operational control. For these reasons, source categories must be carefully examined on a case-by-case basis to determine whether they exceed the threshold of de minimis emissions.

III. GEOGRAPHIC SCOPE

Six National Forests (NFs), two National Parks, and two National Wildlife Refuges are located in the GYA (See Figure 2). This inventory addresses only the Forest Service activities on the six NFs. Geographically, all of the acreage for the Bridger-Teton, Gallatin, and Shoshone NFs is within the GYA boundaries. However, only portions of the Beaverhead-Deerlodge, Caribou-Targhee, and Custer NFs fall within the GYA

boundaries.¹ Table 2 presents the Ranger Districts located inside the GYA boundaries for each Forest. This table was used as a guide to determine which data to mine for the inventory so that whenever possible, the GHG emissions represent activities only within or directly attributable to the GYA.

When possible, activities on Ranger Districts located outside of the GYA are excluded from the inventory. In all cases, activities in the Supervisor’s Offices are included in the inventory; however, when appropriate or possible, apportionments are made to include only a percentage of the SO activities for Beaverhead-Deerlodge, Caribou-Targhee, and Custer NFs that are more directly attributable to the GYA (See Table 3).

The NFs associated with the GYA cover over 15 million acres in Wyoming, Montana, and Idaho in Forest Service Regions 1, 2, and 4. Thirteen million acres of these National Forests are inside the GYA boundary. In FY 2007, there were approximately 1,003 Forest Service employees on these six National Forests devoted to working in the GYA.

Table 2. Forests and ranger districts located in the GYA.

Forest Service Region	National Forest	National Forest Code	Ranger District	Ranger District Code
1	Beaverhead-Deerlodge	2	Madison	6
	Custer	8	Beartooth	2
	Gallatin	11	Big Timber	1
			Livingston	2
			Gardiner	3
			Bozeman	6
			Hebgen Lake	7
2	Shoshone	14	Clarks Fork	1
			Greybull	2
			Washakie	3
			Wapiti	4
			Wind River	5
4	Bridger-Teton	3	Kemmerer	1
			Big Piney	2
			Greys River	3
			Jackson	4
			Buffalo	6
			Pinedale	7

¹ Number of ranger districts located in the GYA: Beaverhead-Deerlodge: 1 of 8; Caribou-Targhee: 5 of 7; and Custer: 1 of 3.

Table 2, cont.

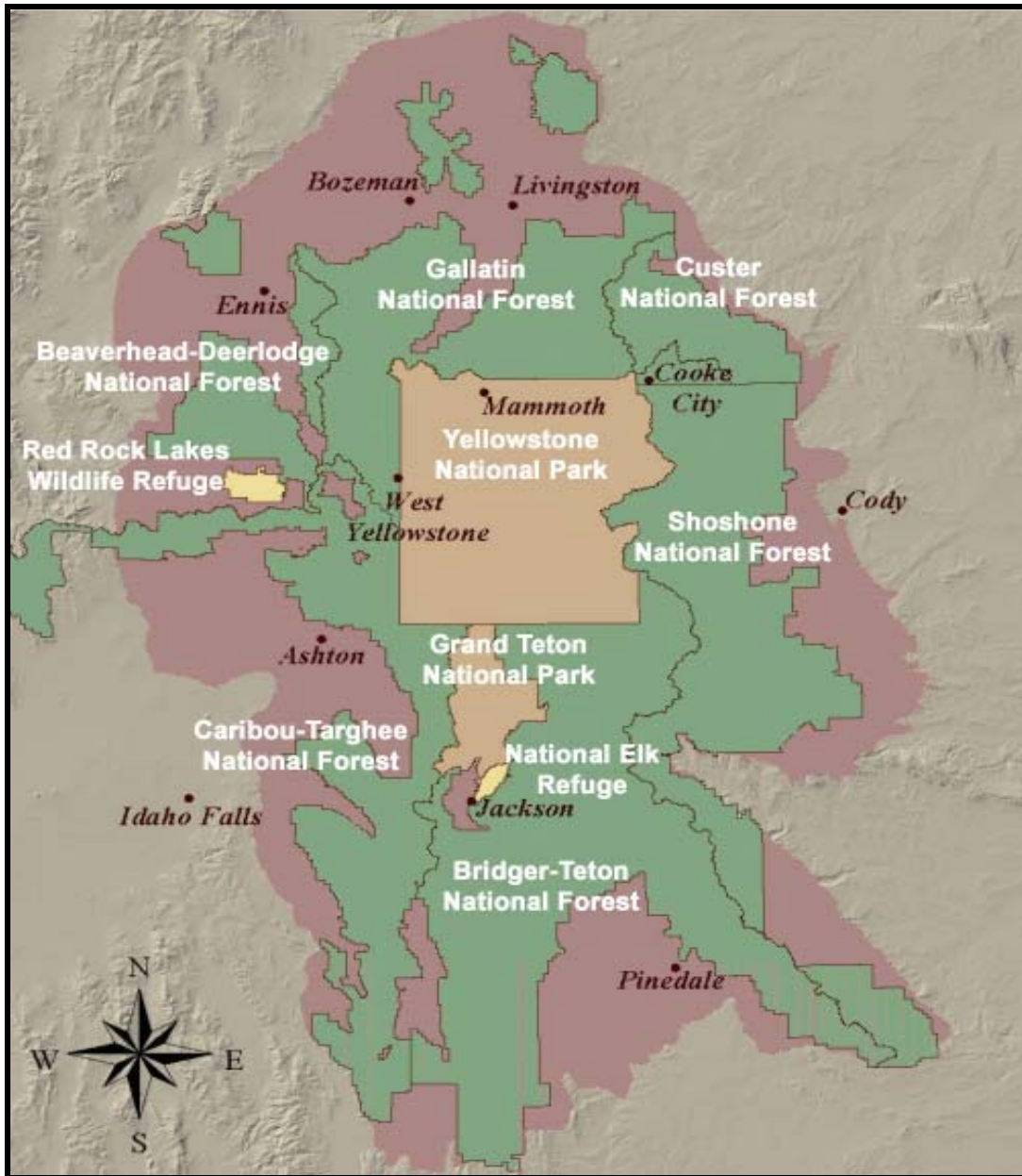
Forest Service Region	National Forest	National Forest Code	Ranger District	Ranger District Code
4	Caribou-Targhee	15	Dubois	51
			Ashton-Island Park	52
			Palisades	54
			Soda Springs	55
			Teton Basin	56

Note: The following Ranger Districts are not located within the GYA boundaries and were therefore excluded from the inventory whenever possible: On the Beaverhead-Deerlodge: Dillon RD, Wise River RD, Wisdom RD, Butte RD, Jefferson RD, Deer Lodge RD, and Pintler RD; on the Custer: Sioux RD and Ashland RD; on the Caribou-Targhee: Montpelier RD and Westside RD.

Table 3. Geographic accuracy of source category estimates

Source Category	Geographic Accuracy
Stationary Sources (15% of total emissions)	Covers sources and activities located throughout the entire Forest (unavoidably includes Ranger Districts outside the GYA)
Mobile Sources (54% of total emissions)	Covers vehicles assigned to the Supervisor's Offices and only those Ranger Districts located in the GYA.
Purchased Electricity Sources (22% of total emissions)	Covers sources and activities located throughout the entire Forest (unavoidably includes Ranger Districts outside the GYA)
Air Travel (1% of total emissions)	Covers travel by all employees on the 6 Forests (unavoidably includes districts outside the GYA)
Employee Commuting (8% of total emissions)	Covers commuting by employees working on Ranger Districts located within the GYA boundaries and only a percentage of commuting by employees at Supervisor's Offices estimated to be attributable to work within the GYA.

Figure 2. Map of the Greater Yellowstone Area.



Note: The green areas are National Forest System lands. The purple area denotes the GYA ecosystem boundary. Map provided by the Greater Yellowstone Coordinating Committee at: <http://fedgycc.org/>

IV. DATA COLLECTION METHODOLOGY

Data was collected at the National, Regional, Forest, and District levels. The inventory team relied primarily on national data sources, such as information from the National Finance Center² (NFC) or GSA, or regional databases such as the Equipment Management Information System (EMIS). Once national and regional resources were exhausted, the inventory team contacted Forests to fill in key data gaps. Forest staff played a critical role by reviewing the national and regional data to ensure its accuracy. See Appendix A for a rating and explanation of the data quality for each source category.

Eleven key steps were taken by the inventory team to obtain the inventory data:

1. **Extracted data from National and Regional sources**, which primarily consisted of stationary and on-road mobile information.
2. **Sent initial questionnaire³ to Forests** to determine the type of GHG activities that exist on each Forest (see Appendix C).
3. **Visited the Shoshone NF (April 1-4, 2008) and Gallatin NF (April 9-11, 2008)** to fill out the initial questionnaire with Forest staff to get a better sense of the type of GHG emitting activities occurring on the Forests. These field visits gave the inventory team a better sense of the type and quality of data that is readily available at the Forest or District levels.
4. **Developed a more refined data request⁴** based on the results of the initial questionnaire and the field visits and sent it to the Forests (see Appendix D) asking for raw data that could not be obtained from national or regional data sources. The majority of the requested information includes electricity and fossil fuel use not reported to NFC, wood consumption for heating purposes, and fuel use information for fleet that is not reported in EMIS or GSA databases (e.g., fuel used in off-road vehicles). Also, this information was used to validate the reasonableness of the national GSA data used in the inventory. For example, when possible, Forests provided the amount of fuel used in GSA vehicles. The inventory team used this Forest-reported information to validate the fuel amounts calculated based on GSA-reported mileage.
5. **Requested the Regional Offices and Forests to provide business air travel** by Forest employees in FY 2007, which consisted of one-way and round-trip commercial flight itineraries⁵.

² NFC contact: David Dufour, IT specialist, OCFO-FS, CSOB. (504) 426-5244, dave.dufour@nfc.usda.gov

³ File "Forest Data FY07_Questionnaire_Final.xls."

⁴ "Refined Forest Data FY07_Questionnaire_Final.xls."

⁵ To populate the GHG Calculator Tool, the inventory team looked up the air miles for each itinerary at <http://www.terrapass.com/>.

6. **Asked each Forest to provide the number of permanent and seasonal employees** on their Forest in FY 2007 and estimate the number of round-trip miles these two different groups of employees typically commute to the workplace each day.
7. **Populated the GHG Calculator Tool with all of the raw data.** Performed analyses and quality assurance checks. During the early review process, the inventory team discovered errors in the EMIS and GSA data. As a result, the team consulted with regional fleet managers and GSA contacts to resolve the data errors and avoid any misinterpretation of the raw data. Most significantly, the inventory team had to heavily analyze and process the on-road mobile data to produce information.
8. **Performed additional quality assurance and quality control checks** on the final data and GHG estimates.
9. **Sent the inventory tool to the Forests** and others for review. Each Forest completed a detailed review checklist that required them to spot check specific data for errors (see Appendix E).
10. **Corrected data in the inventory tool** to address minor errors that were discovered in the review process.
11. **Finalized the GHG Calculator Tool**⁶

V. METHODOLOGY FOR EACH SOURCE CATEGORY

There are three categories of GHG emissions: direct, indirect, and optional emissions.⁷ This inventory captures all three types of emissions, which are described below. Table 4 indicates which emission sources were included in the inventory.

Direct emissions originate from sources owned and/or operated by the Forest at the time of emission. This includes emissions from onsite fuel use, such as oil burning in a heating furnace or gasoline combusting in a vehicle. Fugitive emission sources, such as refrigerators and air conditioning units, emit GHGs through equipment leaks, maintenance, or other less direct means.

Indirect emission sources, such as those generated from electricity use, occur as a result of activities on the Forest (office electricity use) but originate from sources located outside the Forest (electric power plant).

Optional emission sources include emissions generated by miscellaneous sources for which emissions have not been traditionally estimated, such as offsite waste disposal, product transport, employee commuting, and business travel.

⁶ GYA Inventory Tool for Report – April 2009.xls

⁷ EPA's "A Program Guide for Climate Leaders, Setting the Standard for Greenhouse Gas Management" (March 2007) http://www.epa.gov/climateleaders/documents/cl_programguide_508.pdf

Table 4. Summary of GHG emission sources included in the inventory.

GHG Emission Type	Source Category	Emissions Included in the Inventory?	Comments
Direct	Mobile sources	Yes	
	Stationary sources	Yes	
	Prescribed fire and wildfire suppression	No	Would be too time consuming and difficult to quantify these emissions. Some activity associated with fire work, especially by fleet, is unavoidably captured under the mobile sources emissions. Emissions from trees or vegetation burning were not addressed.
	Air conditioners, refrigerators, and freezers	No	Emissions are de minimis.
	Fire extinguishers	No	The majority of fire extinguishers on the Forests do not emit GHGs. This is a de minimis emissions source.
	Gas waste streams	No	This activity does not exist on the Forests
	Asphalt paving	No	Emissions are considered de minimis based on the small amount of asphalt paving performed by the Forests. Also, the GHG Calculator Tool does not estimate asphalt paving emissions. Asphalt paving performed by contractors could possibly generate emissions greater than de minimis.
Indirect	Electricity	Yes	
	Imported heat or steam	No	This activity does not exist on the Forests

Table 4, cont.

GHG Emission Type	Source Category	Emissions Included in the Inventory?	Comments
Optional	Employee business air travel	Yes	
	Employee commuting	Yes	
	Product transport	No	Would be too time consuming and difficult to quantify these emissions.
	Off-site waste disposal	No	Would be too time consuming and difficult to quantify these emissions.

A. SOURCES INCLUDED IN THE INVENTORY

1. Stationary Sources

This category covers all fuels used on the Forest primarily for buildings and purposes other than fleet or mobile machines. These fuels are used mostly for heating Forest Service buildings, which includes offices, administrative buildings, quarters, district ranger stations, guard stations, bunkhouses, and any other Forest Service owned or operated facility. Whenever possible, this category includes data from leased buildings and excludes data for rental cabins, concessionaires, visitors, and the public.

Data for stationary combustion was collected from national and Forest information sources. The National Finance Center (NFC) provided more than 90% of the stationary combustion data. The NFC data accounts for all Ranger Districts in the GYA, regardless of whether they are located outside of the GYA boundaries. The Forests provided fuel use data for all other stationary sources that are not reported to NFC (e.g., smaller scale use of propane, distillate oil, diesel, and wood). This non-NFC data submitted by the Forests only includes activities located within or associated with the GYA. That is, the Forests only provided non-NFC data for their Supervisor’s office and the Ranger Districts located within the GYA boundaries.

For heating purposes, the majority of Forests use natural gas, although heating oil, propane, and wood are also used. Wood use is by residential wood stoves. None of the Forests reported using coal for heating. NFC provided data for natural gas and propane use by the Forests from October 1, 2006 through September 30, 2007.⁸ This NFC consumption data includes both government-owned and leased facilities. The data comes from financial reporting systems that feed into the NFC database and does not reflect fuel

⁸ Files “FS.Reg1.SelectUnits.FY07.xls,” “FS.Reg2.SelectUnits.FY07.xls,” “FS.Reg4.SelectUnits.FY07.xls.”

purchases paid through purchase cards. Natural gas, heating oil, propane, wood, and other off the grid fuel that is not billed to NFC is obtained primarily through purchase cards. The Forests provided this non-NFC data via a detailed data request.⁹

All or nearly all of the NFC data for electricity and natural gas is actual use. On the other hand, NFC’s propane data is usually based on the dollar amount billed to the Forest. NFC back-calculates the gallons of propane usage based on the actual dollars billed to each account and the average price per gallon of propane in the region for that year. Therefore, for this stationary source category, the natural gas estimates are more accurate than the propane estimates.¹⁰

2. Mobile Sources (Fleet)

Mobile sources include on-road and off-road vehicles, such as cars, trucks, tractors, construction equipment, lawnmowers, ATVs, etc. The data required for this source includes, at a minimum, the engine type, amount of fuel consumed, and miles driven or hours of use for each vehicle. Fuel consumption can be determined from fuel records or calculated based on the total miles driven or hours of use and the fuel economy for each vehicle type.

Table 5. Count of WCF and GSA on-road vehicles located within the GYA boundaries.

	B-D	B-T	C-T	Custer	Gallatin	Shoshone	TOTAL
Number of WCF Vehicles *	41	120	91	25	54	82	413
Number of GSA Vehicles	15	44	69	10	90	6	234
Forest’s Share of Total GYA Vehicles	9%	25%	25%	5%	22%	14%	647

* These vehicle counts exclude WCF vehicles for which use is reported as hours instead of miles, such as some construction equipment and fire engines. However, “hourly” vehicles are included in the inventory estimates.

Forest fleet are comprised of three main types of vehicles: Working Capital Fund (WCF), General Services Administration (GSA), and other Forest-owned vehicles (e.g., snowmobiles, ATVs, lawnmowers, etc). The distinction between these categories is significant because the data for each category comes from a very different data source and has its own set of challenges. Most WCF and GSA vehicles are on-road vehicles

⁹ File “Refined Forest Data FY07_ Questionnaire_Final.xls.”

¹⁰ NFC Contact: David Dufour, IT Specialist, OCFO-FS, CSOB. (504) 426-5644, dave.dufour@nfc.usda.gov

whereas the rest of the Forest fleet is primarily off-road vehicles like snowmobiles, lawnmowers, tractors, etc. Collectively, the six Forests have more WCF than GSA vehicles in the GYA. However, each Forest has a different distribution of WCF versus GSA vehicles, as shown in Table 5.

Forest employees working in the GYA logged more miles on WCF vehicles (67%) than GSA vehicles (33%). This mileage excludes all vehicles for which use is reported as hours rather than miles, such as some construction equipment and fire engines. However, “hourly” vehicles are included in the inventory. There is no way to determine the number of miles driven by the other Forest-owned fleet (non-WCF and non-GSA).

Emission data for mobile sources was collected from Regional and Forest information sources. The quality of mobile source data varies depending on the information source. After processing all of the mobile data, performing quality checks on it, and receiving Forest feedback, the inventory team has the most confidence in the WCF data and much less confidence in the GSA data (see Appendix A for a letter-based rating of each data source). The Forests did not identify any significant shortcomings with the WCF data during their review. However, the Forests consistently noticed discrepancies in mileage reported for GSA vehicles. These discrepancies are unavoidable and will be explained in a Lessons Learned document. Future improvements in GSA mileage data will substantially improve the emission estimates for GSA vehicles.

Working Capital Fund (WCF) Fleet

For WCF vehicles, each Regional Fleet Manager provided Equipment Management Information System (EMIS) data for FY 2007.¹¹ The inventory team excluded those vehicles assigned to Ranger Districts located outside of the GYA boundaries. All WCF vehicles assigned to the Supervisor’s Offices are included in the inventory regardless of whether the SO was located outside of the GYA boundaries. Usage for all of the on-road vehicles was reported as “miles traveled” whereas the usage for off-road vehicles, such as construction equipment, fire engines, and tractors, was reported as “number of hours operated.” Trailers, such as flatbed or horse trailers, in the EMIS files were excluded from the inventory because they do not have engines and do not use fuel. Figure 3 shows the total miles traveled by WCF vehicles on each Forest in FY 2007. The Bridger-Teton, Caribou-Targhee, and Shoshone NFs have a substantially higher number of miles traveled by WCF vehicles than the other three Forests. As expected, this correlates with the substantially higher number of WCF vehicles on these Forests compared to the other Forests (See Table 5).

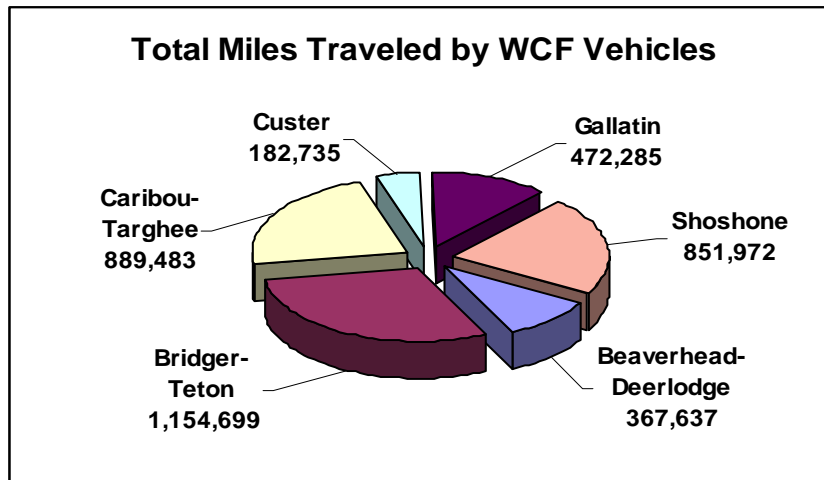
EMIS was not originally designed to provide the type of information needed for this inventory. Therefore, considerable data manipulation was required to extract the necessary information. More specifically, the inventory team had to use Access

¹¹ Fleet Managers/Contacts: Gery Maney, Region 1, 406-329-3697, gmaney@fs.fed.us; Ken Reuer, Region 2, 303-275-5192, kreuer@fs.fed.us; Clifford Coleman, Region 4, 801-625-5184, crcoleman@fs.fed.us; and Janice Ermatinger, Region 4, 801-625-5418, jermatinger@fs.fed.us.

database software to combine two sets of EMIS files for each Region to obtain FY 2007 starting and ending odometer readings for each vehicle to determine annual miles traveled. Processing and performing quality checks on this data was very time consuming.

EMIS does not retain historical data. However, prior year reports are stored on microfiche.¹² The inventory team discovered that complete prior year data, even for FY 2007, is difficult to obtain. The inventory team spoke regularly with a number of Albuquerque Service Center (ASC) staff for two months hoping to obtain one convenient electronic file that would show both the start and ending odometer readings. In the end, ASC was unable to provide the requested information because they were having difficulty with their software used to extract information from NFC-based EMIS files.¹³

Figure 3. Miles traveled in WCF vehicles, by Forest.



The inventory team was unable to obtain one convenient EMIS file for a Forest or Region showing each vehicle's starting and ending odometer reading for FY 2007. EMIS reports show each vehicle's starting odometer reading at the beginning of the fiscal year and the odometer reading at the time the report was generated. Therefore, fiscal year beginning and ending odometer readings would only be captured in the same electronic file if it was extracted from the EMIS database at a specific time at the end of the year. The only way to readily obtain one convenient file showing the start

¹² Wendy Visser (soon to retire), who works as a Database Manager in Region 5, was enormously helpful. She has created a very useful Lotus Notes based database that contains current EMIS data for all Forest Service regions.

¹³ Bart Chinnici, ASC, 505-563-7124; Pat Weinbrecht, ASC, 505-563-7117

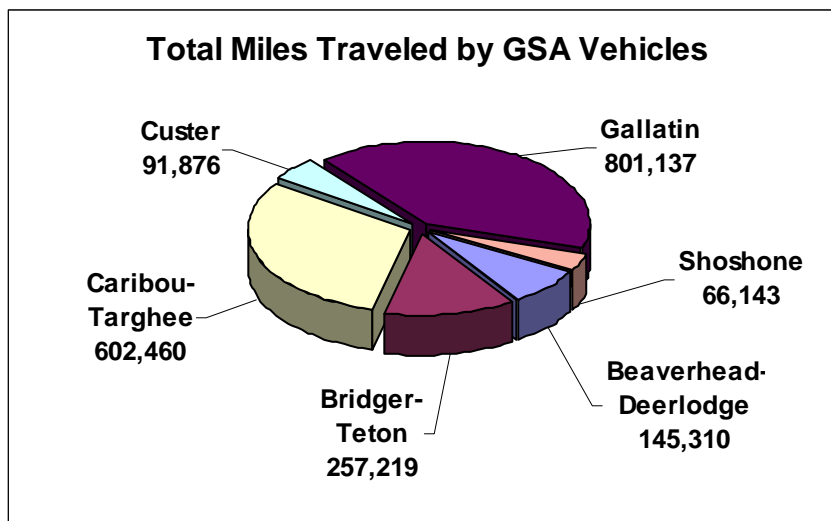
and end odometer readings for a given year is if someone happens to save an EMIS file that was generated at the end of the desired fiscal year. Therefore, to dramatically save time for future inventories, fleet managers should save year end EMIS reports at the end of each fiscal year.

A “Lessons Learned” document will discuss in detail these EMIS data management and reporting limitations as well as some of the other difficulties the inventory team discovered and overcame when trying to obtain accurate data for the GHG inventory.

General Services Administration (GSA) Fleet

GSA provided detailed information for GSA vehicles operating in FY 2007.¹⁴ It was impossible to determine which Ranger District each vehicle was assigned to. GSA does not have this information. Therefore, the inventory team contacted the Forests to exclude from the inventory those vehicles assigned to Ranger Districts located outside of the GYA boundaries. Only emissions from vehicles assigned to Ranger Districts located inside the GYA and vehicles assigned to SOs were included in the inventory.

Figure 4. Miles traveled in GSA vehicles, by Forest.



Usage for all of the GSA vehicles was reported as “miles traveled” and “fuel used.” However, after processing the data and performing quality assurance checks, the inventory team discovered errors (e.g., the first data file submitted by GSA was incomplete and the second GSA file had significant inconsistencies that were only discovered via quality assurance checks). The inventory team consulted with a GSA

¹⁴ Fleet Contacts: Gery Maney, Region 1, 406-329-3697, gmaney@fs.fed.us; Ken Reuer, Region 2, 303-275-5192, kreuer@fs.fed.us; Clifford Coleman, Region 4, 801-625-5184, crcoleman@fs.fed.us; and Janice Ermatinger, Region 4, 801-625-5418, jermatinger@fs.fed.us

contact who advised the team not to rely on the mileage data and to instead use the fuel usage information.¹⁵

Unfortunately, unlike the WCF data, the GSA data did not include the fuel economy for each vehicle. Therefore, for each vehicle, the inventory team had to extrapolate estimated annual miles traveled based on GSA's reported fuel usage and the inventory team's estimated fuel economy for each vehicle.¹⁶ The GSA data included the vehicle make, model, and year, but not the gross vehicle weight, which is another useful indicator for determining fuel economy. This more limited information for each vehicle made the estimation of miles traveled more difficult and less precise than the WCF emissions estimates. Again, as with the WCF fleet estimates, the data processing and quality checks performed for the GSA fleet were very time consuming. Figure 4 shows the total miles traveled by GSA vehicles on each Forest in FY 2007. The Gallatin and Caribou-Targhee NFs have a substantially higher number of miles traveled by GSA vehicles than the other four Forests. As expected, this correlates with the substantially higher number of GSA vehicles on these Forests compared to the other four Forests (See Table 5).

Other Mobile Sources

The Forests provided the data for off-road vehicles such as ATVs, snowmobiles, and other smaller off-road vehicles that are not part of the WCF or GSA fleet. Most of these estimates were based on staff's best guess of annual fuel use. Some Forest estimates were more precise than others depending on the level of documentation available for the vehicles. The Forests also provided estimates of fuel use for small mobile machines and hand held machines, such as lawnmowers and chainsaws.

3. Electricity

This emission source is limited to electricity purchased for any purpose, such as lighting or heating a building. This inventory does not capture or account for any renewable electricity generated on-site, such as solar panels or wind mills. The type of data required for this source is electricity consumption in kilowatt-hours, typically reported on an electric bill or invoice.

¹⁵ Email correspondence on September 22, 2008 from Jeremy Courtney, GSA, to Julie Tucker, USDA Forest Service. Jeremy Courtney, Business Manager, GSA, Fleet Management Division - Services Branch (AQMDA), 253-931-7562, jeremy.courtney@gsa.gov

¹⁶ GSA provided the make, model, and model year for most of the vehicles. Some of this information was unavailable for many vehicles. GSA did not provide the gross vehicle weight or fuel economy for any of the vehicles. Therefore, the inventory team estimated the fuel economy based on the best available data for each vehicle. In most cases, the average fuel economy was determined or estimated to be that for a light duty truck.

All of the six Forests rely on electricity from the grid. Emission data for purchased electricity was collected from National and Forest based information sources. NFC provided the actual use in “kilowatt-hours purchased” by each Forest in FY 2007.

The electricity emissions cover all facilities located on each Forest and not just those facilities located within the GYA. The inventory team decided not to extract from the national data sources electricity use only from those facilities or Ranger Districts located in the GYA because it would be too labor intensive for the Forests and too time consuming. For the three Forests (Beaverhead-Deerlodge, Caribou-Targhee, and Custer) with facilities located inside and outside of the GYA, it might be more informative for future inventories to segregate electricity emissions more specifically by Ranger Districts to better assess where the bulk of the Forest’s electricity emissions are generated.

The NFC data covers both leased and government-owned facilities.¹⁷ This NFC data reflects only those financial systems that feed into the NFC database and does not include electricity acquired through purchase cards or electricity that would be included as part of the lease contract. Therefore, the inventory team asked the Forests to provide electricity acquired through purchase cards.



These solar panels were installed recently at a Madison Ranger District facility on Beaverhead-Deerlodge NF.

To accurately calculate electricity emissions, one must determine where on the national grid the electricity is generated because not all regions of the country use the same type of fuel to generate electricity. Each energy source (e.g., coal, natural gas, hydropower) generates different levels of GHG emissions. The EPA Climate Leaders program encourages using eGRID 2006 Version 2.1 subregion emission factors for calculating indirect emissions from electricity use.¹⁸ These emission factors indicate where on the national grid the electricity was generated. According to the eGRID 2006 Version 2.1 subregion map, all of the GYA is located in the NWPP (WECC Northwest) subregion of the electric grid. Therefore, the inventory team entered the “WECC Northwest” subregion in the GHG Calculator Tool to fine-tune the electricity estimates for each Forest.

¹⁷ NFC Contact: David Dufour, IT Specialist, OCFO-FS, CSOB. (504) 426-5644, dave.dufour@nfc.usda.gov

¹⁸ <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html> Please note that in January 2009 this website posted the updated eGRID emission factors for 2007. Again, this inventory and the GHG Calculator Tool are based on eGRID 2006 Version 2.1 subregion emission factors.

GHG emissions from electricity vary depending on the amount of electricity used and the original fuel or source used to generate the power (coal, geothermal, hydro, etc). The exact percentages of the Forest’s electricity use generated by renewable energy from the grid cannot be quantified. However, knowing how the local power company generates electricity gives some insights. For example, Rocky Mountain Power (Pacific Corp) and High Plains Power (Tri State) provide energy for the Shoshone National Forest. In addition to coal, both of these electric companies generate electricity from renewable sources such as wind, small hydroelectric facilities, solar, geothermal, and biomass. EPA’s eGRID map uses the following state resource mix shown in Table 6, some of which should be updated to reflect power companies’ recent increased focus on renewable energy.

Table 6. Year 2004 state resource mix - percentage of electricity generated from various sources.

Energy Source	Montana	Wyoming
Coal	65 %	96.7 %
Oil	1.6 %	0.1 %
Gas	0.1 %	0.2 %
Other fossil fuels	0.1 %	0 %
Biomass	0.2 %	0 %
Hydro	33.1 %	1.3%
Nuclear	0 %	0 %
Wind	0 %	1.38 %
Solar	0 %	0 %
Geo-thermal	0 %	0 %
TOTAL:	100.1%	99.68 %

*Source: Year 2004 State Resource Mix - eGRID2006
Version 2.1, April 2007.*

4. Employee Commuting

The inventory team calculated emissions from Forest Service employees commuting in their personal vehicles. The Forests provided the number of full-time and seasonal employees working on their forest in 2007. They also gave an estimate of the “typical” miles traveled daily by full-time and seasonal employees (round-trip from home to office). In all cases, except the Gallatin, full-time employees had a longer commute.

For all of the Forests, the inventory team assumed that full-time employees work 235 days per year and that seasonal employees work 100 days per year.¹⁹ The 235 days is derived by assuming that a “typical” full-time employee works 5 days a week for 52 weeks a year and takes 10 federal holidays, two weeks annual leave, and one week of sick leave each year leaving 235 days worked. It was assumed that seasonal employees did not take any time off. Also, it was assumed that all commuting took place in a passenger car, not a light-duty truck or motorcycle. Obviously, there are flaws in these assumptions, but this approach provides the best estimates under limited resources for this optional category.

During the field visit to the Shoshone NF, the inventory team discovered that law enforcement officers often commute in government vehicles. Considering that most employees don’t commute by government vehicles, the inventory team decided not to adjust the rough commuting estimates to account for this and any other commuting that might occur in government owned vehicles. This less refined level of emissions estimation is appropriate for this optional category.²⁰

Finally, the inventory team adjusted the commuting estimates for the Caribou-Targhee, Custer, and Beaverhead-Deerlodge NFs to include only 5/7, 1/3, and 1/8 of the Supervisor Office commuting activity by permanent and seasonal employees. This adjustment was made based on feedback from the Forests and a crude assumption that the amount of work performed for the GYA by Supervisor Office employees is directly proportional to the percentage of the Forest’s Ranger Districts located in the GYA. Table 7 presents the statistics for employee commuting.

These statistics account for all or a portion of each SO and only Ranger Districts located in the GYA (See Tables 3 and 7). It is assumed that: 1) permanent employees work 235 days a year; 2) seasonal employees work 100 days each year; 3) an employee's commute distance from home to office is roughly the same for each office within a given Forest; and 4) all employees commute by light duty passenger vehicle.

¹⁹ The Caribou-Targhee reported their commuting estimates in a slightly different format than the other five Forests (See Appendix F).

²⁰ Double counting will occur in this case because emissions from commuting in these three government vehicles are already accounted for in the mobile emissions estimates for WCF or GSA vehicles.

Table 7. GHG emissions generated by employee commuting in FY 2007.

Forest Name	Number of Permanent Employees	Number of Seasonal Employees	Estimated Daily Roundtrip Miles Per:		Annual Metric Tons of CO ₂ e Emissions
			Permanent Employee	Seasonal Employee	
Beaverhead-Deerlodge	30 (98)	24 (38)	6	5	13
Bridger-Teton	141	93	20	3	164
Caribou-Targhee	145 (166)	172	26	16 or 5	245
Custer	29 (56)	25 (27)	24	2	39
Gallatin	96	80	26	25	184
Shoshone	98	70	16	2	91

Number in parentheses is original employee count before it was adjusted for the inventory. See Appendix F for additional notes on the commuting estimates for the C-T, B-D, and Custer NFs.

5. Business Air Travel

This emission source encompasses employee business travel in non-government owned vehicles such as rental cars, taxis, trains, commercial airplanes, and personal vehicles. Due to data limitations, this inventory only addresses employee business travel in commercial airplanes.

The GHG Calculator Tool calculated the GHG emissions for business air travel. The Regional Offices and Forests provided information that shows the number of commercial flights taken each year by Forest employees as well as the itinerary for each trip, including where flight connections were made. After processing the data and putting it in a consistent format for each Forest, the inventory team had to determine the actual flying miles for each leg of every itinerary. The team used an internet website²¹ to determine air mileage between cities because air mileage was not included in the Forest Service data (only city names for each itinerary were included). The GHG Calculator Tool calculates emissions associated with air travel slightly differently between short haul (0-300 miles), medium haul (300-700 miles) and long haul (700+ miles) trips. More fuel is used during takeoff and landing than during the main part of the flight. It is much more accurate to estimate emissions based on each leg of the itinerary rather than on only the originating departure and destination airports.

²¹ <http://www.terrapass.com/carbon-footprint-calculator/#air>

B. SOURCES EXCLUDED FROM INVENTORY

1. Prescribed Fire and Wildfire Suppression

Anthropogenic activities associated with prescribed fire and wildfire suppression are not included in this inventory because any effort to capture the depth and breadth of these activities would be enormous. Wildfire suppression activities are very complex because personnel from multiple agencies, administrative units, and private companies respond to wildfire events.



Fire activities require diverse resources, including rental vehicles, rental equipment, contractor vehicles and aircraft, and fleet from multiple Forests and even multiple Regions. GHG pollutants are also released from trees and vegetation when they burn during prescribed fire and wildfire suppression events; these are complex and enormous as well. Therefore, the inventory team decided early on, with input from the Washington Office, that it would be too difficult to accurately capture fire activities in this inventory.

However, it is important to note that this inventory inevitably captures some activities associated with prescribed fire and wildfire suppression. The inventory accounts for emissions from fire engines and Forest fleet located within the GYA that most likely have been directly associated with fire activities. Fire engines are used for a variety of fire and non-fire activities (e.g., wildfire suppression, prescribed fire, training, cleaning out Forest Service latrines). It would be difficult to try to apportion the use of these vehicles only to non-fire activities. Therefore, the inventory team decided to be more inclusive with the data by including in the inventory all fire engines and vehicles located within the GYA. Future agency efforts might focus more comprehensively on estimating emissions from fire activities.

2. Air Conditioners, Refrigerators, Freezers, and Fire Extinguishers

These sources include refrigerators and freezers as well as air conditioners in buildings or vehicles. The data required for this source includes the type and number of air conditioning equipment, total refrigerant charge, annual leak rate, and types of refrigerant. This type of data is often collected from maintenance and inspection records, work orders, or invoices from contractors that service this equipment.

Fire extinguishing devices are another possible source of GHG pollutants. These sources can range from a small portable fire extinguisher to a large-scale fire suppression system for an office building or warehouse. Emissions from fire suppression devices occur during use, maintenance, and disposal. Data for these sources is often collected from

maintenance and inspection records, work orders, or invoices from contractors that service the equipment.

Table 8 gives an example of the type of information available from the Forests for air conditioners, refrigerators, and fire extinguishers. This information was obtained during a field visit to the Gallatin and Shoshone NFs, but was not pursued for the other Forests.

EPA Climate Leaders Program staff²² provided information to help the inventory team decide whether it was worth pursuing data for air conditioners (A/C) and refrigerators. Several Forests were able to readily provide the number of A/C units and refrigerators on their Forest. However, to accurately calculate emissions from these sources, more information is needed, such as repair rates, replacement rates, and refrigerant type. This additional information is not readily available.

Nonetheless, the inventory team attempted to assess the level of GHG contribution that A/C units might have on the total inventory. Based on the number of A/C units reported by a sample of Forests and using some default values, the estimated GHG emissions from A/C units are below the de minimis threshold. Most significantly, the sample of A/C units on several Forests revealed that most, if not all, of the A/C units use a refrigerant called R-22. EPA Climate Leaders does not require partners to estimate GHG emissions for A/C units that use R-22.

Table 8. Sample of data available for A/C units, refrigerators, and fire extinguishers

GHG Emission Source Data	Gallatin National Forest	Shoshone National Forest
A/C Units		
Number of A/C units	5	7
Repair rates for A/C units	Not easily determined	2 units repaired, but repair rate data is not readily available
Refrigerators		
Number of refrigerators	26	29
Repair rates for refrigerators	Not easily determined	1 unit repaired, but repair rate data is not readily available
Fire Extinguishers		
Number of fire extinguishers	110	91
Repair/replacement rates for fire extinguishers	Not determined	100% of fire extinguishers are serviced each year. Estimated repair or replacement costs can easily be \$200/year on a Ranger District.

²² Mani Oliva, EPA Climate Leaders Program staff (Mani left EPA in the Fall of 2008).

The refrigerant R-22 is being phased out nationally in the next few years because it contributes to ozone depletion. R-22 will likely be replaced with refrigerants for which EPA requires emissions to be estimated and tracked because they generate greater GHG emissions than R-22.²³ Newer A/C units are expected to be most impacted by the R-22 phase-out efforts.²⁴ It will be important to re-evaluate GHG impacts from A/C units in future inventories, particularly once many A/C units on Forests are no longer using R-22.

Though a fairly accurate count of refrigerators (and freezers) on the Forests could be obtained with some effort, the inventory team decided early on not to pursue estimating these emissions. Most significantly, the EPA Climate Leaders Program does not normally estimate emissions from refrigerators because they rarely leak GHGs into the atmosphere.

The number of fire extinguishers on each forest is fairly easy to determine because they are inventoried annually as part of each Forest's safety program. However, repair and replacement rate information is more difficult to collect. Based on preliminary feedback from a sampling of the Forests, the inventory team estimates that there are well over 500 fire extinguishers in buildings and vehicles on the six Forests.

Emissions from fire extinguishers are caused by chemicals (e.g., HFCs or CO₂) emitted from the device during use, maintenance, and disposal. The Forests most commonly use fire extinguishers containing a dry chemical mix that does not emit GHGs. Compounds typically used for these dry chemical mixes include monoammonium phosphate, sodium bicarbonate, and potassium bicarbonate, which are not GHG producing compounds. Also, the propellant used in this equipment is nitrogen, which also has no GHG emissions associated with it. Consequently, the inventory does not include emissions from fire extinguishers.

3. Gas Waste Streams

These are sources that combust gas waste streams using a combustion device, like a flare or thermal oxidizer. These sources are not common for most office-based organizations.²⁵ Nonetheless, the inventory team asked the Forests if this activity occurs on their Forest. According to responses from all six National Forests, there are no sources burning gas waste on the National Forests. Therefore, this source category was not analyzed further.

²³ Email from Yuki Iida, E-Source (EPA contractor) to Julie Tucker, USDA Forest Service on February 26, 2009.

²⁴ <http://www.epa.gov/ozone/title6/phaseout/22phaseout.html>

²⁵ "Climate Leaders Guide to Greenhouse Gas Management for Small Business & Low Emitters" (2008); Website: http://www.epa.gov/stateply/documents/resources/lowemitter_guidance.pdf.

4. Imported Heat or Steam

According to the Forests, they do not import heat or steam. Therefore, this category was not further analyzed.



5. Product Transport

This emission source includes product and material shipments by non-government-owned vehicles. Considering the complexity of estimating these emissions and the heavy burden it would place on the Forests to collect product transport data, the inventory team decided not to include this category in the inventory. Individual Forests should consider evaluating this optional category in the future.

6. Off-Site Waste Disposal

This emission source accounts for garbage being hauled away from government-owned or leased facilities. The amount of garbage hauled away from Forest facilities in the GYA would be difficult to accurately quantify and a heavy reporting burden on Forest staff. Also, the GHG Calculator Tool does not quantify emissions from off-site waste disposal. Considering the potential GHG impact of recycling, Forests should consider quantifying off-site waste disposal emissions in future inventories.

7. Asphalt Paving

This emission source involves the application of asphalt mixtures on large surfaces, such as roads and parking lots. Although the GHG Calculator Tool does not calculate asphalt paving emissions, the inventory team initially investigated the potential impact from this emission source.

The emissions from this source category are considered de minimis because most of the Forests only do minor amounts of asphalt paving, with the exception of one Forest that reported having a road crew dedicated to doing asphalt paving. For future inventories, Forests might want to consider capturing asphalt paving emissions only if asphalt paving constitutes more than a de minimis share of that Forest's emissions. The Custer NF reported that it awarded a pavement patching contract to use 40 tons of asphalt on the Forest in FY 2007. This data was excluded from the inventory because contract work is outside the scope of this inventory (as explained earlier in this report, contract work is not within the agency's operational control). If the scope of future inventories is expanded to include contract work, then asphalt paving should be more carefully evaluated.

VI. QUALITY ASSURANCE AND QUALITY CONTROL

Thorough quality assurance and quality control measures were implemented to ensure the highest quality data. During data collection, the inventory team compared data between Forests to identify any information that seemed out of the expected range. Most importantly, analyses were performed during each major data processing step. Calculations were performed on the fleet data to ensure that mileage and fuel use was reasonable for each vehicle. For example, when calculating the miles per gallon for each vehicle based on the mileage and fuel use reported, the inventory team discovered problems with the mileage data (vehicle miles traveled) originally reported by GSA for the GSA fleet. After discussing this issue with the GSA representative, the inventory team resolved the issue by relying on the GSA's reported fuel usage for each vehicle and calculating the miles traveled based on the EPA-estimated fuel economy for each vehicle.

A variety of people throughout the Forest Service, USDA, and EPA reviewed the draft inventory data. Moreover, each Forest staff looked at the raw inventory data for their Forest and completed a review checklist, which was used by the inventory team to validate the accuracy of the information. Some minor errors were discovered during the review process and the inventory team adjusted the data accordingly. The review checklist used by each Forest to evaluate the accuracy and completeness of the data are provided in Appendix E.

VII. EMISSIONS SUMMARY

Total GHG emissions are calculated in metric tons of CO₂ equivalent (CO₂e). This is the standard unit for comparing the degree of potential climate impact caused by emissions of different greenhouse gases. Table 9 summarizes the total CO₂e by source category for each National Forest and the entire GYA (only Forest Service activities). Emissions from purchased electricity, stationary sources, and business air travel for the Custer, Caribou-Targhee, and Beaverhead-Deerlodge NFs are overestimated because they include activity outside the GYA boundaries. The electricity, stationary source, and business air travel emissions for the Bridger-Teton, Gallatin, and Shoshone NFs represent activity only within the GYA because these Forests are located entirely within the GYA boundaries (see Table 3). Mobile source and employee commuting emissions for all 6 Forests reflect activity only within the GYA.

Table 9. Emissions by source category for each forest (metric tons CO₂e).

Source Category	Beaver-head-Deerlodge	Bridger-Teton	Caribou-Targhee	Custer	Gallatin	Shoshone	GYA Total
Mobile sources	526	1,050	1,270	170	772	797	4,586
Purchased electricity	457	558	326	128	275	170	1,913
Stationary sources	322	287	247	69	218	123	1,265
Employee commuting	13	164	245	39	184	91	735
Business air travel	13	22	29	11	21	11	106
TOTAL:	1,332	2,080	2,117	417	1,469	1,190	8,605

Figure 5 shows each Forest’s percentage share of total GHG emissions. Other than the Custer NF, each Forest’s GHG contribution ranges from 14-25% of total Forest emissions.

Figure 5. Forests’ share of GHG emissions, in percent.

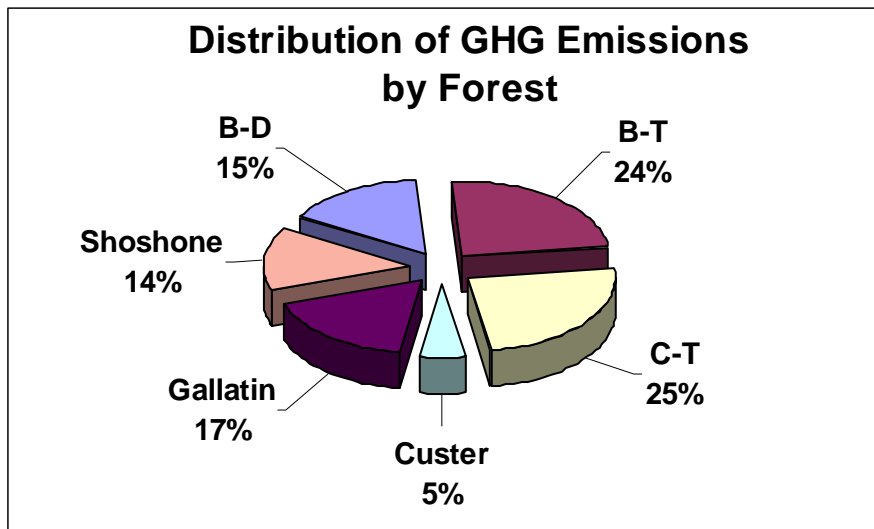


Figure 6. Forests' share of GHG emissions by sources.

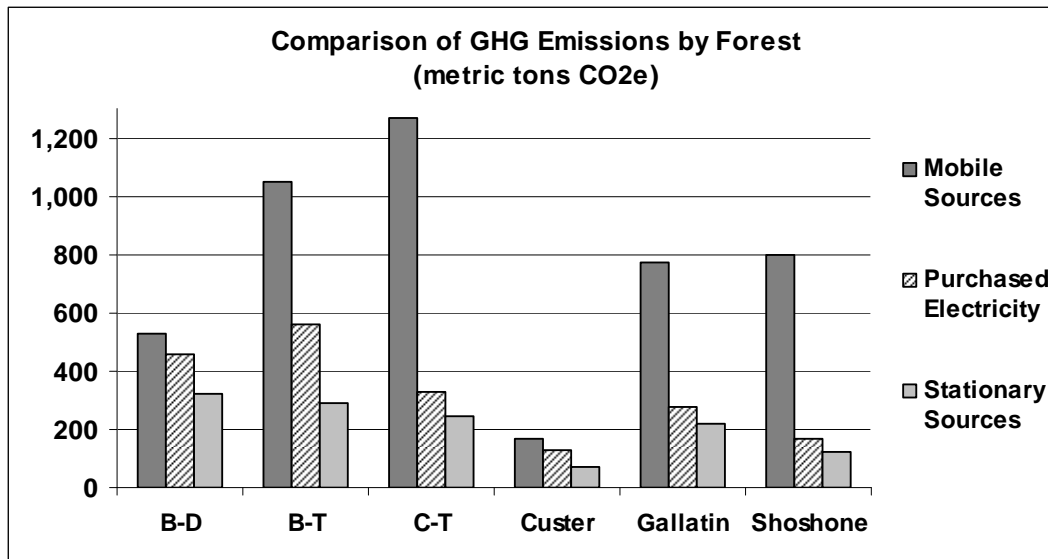


Figure 6 shows GHG emissions generated by each Forest for the three main source categories: mobile sources, purchased electricity, and stationary sources. This figure illustrates that mobile sources are the most dominant emission source for every Forest. Again, keep in mind that the majority of stationary source and electricity emissions and all of the business air travel emissions represent the entire Forest even for the three Forests with land outside of the GYA. The employee commuting emissions represent activity only within the GYA.

Finally, Figures 7 and 8 show the total GHG emissions generated by employee commuting and business air travel for each Forest. Caribou-Targhee, Gallatin, and Bridger-Teton NFs have the highest commuting and business air travel emissions, which correlate respectively to their higher number of permanent and seasonal employees relative to the other three Forests. The Gallatin NF has nearly the same number of employees as the Shoshone NF, yet its employees generate roughly twice as many commuting emissions, in large part, because their seasonal employees live substantially farther from their workplace (25 versus 2 miles) than seasonal employees on the Shoshone NF (Table 7). This longer commuting distance for Gallatin seasonal employees also explains why Gallatin NF's commuting emissions are higher than those of the Bridger-Teton NF despite the Gallatin having much fewer employees than the Bridger-Teton NF.

Figure 7. GHG emissions generated by employees commuting.

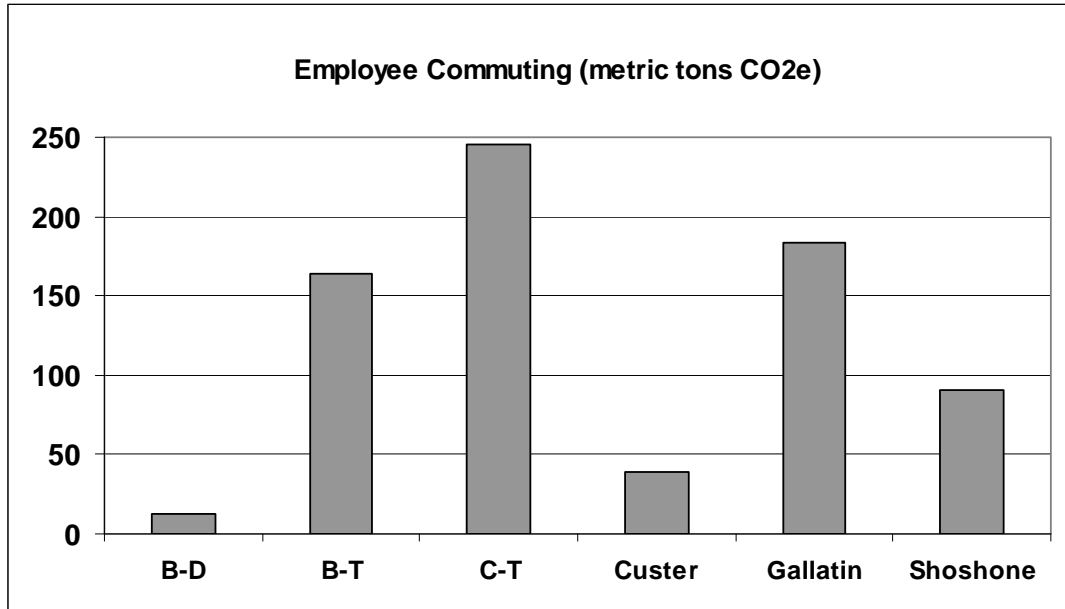
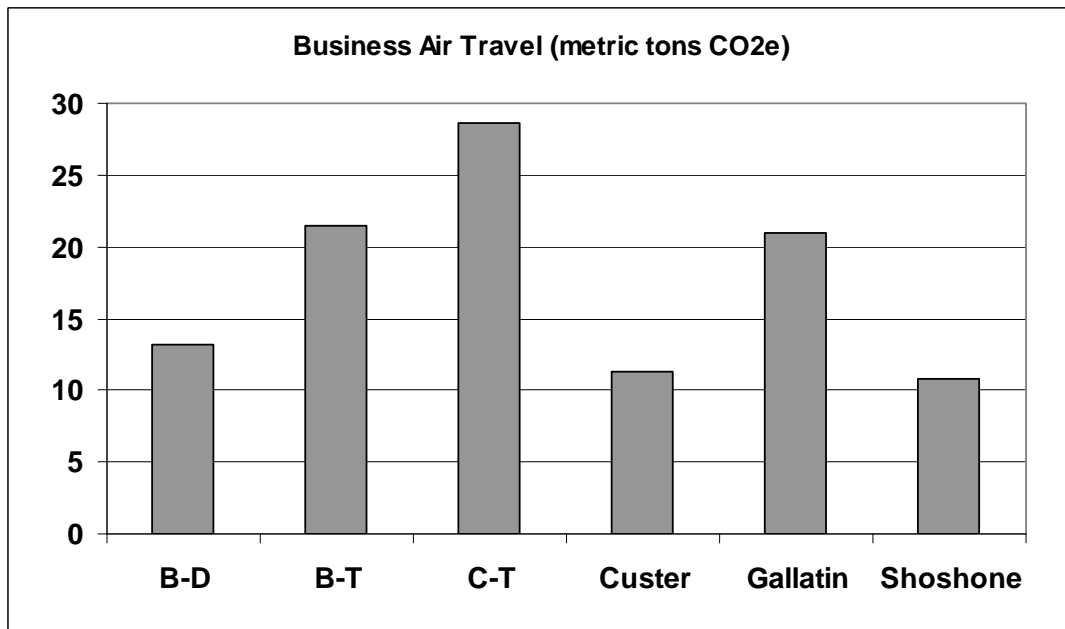


Figure 8. GHG emissions generated by employees air travel for business.



VIII. SUMMARY OF INVENTORY FINDINGS

A. BIG PICTURE PERSPECTIVE

This inventory is the first step for the Forest Service to understand the level of emissions occurring on the National Forests located in the GYA. The underlying story for all six National Forests in the GYA is that mobile sources are by far the largest GHG contributor. Purchased electricity and stationary sources are the second and third largest sources of GHG emissions, respectively. Therefore, greenhouse gas emission reduction goals should start with reducing gasoline and diesel use by Forest fleet. Each Forest will have to determine how this can best be achieved without adversely impacting natural resource management activities, such as field work, or other activities paramount to the agency's mission. Also, each Forest should look more carefully at their individual Forest's sources of GHG emissions to determine where and how they can best reduce emissions immediately and in the near future. Opportunities to make significant changes to operations will likely be unique to each Forest while some opportunities will be readily available and achievable by all of the six Forests.

This inventory should be used to set aggressive goals to reduce GHG emissions and the overall carbon footprint in this large ecosystem. Ideally, the Forest Service and the two other federal agencies managing land in the GYA should collaborate to collectively reduce GHG emissions in the GYA. Sharing GHG inventory results, comparing inventory findings, and discussing agency insights and lessons learned will go a long way toward achieving a broader GHG reduction objective.

B. TAKE HOME MESSAGES

Several take home messages emerged from this inventory development process. Some of the most important messages are listed below with some accompanying detail and are separated into two main categories: (1) findings that reveal significant GHG reduction opportunities; and (2) findings that should be carefully evaluated for future inventory efforts.

1. Findings that reveal significant GHG reduction opportunities

Mobile sources are the largest contributor of GHG emissions.

Mobile sources account for 54% of the total GHG emissions from Forests in the GYA despite stationary and electricity emissions being overestimated for three of the Forests (those with land also outside the GYA). Of the six Forests, Bridger-Teton and Caribou-Targhee NF contribute the greatest amount of mobile emissions. Looking at individual Forests, mobile emissions make up the greatest share of the Caribou-Targhee (60%) and Shoshone NF's (67%) emissions.

Based on the inventory data, total miles driven annually by Forest fleet correlates with the size of the geographic territory being managed within the GYA. Table 10 shows each Forest’s percent share of total GYA acreage managed by the Forest Service and each Forest’s percent share of total miles driven by Forest fleet located in the GYA (WCF and GSA vehicles).



These statistics suggest that miles driven are more directly proportional to the geographic distances that must be traveled by Forest personnel to manage resources. Obviously, factors other than geography impact miles driven. It is impossible to determine quantitatively or qualitatively whether the miles driven were necessary for the Forest Service’s mission. These statistics simply offer one potential insight into the differences between Forests in miles traveled. Further analyses could reveal patterns among and between Forests that will help Forests identify hidden opportunities to reduce their GHG impact.

Table 10. Percent share of acres managed and miles driven (WCF and GSA vehicles), by forest.

	Beaverhead-Deerlodge	Bridger-Teton	Caribou-Targhee	Custer	Gallatin	Shoshone
% of GYA Acreage	7%	33%	17%	5%	15%	23%
% of GYA Fleet Miles Driven	9%	24%	25%	5%	22%	16%

☑ Fleet fuel economy is low.

The average fuel economy for Forest fleet does not vary significantly from Forest to Forest. As shown below in Figure 9, compared to the other sister Forests in the GYA, Custer NF has the best fuel economy for WCF fleet (15 mpg) and the Shoshone has the worst (11 mpg). However, the average fuel economy on any one of the six Forests is not impressive considering the types of fuel efficient vehicles available in the marketplace. Forests can make substantial strides in reducing their GHG emissions in the GYA by increasing the fuel economy of their fleet and, of course, by driving less. Also, Forests should determine which are the most efficient and appropriate vehicles to use for any given field or

administrative task. Forests will likely need to make behavioral, cultural, and administrative changes to use the right vehicle for the right purpose more of the time.

Figure 9. Forest fuel economy for WCF vehicles.

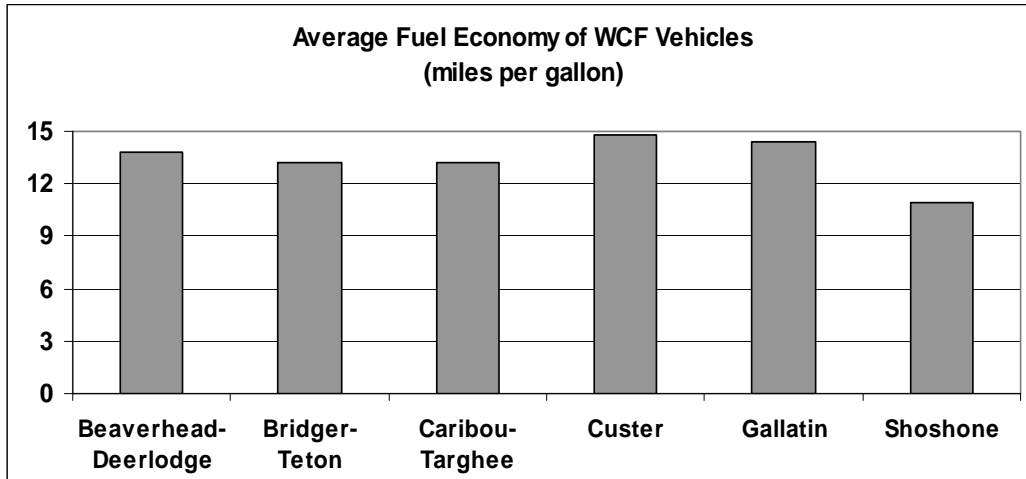
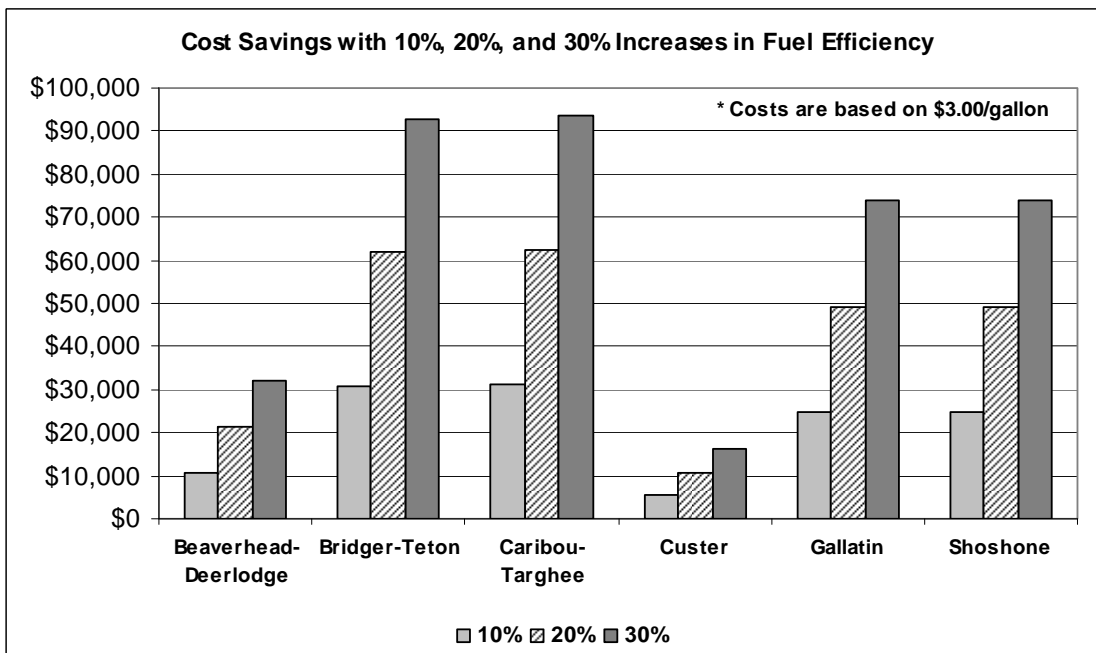


Figure 10. Cost savings, by forest, if fuel efficiency increases.



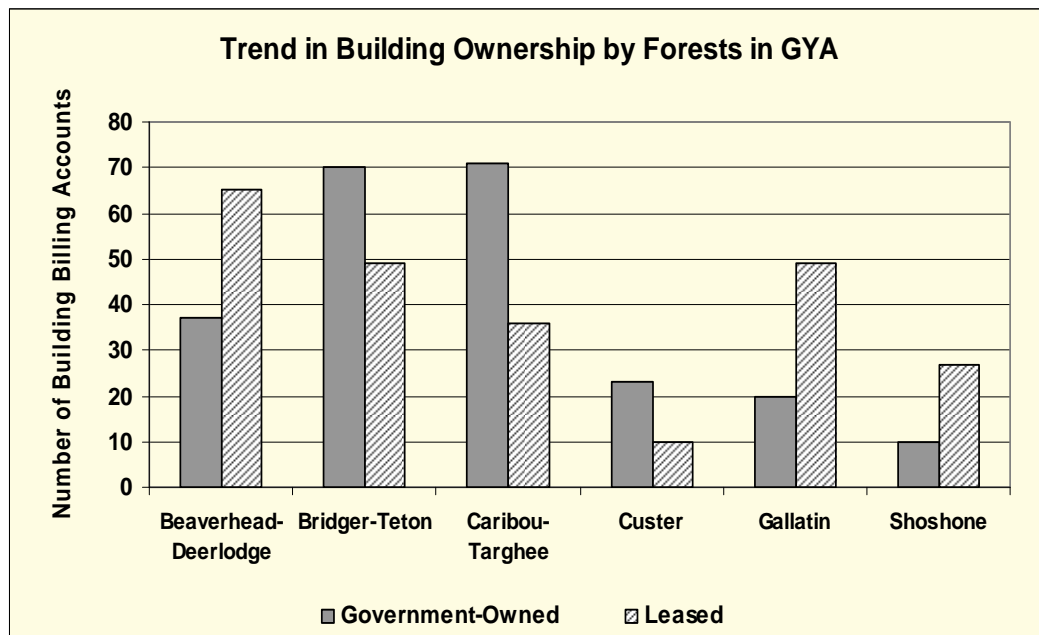
As companies in the industrial sector have discovered, efforts to reduce GHGs can result in substantial cost savings. Based on the mobile information collected for this inventory, Figure 10 shows cost savings that the Forests would have achieved in FY 2007 if their fleet had better fuel economies.

☑ Buildings are the second largest contributor of GHG emissions.

Electricity and energy use by buildings occupied by the Forest Service (owned and leased) contribute 37% of the total GHG emissions. Forests should closely examine electricity and energy use of individual buildings, especially Forest-owned buildings, to determine which ones would benefit most from energy efficiency upgrades. A more detailed analysis of the administrative use and energy efficiency of buildings will reveal opportunities to consolidate facilities and operations, install renewable energy systems, or achieve other energy saving measures that could reduce GHG emissions and energy costs.

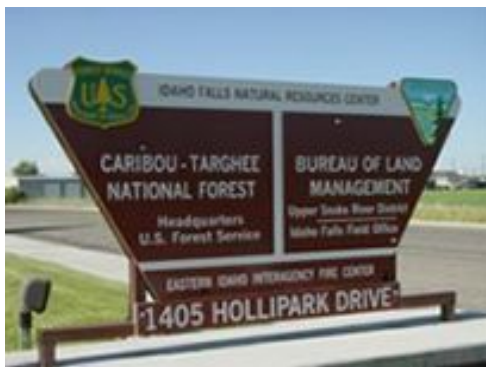
According to the NFC data, the percentage of leased versus government-owned buildings on each Forest varies widely. Figure 11 shows the total number of separate billing accounts associated with leased versus government owned buildings. Keep in mind that any given account can cover more than one building. Also, NFC data will not capture electricity or energy use for leased buildings if the energy and electricity are included in the lease. These statistics merely represent a rough trend in building ownership rates from Forest to Forest.

Figure 11. Number of leased versus government-owned buildings by forest.



Of the six Forests, the Shoshone and Gallatin NFs have the highest percentage of leased buildings (based on number of accounts). The Custer NF has the lowest percentage of leased buildings (30%). As expected, a larger number of buildings correlates with higher electricity and stationary source fuel use. For example, the Bridger-Teton, Caribou-Targhee, and Beaverhead-Deerlodge NFs have the highest total number of accounts associated with buildings regardless of ownership type. These three Forests also use the greatest amount of electricity and stationary source fuels. Similarly, one would expect to see greater energy use when there is a greater square footage of heated buildings.

Forests, such as the Caribou-Targhee, with a greater percentage or number of government owned facilities may be able to more readily reduce GHG emissions



Many Forest Service buildings are co-located with other agencies.

from stationary sources because they have full control over their facilities. Forests wanting to improve the energy efficiency of any leased buildings will have to work with the owner of the leased building and possibly co-tenants to institute certain GHG reducing activities. For example, the government can more readily make physical changes to their own buildings, such as replacing inefficient energy systems, installing motion detectors for lights, or installing solar panels. But, only the owner of a leased building, not the government,

must be capable of and willing to make similar changes in a leased building. Even trying to monitor the agency's energy use at a leased building with multiple tenants by installing a separate energy or electricity meter can be time consuming or possibly infeasible. Administrative limitations like building ownership should not necessarily be viewed as a barrier, but these limitations should be carefully considered early on when establishing GHG reduction goals. Also, Forests should consider requesting separate electricity and energy metering at leased facilities for monitoring purposes, even if their lease includes utilities.

2. Findings that should be carefully evaluated for future inventory efforts

- ☑ **Data provided by Forest staff can play a significant role to ensuring a complete and accurate inventory, but the level of effort to accomplish this can be equally significant.**

Obtaining data directly from Forest staff can substantially increase the amount of greenhouse gas emissions captured by the inventory. This ensures a more complete and accurate inventory because it captures more of the GHG generating activities on the Forests.

Roughly 50 percent of the stationary source emissions are based on data provided by Forest staff and the other 50 percent of the stationary emissions are based on NFC data. This illustrates that NFC data alone will not capture the majority of stationary emissions. Moreover, had the inventory team not pursued Forest level data, they would not have discovered the role that wood plays in stationary source emissions (see separate finding below discussing wood). As for optional sources, the commuting and business air travel estimates could not have been developed with any degree of reliability without Forest staff assistance.

By contrast, regional and national data sources (EMIS and GSA data) readily capture over 95 to 98 percent of the mobile source emissions for each Forest. Similarly, over 98 percent of the electricity emissions are based on national data sources (NFC data). Keep in mind that it is unknown how much electricity or heating fuel (i.e., propane, heating oil) purchased for leased buildings was not captured by this inventory because this data is not readily available for those leased buildings where the electricity and heating fuel costs are included in the lease costs. The level of effort to develop emission estimates will depend largely on the estimation method used, the steps required to obtain the data, and the completeness and accuracy of the raw data. With that said, achieving a more refined level of detail and inventory thoroughness by including data provided by Forests can take significantly more time compared to relying predominantly on only national and regional databases and resources. It is important for anyone embarking on inventory work of this type to understand the advantages and disadvantages of pursuing data from Forests. For most inventories, there is a threshold where any greater level of effort produces diminishing returns in obtaining greater accuracy and thoroughness. Sometimes, and unfortunately, an inventory team determines this threshold only through trial and error. This inventory report should help inform future inventory teams about where to draw that line and concentrate their efforts.

The challenges inherent in conducting an inventory of this type and magnitude are many. For this inventory, obtaining data for six National Forests in three different Regions proved to be extremely time consuming. The process not only demanded persistence, patience, and utmost attention to detail, but it also revealed differences, shortcomings, and inconsistencies in data management and data retention procedures between regions and Forests. Data quality and data format largely determined the level of effort needed to process and validate the data. Additional coordination was necessary at the Forest level because inventory data was usually stored or managed by multiple staffs. See Appendix A for a rating and explanation of the data quality for each source category.

Working with Forest level staff adds the greatest layer of uncertainty to the project timetable. These staffs are very stretched for time. It is difficult for some Forests to respond to data requests in a timely manner because of ever present strains on the Forests – limited staff, new staff, key positions being temporarily

empty, etc. Therefore, even simple data requests can become more difficult and time consuming than anticipated.

Considering the amount of time and effort exerted by Forests to provide Forest level data and the strain that the Forests are already under to meet basic resource objectives, some future inventory efforts might, out of necessity, have to be based more strictly on national and regional data sources and rely minimally on the Forests. Though, some higher priority inventories that require a greater degree of accuracy will have to depend heavily on Forest input. Even if only national and regional data sources are used for future inventories, Forests will still have to be involved and carefully consulted because clarification, validation, and review of the data is absolutely necessary to ensure a thorough inventory and accurate emission estimates. Changes in agency reporting systems and the nature of GHG generating activities will also dictate the degree of Forest staff involvement needed in the future.

☑ Some Forest Service reporting and data storage systems are outdated and contain inconsistencies and data gaps.

To best facilitate the development and updating of future inventories, the agency should consider modernizing and improving many of its reporting and data storage systems. The inventory team regularly encountered barriers when trying to obtain data from agency reporting systems. Many of the data reporting and storage systems are outdated and are only known and understood by very select personnel, many of whom even have difficulty extracting desired information.

Considering that mobile sources are the primary source of GHG emissions in the GYA and most likely for the agency at large, future inventory updates should address any data quality issues and reporting inefficiencies associated with mobile sources. See Appendix A for a rating and explanation of the data quality for each source category

All of the mobile source data presented a variety of unexpected challenges, most of which were overcome. For example, when processing the WCF fleet data from EMIS, the inventory team discovered that all three regions classify their fleet differently. Also, not all fleet personnel are well versed in EMIS reporting, which can result in misinformation, misinterpretation, and misreporting of data.

Some of these findings have recently spurred fleet managers from several western regions to review how they classify their vehicles and consider a nationally standardized system. Brian Ingalls, Regions 1 and 2 Fleet Manager, expressed the following sentiments in a recent email:

“As it is becoming more and more apparent, Fleet Management has operated under the radar for many years. The system just seemed to “work” for what we needed. Adding more accountability and initiatives (like EMS and Sustainability) that require specific measurable data fields that fall outside of the data Fleet Managers typically used is now bringing it into the radar.”

As for electricity and energy use data provided by NFC, the inventory team abandoned the idea of excluding the activity from ranger districts located outside of the GYA because it would be too time consuming considering the format in which the NFC data are provided. If the NFC reports simply identified the ranger districts where each building or facility is located, the inventory team could have generated more geographically focused emissions for stationary sources and electricity use. This is an example of simple fixes that can be made in reporting systems at the national level that will benefit a variety of end users, including those preparing GHG inventories in the future.

Currently, there are internal inconsistencies and data gaps in the agency’s reporting systems. It is difficult to set comprehensive GHG reduction goals without accurate data. The agency should carefully evaluate how to modify reporting and data storage systems so that they can better accommodate the type of data requests inherent to GHG inventory, environmental management system tracking, and other data needs. If agency reporting and storage systems were more flexible and accurate, then annual inventories could be readily updated to be used as a benchmark for progress.

☑ GSA mileage data is of poor quality.

As explained in Section IV (A)(2) of this report, mileage data for GSA vehicles is not reliably accurate. Considering the magnitude of mobile source emissions, the Forest Service should evaluate the quality of GSA data and identify ways to improve future reporting of this information. See Appendix A for a rating and explanation of the GSA data.

☑ Wood contributes a disproportionately larger amount of methane and nitrous oxide emissions than fossil fuels.

Combustion of wood or any fossil fuel produces CO₂ emissions. Most, if not all, of the carbon released from burning wood will be taken up by vegetation in less

than 100 years, which is why many consider it a carbon neutral bio-fuel. The difference between bio-based fuels and fossil-based fuels, like natural gas, is that the bio-based fuel emits carbon that is already part of the vegetation-to-atmosphere-to-vegetation cycle that is constantly occurring. Conversely, when oil is pumped up from deep, stable, long-term storage and burned, that previously fixed carbon is added to the atmospheric cycle.

Wood represents 6 percent of the total heating value of all the fuels used by stationary sources on the six Forests, whereas the fossil fuels (natural gas, distillate fuel, propane, and LPG) represent 94 percent.²⁶ Despite the relatively small amount of wood used in the GYA for heating, wood contributes 87 percent of the methane emissions, 69 percent of the nitrous oxide emissions, and 19 percent of the carbon dioxide emissions from all stationary sources. In terms of CO₂e, wood burning is responsible for approximately 20 percent of total emissions from stationary sources. Therefore, wood contributes a disproportionately higher percentage of methane and nitrous oxide emissions than the fossil fuels used by the Forests. Wood's contribution of methane and nitrous oxide emissions in the GYA is significant considering that the global warming potential²⁷ of these two pollutants is much higher than that of CO₂. This illustrates why it can be important to look at individual pollutant estimates in addition to the CO₂e estimates. Fortunately, the GHG Calculator tool provides individual pollutant emissions for all source categories.

These results will likely spur further discussion around wood energy use. On one hand, wood is a renewable resource that is largely carbon neutral, while on the other hand, the high methane and nitrous oxide emissions raise additional issues that should be more carefully considered.

☑ Estimating emissions for a geographic boundary smaller than the administrative boundary can be time consuming and complex.

GHGs do not remain within a geographic or administrative boundary upon release. Therefore, depending on the objective of any given inventory, Forests could consider estimating GHGs for all Ranger Districts on a Forest rather than only those located within the GYA boundaries. Such an approach would significantly ease the data processing burden, simplify the inventory reporting, and enable Forests to look more holistically at their entire operations rather than just those located within or directly associated with the GYA. After all, operations located both inside and outside of the GYA boundaries emit pollution that adds to the same global air shed, which expands beyond regional, state, or national

²⁶ Heating value is the amount of energy in fuel.

²⁷ Global warming potential is the ability of a gas to warm the atmosphere.

borders. On the other hand, narrowing this particular inventory to activities within or directly associated with the GYA offers a unique opportunity to assess emissions generated from the management of one of the largest remaining intact ecosystems in North America that is mostly under federal control by multiple agencies. It is a good test case to see how changes in administrative processes can impact the federal carbon footprint.

Many lessons learned emerged from this process beyond the eight findings listed above that will assist future inventory efforts and inform the agency about improvements needed for agency reporting and data storage systems. A more comprehensive “Lessons Learned” document is forthcoming. This “Lessons Learned” document will be invaluable to anyone embarking on inventory work for our agency. It will also serve as a useful guide to anyone developing inventories for other land management agencies, especially government entities.

X. CONCLUSION

With the release of this inventory, the time is ripe for each Forest to take individual steps to reduce their greenhouse gas emissions. All federal agencies managing land in the GYA should also act now. Over the past decade, federal agencies in the GYA have successfully collaborated on land management issues to achieve measurable results. Similarly, the opportunity is ripe for these same federal partners to collaborate to collectively reduce the GHG emissions from their operations in the GYA.

This report is the cornerstone for developing a GYA-wide emissions reduction plan across three federal agencies. The process for creating an ecosystem-wide strategy is already moving forward. Specifically, similar GHG inventories are being completed for the two National Parks and two Fish and Wildlife Refuges in the GYA. Pursuant to an interagency agreement, the National Renewable Energy Lab (NREL) will consolidate and analyze the information and findings from these individual GHG inventories to determine where the most significant opportunities for GHG reductions exist across the ecosystem. This information will then be used to create a collaborative action plan that establishes ecosystem-wide GHG reduction goals for federal lands in the GYA. This action plan should be available by the end of FY 2009. This process will move the three federal agencies closer to substantially reducing their GHG impact and will also serve as a real-life example of collaboration.

XI. ACKNOWLEDGMENTS

The inventory team, which primarily consisted of Julie Tucker and Dan Golub, received considerable assistance from Kerri Fiedler, an EPA employee who served on a detail with the Forest Service in early 2008. Her assistance was critical, especially information gleaned from her two field visits. Heather Davis, a Region 2 Forest Service employee, also provided key information and assistance. Most significantly, we extend our deep gratitude to Anna Jones-Crabtree who motivated us with her boundless passion and commitment to sustainable operations. Anna provided critical oversight and feedback to the team and Forests throughout the year-long process. We would also like to thank Jacqueline Myers, Associate Deputy Chief of Business Operations, for the funding she provided to support this project.

This inventory could not have been accomplished without the assistance of Regional staff, especially the Regional Fleet managers. To them, we extend heartfelt thanks. We would also like to thank the Shoshone and Gallatin National Forests for hosting the field visits and providing early input and feedback during the initial stages of this endeavor. Wendy Visser, a Database Manager in Region 5, was instrumental in enlightening us about the nuances and issues associated with EMIS data. Thank you Wendy and best wishes for a wonderful retirement in 2009! We would also like to thank Mani Oliva of the EPA Climate Leaders for assisting us with estimating emissions for Optional Sources and sorting out issues associated with the GHG Calculator tool. Also, a special thank you goes to Paula Randler and Leslie Horsch for improving the format and presentation of this report.

Finally, our most sincere thanks go to the Forest Service employees who provided key information and insights into their operations. Despite the tedium of our data requests, National Forest staffs demonstrated an admirable commitment to this effort from beginning to end. This inventory would have been impossible without their valuable and thoughtful contributions. They are our heroes.

In addition, we would like to thank the following individuals who contributed to this effort:

Becky Aus, Grace Bailey, Pete Becken, We Burton, Jayne Cardenas, Kerry Carlock (GSA), Cliff Coleman, Jeremy Courtney, Dave Dufour (USDA), Jacque Edkins, Janice Ermatinger, Steve Esquibel, Jim Evanoff (NPS), Matthew Gibbs, Stephen Haydon, Brian Ingalls, Steve Jenkins, Lynne Johnson, John Kastner, Arlin Krogstad, Mark Libby, Jim Lootens, Karin Lovgren, Gerry Maney, Bill Neckels, Traute Parrie, Matthew Pittman, Richard Porter, Frank Preite, Ken Reuer, Chris Riley, Alejandro Romero, Jane Ruchman, Trey Schillie, Cary Schumacher, Sandra Seaton, Tyrone Stone, Wes Stumbo, Jeri Taverner, Wendy Urie, and Dee Dee Witsen. For any other folks we might have omitted who provided information and assistance – Thank You!

APPENDIX A – DATA SOURCE, QUALITY, AND GEOGRAPHIC COVERAGE OF INVENTORY DATA

Source Category	Data Source	Data Quality Rating ²⁸	Comments	Geographic Scope
Stationary Sources (15% of total emissions)				
Natural gas	National Finance Center	A	Data reflects actual usage.	Forest-Wide (unavoidably includes districts outside the GYA)
	Forest Staff	A-	The data is accurate, but a few facilities might be unintentionally excluded.	Activity only inside GYA boundaries & in Supervisor's Offices
Propane	National Finance Center and Forest Districts	A-	Usage estimated by NFC based on dollars charged and the average price per unit of propane in 2007.	Forest-Wide (unavoidably includes districts outside the GYA)
	Forest Staff	A-	The data is accurate, but a few facilities might be unintentionally excluded.	Activity only inside GYA boundaries and in Supervisor's Offices
Fuel oil	Forest Staff	B	The data is accurate, but a few facilities might be unintentionally excluded.	Activity only inside GYA boundaries and in Supervisor's Offices
LPG	Forest Staff	C	Only Gallatin reported LPG use. This estimate was back calculated based on propane canister use.	Activity only inside GYA boundaries and in Supervisor's Offices
Wood	Forest Staff	C-	Forests are only able to provide best guess estimates, coverage may not be complete	Activity only inside GYA boundaries and in Supervisor's Offices

²⁸ Data Quality Rating is a subjective grade from A to F given by the inventory team to assess the accuracy and completeness of the data. A= excellent quality data based on actual measured or reported activity and the data appears to be comprehensive. B= good quality data. C = adequate quality data that is based on estimated activity and/or is probably not comprehensive in covering all activity.

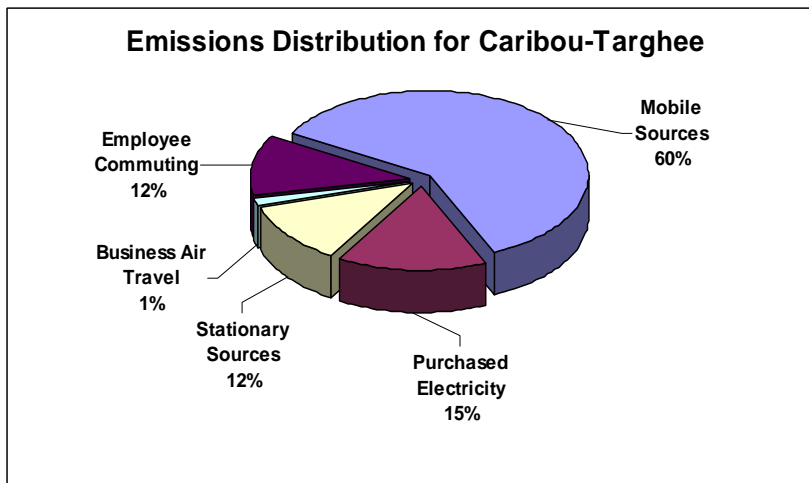
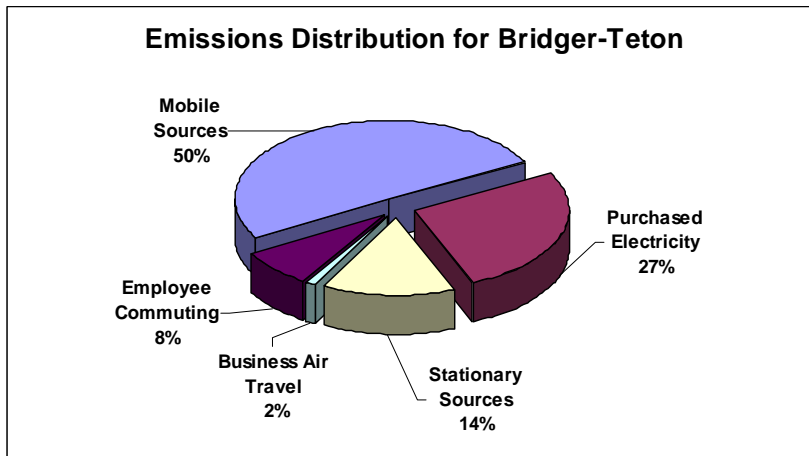
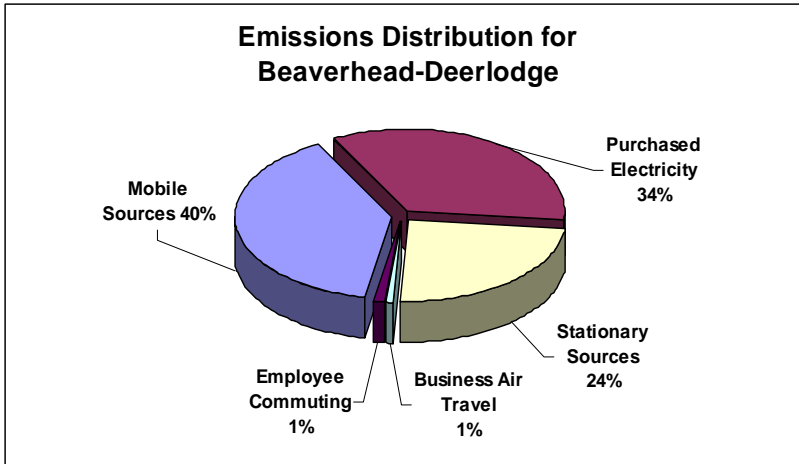
Source Category	Data Source	Data Quality Rating	Comments	Geographic Scope
Mobile Sources (54% of total emissions)				
GSA Fleet	GSA	B-	This data is of limited quality. GSA has adequate confidence in the fuel usage reported but not the mileage traveled. Thus, the inventory team had to generate mileage estimates, some of which were based on incomplete vehicle information (vehicle type, model, weight, etc).	Activity only inside GYA boundaries and in Supervisor's Offices
WCF Fleet	Regional Fleet Managers	A-	This data was of fairly good quality, though there were still some challenges with the validation process.	Activity only inside GYA boundaries and in Supervisor's Offices
Other Mobile Sources (Non-GSA, non-WCF fleet. For example, ATVs, snowmobiles, lawnmowers)	Forest Staff	C	This data was mostly estimated by forest staff based on their rough estimate of average use.	Activity only inside GYA boundaries and in Supervisor's Offices
Purchased Electricity Sources (22% of total emissions)				
Electricity	National Finance Center	A	Data reflects actual usage.	Forest-wide (unavoidably includes districts outside the GYA)
	Forest Staff	A-	The data is accurate, but a few facilities might be unintentionally excluded.	Activity only inside GYA boundaries and in Supervisor's Offices

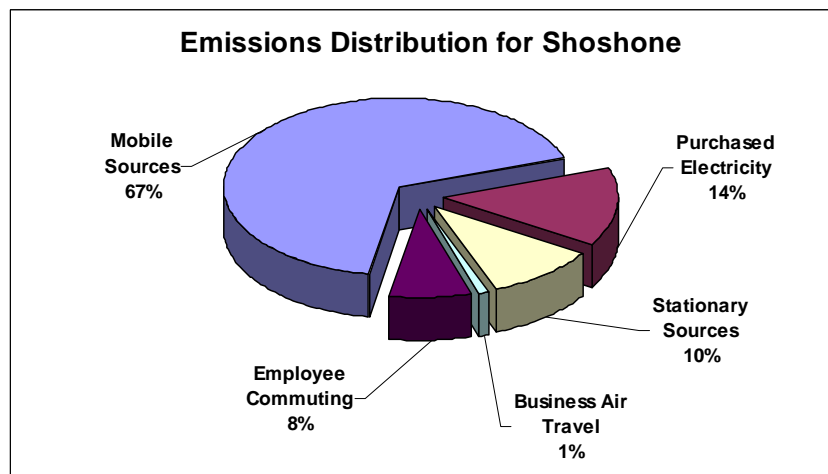
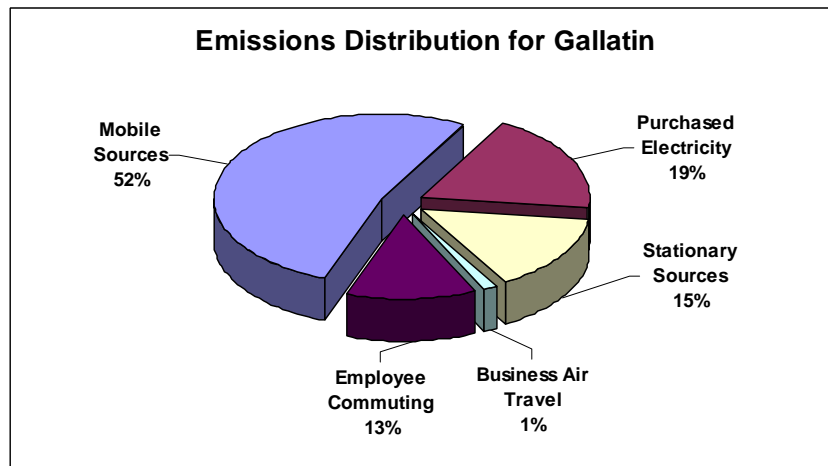
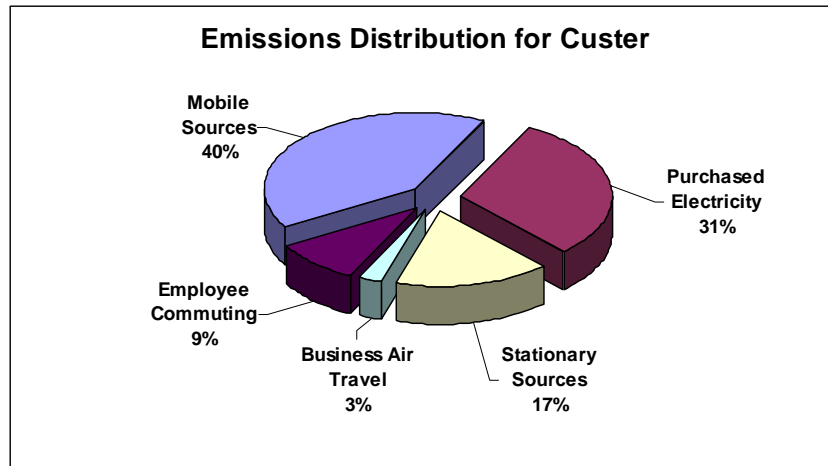
Source Category	Data Source	Data Quality Rating	Comments	Geographic Scope
Air Travel (1% of total emissions)				
Air Travel	Administrative Center for Excellence for R1, the Forest Engineer for R2, and from various budget offices for R4.	B+	High quality data, but more information is needed to confirm accuracy. Keeping business air travel records in a centralized, accessible location would be a good idea.	Forest-wide (unavoidably includes districts outside the GYA)
Employee Commuting (8% of total emissions)				
Employee Commuting	Forest Staff	C	All data is based on average distances and estimated number of seasonal and permanent employees.	Activity only inside GYA boundaries and percentage of activity in Supervisor's Offices associated with the GYA. ²⁹

²⁹ Commuting estimates for the Supervisor's Offices (SO) on the following three Forests are apportioned crudely based on the number of ranger districts located in the GYA: Beaverhead-Deerlodge: 1 of 8; Caribou-Targhee: 5 of 7; and Custer: 1 of 3. Therefore, 13%, 71%, and 33% of the commuting activity from the SO is included in the inventory emissions estimates for the Beaverhead-Deerlodge, Caribou-Targhee, and Custer NFs, respectively.

APPENDIX B – DISTRIBUTION OF GHG EMISSIONS BY SOURCE CATEGORY FOR EACH FOREST

The following charts display the distribution of GHG emissions by source for each forest.





APPENDIX C – INITIAL QUESTIONNAIRE FOR STATIONARY COMBUSTION, MOBILE, AND MISCELLANEOUS SOURCES

STATIONARY COMBUSTION SOURCES

In Fiscal Year 2007, did your Forest use any of the following?	YES	NO	NOT SURE	Where is this data stored or how can you obtain this information?	Any reporting burdens or other comments?	Contact person who can provide the information (please include phone & email, if possible)
Coal						
Natural Gas						
Distillate Fuel Oil (#1, 2 & 4)						
Residual Fuel Oil (#5 & 6)						
Kerosene						
LPG						
Propane						
Wood or Wood Waste						
Landfill Gas						
Diesel						
Steam						
Any fossil fuel or other energy sources that are paid by purchase cards?						
<p>Note 1: The above questions refer only to heating, cooling, or supplying energy to buildings or other more permanent structures. Fuel use for mobile sources (cars, trucks, ATVs, snowmobiles, etc) and hand-held machines is asked about in another worksheet.</p>						
<p>Note 2: Typical sources that use the above fossil fuels and energy sources include: diesel generators, natural gas hot water heaters, wood stoves, boilers, furnaces, space heaters, flares, etc. Any system or device that uses electricity, such as electric space heaters, are already accounted for in the electricity consumption data that we have for your forest.</p>						
<p>Please type your name, position, and phone in the box to the right ----></p>						

MOBILE SOURCES

In Fiscal Year 2007, can you estimate the following for your Forest?	YES	NO	NOT SURE	Where is this data stored or how can you obtain this information?	Any reporting burdens or other comments?	Contact person who can provide the information (please include phone & email, if possible)
Miles traveled or amount of fuel used by ATVs?						
Miles traveled or amount of fuel used by Snowmobiles?						
Miles traveled or amount of fuel used by Motorcycles?						
Amount of fuel used in Tractors?						
Amount of fuel used in Bobcats?						
Amount of fuel used in Backhoes, Dozers, Snow groomers?						
Amount of fuel used in Forklifts, Cranes?						
Amount of fuel used in Riding Lawn and Bush Mowers?						
Amount of fuel used in Front-end Skip Loaders?						
Amount of fuel used in Helicopters (exclude fuel used during fire suppression operations)?						
Amount of fuel used in Airplanes (exclude fuel used during fire suppression operations)?						
Amount of fuel used in Watercraft (exclude fuel used during fire suppression operations)?						
Miles traveled in GSA vehicles?						

In Fiscal Year 2007, can you estimate the following for your Forest?	YES	NO	NOT SURE	Where is this data stored or how can you obtain this information?	Any reporting burdens or other comments?	Contact person who can provide the information (please include phone & email, if possible)
Miles traveled in commercial rental vehicles?						
Miles traveled in any non-WCF vehicle?						
Gallons of biodiesel used?						
Gallons of ethanol used?						
Amount of fuel used in hand-operated machines (chainsaws, trimmers, leaf blowers, mowers, etc)?						
Number of hours of operation for any Forest Service-owned heavy equipment?						
Fuel usage, hours operated, or miles traveled for any OTHER off-road vehicles or equipment not listed in the above questions?						
Amount and type of fuel purchased on purchase cards?						
Number of employees who use a Government vehicle to commute to/from work?						

MISCELLANEOUS SOURCES

In Fiscal Year 2007, can you estimate the following for your Forest?	YES	NO	NOT SURE	Our Forest Does Not Have This Activity	Where is this data stored or how can you obtain this information?	Any reporting burdens or other comments?	Contact person who can provide the information (please include phone & email, if possible)
How much garbage was generated?							
Percent of garbage that was recycled?							
How much water was sent to a wastewater treatment plant?							
Amount of fertilizer applied to the land?							
Amount of asphalt paving used?							
Amount of cleaning solvents used?							
Amount of paint applied to structures, buildings, bridges, etc.							
Number of air conditioning units?							
Repair rates for air conditioning units?							
Number of refrigerators?							
Repair rates for refrigerators?							
Number of fire extinguishers?							
Repair/replacement rates for fire extinguishers?							
Is there any manufacturing or lab research on your Forest?							

<p>Big Picture 1 In your opinion, what is the biggest environmental impact on the Greater Yellowstone Area ecosystem? <i>Please respond in the box to the right – THANKS!</i></p>	
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<p>Big Picture 2 In your opinion, what can the Forest Service do to most significantly reduce greenhouse gas emissions from human activities in the Greater Yellowstone Area? <i>Please respond in the box to the right - THANKS!</i></p>	
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APPENDIX D – FINAL QUESTIONNAIRE FOR STATIONARY AND MOBILE SOURCES

2007 Greenhouse Gas Inventory - Data Request for the 6 National Forests in the Greater Yellowstone Area	
Please type your name, forest, position, and phone in the box to the right ---->	
<p>Note 1: The following questions refer only to heating, cooling, or supplying energy to facilities owned or managed by the Forest Service, which includes administrative buildings, offices, guard stations, Forest Service quarters, bunk houses, district ranger stations, etc. Please exclude fuel used by rental cabins, concessionaires, visitors, and the public. Fuel use for mobile sources (cars, trucks, ATVs, snowmobiles, chainsaws, etc) is asked in Table 2.</p> <p>Note 2: Typical sources that use the above fossil fuels and energy sources include: natural gas hot water heaters, wood stoves, boilers, furnaces, space heaters, flares, etc. Any system or device that uses electricity, such as electric space heaters, are already accounted for in the electricity consumption data that we have for your forest.</p> <p>Note 3: Please report data for Fiscal Year 2007, which covers the time period from October 1, 2006 through September 30, 2007.</p>	

Table 1. Stationary Sources								
In Fiscal Year 2007, did your Forest use any of the following?	YES	NO	Where is this data stored or how can you obtain this information?	Contact person who can provide the information (please include phone & email, if possible)?	Type of Fuel? (Gasoline, Diesel, Other)	Amount of Fuel Used in FY07?	Units? (gallons, standard cubic feet, tons, kilo-Watt hour, etc)	HINT: Typical location of data
Natural Gas								Energy bills
Distillate Fuel Oil (#1, 2 & 4)								Energy bills
Propane								Purchase card receipts
Wood or Wood Waste <i>Note: 1 cord of wood = 2 tons</i>								Estimate usage
Purchased Electricity not billed to NFC (Forest Service Quarters)								Energy bills
Any fossil fuel or other energy sources that are paid by purchase cards? Indicate type of fuel.								Purchase card receipts

Table 2. Mobile Sources								
In Fiscal Year 2007, can you estimate the following for your Forest?	YES	NO	Where is this data stored or how can you obtain this information?	Contact person who can provide the information (please include phone & email, if possible)?	Type of Fuel? (Gasoline, Diesel, Jet Fuel, Other)	Amount of Fuel Used in FY07?	Units	HINT: Typical location of data
Amount of fuel used in ATVs, Snowmobiles?							gallons	Fuel logs, estimate usage
Amount of fuel used in Motorcycles?							gallons	Fuel logs, estimate usage
Amount of fuel used in Tractors, Bobcats, Backhoes, Dozers, Snow Groomers, Forklifts, Cranes, Riding Lawn Mowers?							gallons	Fuel logs, estimate usage
Amount of fuel used in Helicopters (exclude fuel used during fire suppression operations)?							gallons	Fuel logs
Amount of fuel used in Airplanes (exclude fuel used during fire suppression operations)?							gallons	Fuel logs
Amount of fuel used in Watercraft (exclude fuel used during fire suppression operations)?							gallons	Fuel logs

Table 2. Mobile Sources								
In Fiscal Year 2007, can you estimate the following for your Forest?	YES	NO	Where is this data stored or how can you obtain this information?	Contact person who can provide the information (please include phone & email, if possible)?	Type of Fuel? (Gasoline, Diesel, Jet Fuel, Other)	Amount of Fuel Used in FY07?	Units	HINT: Typical location of data
Amount of fuel used in GSA vehicles?							gallons	SO database
Amount of biodiesel used?							gallons	SO database
Amount of ethanol used?							gallons	SO database
Amount of fuel used in hand-operated machines (chainsaws, trimmers, leaf blowers, mowers, etc)?							gallons	Fuel logs, estimate usage
Amount of fuel used in any OTHER off-road vehicle or equipment not listed above?							gallons	Fuel logs, estimate usage
Amount of fuel used from bulk storage or a Concrete Vault ("convault")?							gallons	
Amount and type of fuel purchased on purchase cards?							gallons	Purchase card receipts

APPENDIX E – FOREST REVIEW CHECKLIST FOR GYA GREENHOUSE GAS INVENTORY

If you discover any incorrect or missing data in the inventory, please document your findings with an explanation and send them to Julie Tucker (julietucker@fs.fed.us) and Dan Golub (dgolub@fs.fed.us).

Abbreviations

FY 2007	Fiscal Year 2007 (October 1, 2006 though September 30, 2007)
NFC	National Finance Center
WCF	Working Capital Fund
EMIS	Equipment Management Information System
GSA	General Services Administration

Check the box after you have completed each task.

Stationary Worksheet (Table 1):
<input type="checkbox"/> Validate total propane and natural gas use reported by NFC for your forest for FY 2007. (Cells D15 and D16)
<input type="checkbox"/> The NFC propane and natural gas totals represent all Ranger Districts on each Forest including those located outside the GYA. Does your Forest want to see this data broken out by Ranger District (it can be done with your help)? YES or NO?
<input type="checkbox"/> For the non-NFC data that your Forest provided, confirm that the quantity used for at least one of the fuel types (other than wood) seems reasonable (Cells D17 and below in Table 1. “Stationary Source Fuel Combustion”). If there is no non-NFC data in Table 1, then your Forest indicated that there was no other fuel use for stationary sources other than what was already reported to NFC.

Fleet Worksheet (Table 1):

NOTE: Under Column A, WCF vehicles have a strictly numeric “Source ID” whereas GSA vehicles have an alphanumeric (numbers and letters) “Source ID.” The “Source Description” under Column B indicates whether it is a WCF or GSA vehicle as well as the administrative unit that the vehicle is assigned to. For GSA vehicles, the “Source ID” is the license plate number. For WCF vehicles, the “Source ID” is the ID # assigned to that vehicle in EMIS.

Big-Picture Data Checks:

- Confirm the **total # of GSA fleet for your forest for FY 2007** (Column A).
- Confirm the **total # of WCF vehicles for your forest for FY 2007** (Column A).
- This inventory only includes vehicles assigned to Ranger Districts located within the GYA boundaries. **For the Caribou-Targhee, Custer, and Beaverhead-Deerlodge** (these Forests are not entirely within the GYA boundaries), we plan to apportion the **Supervisor Office’s fleet emissions** based on the Forest’s best guestimate of the percentage of the SO fleet activity that is more directly associated with Ranger Districts located only within the GYA. The apportionments are planned as follows: Caribou-Targhee: 5/7; Custer: 1/4; Beaverhead-Deerlodge: 1/8. Are these reasonable apportionments? YES or NO?
If no, please explain:

Fleet Worksheet (Table 1) continued:

Vehicle-specific Date Checks

Working Capital Fund Fleet:

Please randomly select 3 WCF vehicles that are NOT highlighted in blue. Please write the Source ID for each of these vehicles for which you will be checking information. (The Source ID is shown in Column A of the Fleet worksheet for your forest): _____, _____, and _____.

Then, please validate the following for each of these WCF vehicles:

- Confirm that vehicle was part of your fleet in FY 2007 (Column A).
- Validate that the vehicle is assigned to the correct administrative unit (Column B).
- Confirm the **Miles Traveled** is accurate for FY 2007 (Column G).
- Validate the **Model Year** (Column D).
- Confirm the **Vehicle Type** (Column C). If you click on the cell in Column C, you can view the dropdown list of all vehicle types.
- Did you find any inconsistencies or errors when checking the above information? If so, please document and explain below:

- For all Forests, **except the Shoshone, Gallatin, and Custer**, randomly select 2 WCF vehicles that are highlighted in BLUE. The use for these vehicles is reported as “Hours Operated” rather than “Miles Traveled” under Column G. Confirm that the number of “Hours Operated” is reasonable for FY 2007 (Column G). Please list the Source ID of the 2 “Hourly” vehicles that you checked: _____ and _____. Do the hours reported for each of the 2 vehicles seem reasonable? YES or NO _____. If NO, please explain:

Fleet Worksheet (Table 1) continued:**Vehicle-specific Date Checks****General Services Administration Fleet:**

Please randomly select 3 GSA vehicles and write the Source ID for each of these vehicles for which you will be checking information: _____, _____, and _____.

Then, please validate the following for each of these GSA vehicles:

- Confirm that vehicle was part of your fleet in FY 2007 (Column A).
- Validate that the vehicle is assigned to the correct administrative unit (Column B).
- Confirm the **Miles Traveled** is accurate for FY 2007 (Column G).
- Validate the **Model Year** (Column D).
- Confirm the **Vehicle Type** (Column C). If you click on the cell in Column C, you can view the dropdown list of all vehicle types.
- Did you find any inconsistencies or errors when checking the above information? If so, please document and explain below:

Electricity Worksheet (Table 1):

- Validate that the total number of **kilowatt hours** of electricity reported by NFC is accurate for your Forest for FY 2007. (Cell D17)
- Did you find any inconsistencies or errors when checking the above information? If so, please document and explain below:

- The NFC electricity totals cover all Ranger Districts on each Forest, including those located outside the GYA. Does your Forest want to see the electricity data broken out by Ranger District? YES or NO? Can your Forest assist us in doing this? YES or NO?

Commuting Worksheet (Table 1):

- Confirm that the **number of permanent and seasonal employees** for your forest is **within 10%** for FY 2007 (Column E).
- Validate that the number of **Roundtrip Daily Miles** is reasonable (Column D).
- Validate that the **Number of Days Worked Annually** for each type of employee – **permanent and seasonal** -- seems reasonable (Column F).
- Did you find any inconsistencies or errors when checking the above information? If so, please document and explain below:

GYA Boundaries Worksheet:

- Please review the table titled, “**Forests and Ranger Districts Located in the GYA.**” Please check that we have properly listed **ONLY** those Ranger Districts that are within the GYA Boundaries. Is all of the information for your Forest correct? YES or NO? . If NO, please explain:

Other Review Feedback:

Please provide any other feedback that you think will aid us in generating a more accurate greenhouse gas inventory for your Forest or the other Forests within the GYA. Also, if you have any concerns about the quality of the data that you have reviewed, please indicate that below. Feel free to provide any other comments. **THANK YOU FOR YOUR ASSISTANCE!!**

APPENDIX F – ADDITIONAL NOTES ON EMPLOYEE COMMUTING

Below are additional notes associated with the commuting discussion and Table 7 in Section V of this report.

Caribou-Targhee

On the Caribou-Targhee, roughly 143 seasonal employees travel an estimated 5 miles roundtrip and 29 seasonal employees travel an estimated 16 miles roundtrip. The Caribou-Targhee commuting estimates were adjusted so that only 5/7 of the SO employees' commuting is included in the inventory. In 2007, there were 74 SO permanent employees; therefore, this inventory accounts for commuting by 53 SO permanent employees.

The Caribou-Targhee submitted their commuting estimates in a slightly different format than the other Forests. They reported 203 permanent employees who work 235 days per year, 144 seasonal, part-time employees who work 100 days per year, and 35 permanent part-time employees. Some of the 35 permanent, part-time employees work an 18 week on/8 week off schedule (18/8), some a 13 week on/13 week off schedule (13/13), and some work year-round. The inventory team divided this permanent, part-time group into three parts with 12 employees assigned to 18/8 (working 163 days/yr), 12 employees to 13/13 (working 118 days/yr), and 11 employees to year-round working (working 235 days/yr).

Beaverhead-Deerlodge

Commuting estimates for Beaverhead-Deerlodge only include employees working in the SO and on the Madison Ranger District. The Beaverhead-Deerlodge commuting estimates were adjusted so that only 1/8 of the SO employees' commuting is included in the inventory. In 2007, there were 78 permanent and 16 seasonal SO employees; therefore, this inventory accounts for commuting by 10 permanent and 2 seasonal SO employees.

Custer

Commuting estimates for Custer include only 1/3 of SO employees and all of the Beartooth Ranger District employees. In 2007, there were 41 permanent and 3 seasonal SO employees; therefore, this inventory accounts for commuting by 14 permanent and 2 seasonal SO employees.