

LESSONS LEARNED FROM CONDUCTING A GREENHOUSE GAS INVENTORY FOR FOREST SERVICE OPERATIONS

by Julie Harllee Tucker
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I. BACKGROUND

Over the past year, a small inventory team developed a GHG (greenhouse gas) inventory for the 6 National Forests in the Greater Yellowstone Area (GYA) pursuant to protocols established by the EPA Climate Leaders program, which the USDA Forest Service formally joined in 2007. In April 2009, we finalized the GYA inventory database and GYA inventory report, which can be accessed online.¹ This “Lessons Learned” document supplements the GYA inventory report by sharing additional insights, challenges, and discoveries beyond what is presented in the inventory report. Therefore, you should first read the inventory report prior to digesting this document. This “Lessons Learned” document should help you avoid common pitfalls, save time, minimize frustrations, and improve the quality of your inventory, especially inventories developed pursuant to the EPA Climate Leaders program.

This document presents some of the key lessons learned during our inventory process. Many of the lessons learned are unique to working with Forest Service data, reporting systems, and staff, whereas some of the lessons apply more generally to any GHG inventory. Section XI of this document presents recommendations intended primarily for Forest Service national leadership.

II. GENERAL LESSONS LEARNED

- Establish your inventory year from the beginning. Most agency data is reported and stored by fiscal year. Therefore, it is easiest and less time consuming to establish an inventory year based on an agency fiscal year. If you use a fiscal year as your inventory base year, it is extremely important that all team members understand the time period that the fiscal year covers. Moreover, it is paramount for the team to always clarify with any person providing information the time period that the data represents. Even seasoned Forest staff can forget that a fiscal year covers parts of two calendar years and inadvertently supply you with data representing a calendar year rather than a fiscal year. For example, our agency’s 2007 fiscal year covers the time period from October 1, 2006 through September 30, 2007.
- Be prepared for inconsistent and incomplete data. When in doubt about data accuracy or completeness, go back to your source even if you notice only minor

¹ The report, “*Greenhouse Gas Inventory for the National Forests in the Greater Yellowstone Area (April 2009)*” and the inventory database, “*GYA INVENTORY TOOL FOR REPORT - APRIL 2009.xls*”, are available on-line at: <http://www.fs.fed.us/sustainableoperations/climate-change.shtml#greenhouse>.

discrepancies. Sometimes minor aberrations uncover major flaws or challenges with the data. Also, consider consulting with another person who might also be familiar with your data.

- You must be flexible and creative in filling in data gaps or developing alternative estimation methodologies. Always run your inventory approach, such as an estimating methodology or assumption, by an experienced 3rd party, such as EPA Climate Leaders staff or their consultants. Whenever the opportunity arises, discuss methodologies and data issues with Forest Service staff from the unit you are inventorying because they are usually the best barometers for confirming the reasonableness, accuracy, and sanity of your assumptions and approach. Sometimes, staff can quickly identify flaws with your approach based on their more intimate knowledge of their own operations. Be sure to document any estimation methods used to fill data gaps. Estimates must be able to be replicated by others, especially if inventory updates will be conducted in the future to track progress on emission reductions.
- Most importantly, do not take any data at face value prior to using it. Whenever possible, perform validation checks on data to determine its accuracy. For example, when we conducted a few sanity checks on the mobile data, we discovered that based on the miles and fuel usage reported by GSA, many vehicles were achieving impossible fuel efficiencies, such 80 miles per gallon. This initial discovery saved us tremendous processing time, enabled us to obtain better data, and helped us avoid using GSA's less reliable and largely inaccurate mileage data. In another example, employee population data obtained from individual Forests was substantially different from numbers provided by Human Capital Management staff. We made a judgment to rely on the data provided by Forest staff.
- For critical data, it is wise to obtain the same data from multiple sources to ensure its accuracy and discover any nuances in the data. Though this might appear to be time consuming, it will save significant time in the end. Again, this is only recommended for key information that can be readily obtained through a simple request.
- From a big picture perspective, data provided by a Forest can represent a substantial portion of the total emissions for some categories compared to data obtained from regional and national data sources (e.g., NFC, GSA, and EMIS). Therefore, considering the amount of time and effort that would be required by Forests to provide Forest level data, you should carefully consider whether or not to pursue less centralized data. Keep in mind that if you are estimating emissions at the Forest level, you will still need to consult regularly with Forest staff throughout the inventory process for clarification, validation, and review of the data even if your inventory is based on more centralized regional and national data sources.
- It will be 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, be patient, plan ahead, and give your inventory team ample time to complete any given task. Also, depending on agency policies, you may need to obtain approval to initiate any data requests.

- The most time consuming part of developing an inventory is following up on data requests, processing the data, and performing quality assurance and quality control (QA/QC) checks on the information. Give yourself twice as much time as originally estimated to collect data. Also, if requesting data from Forest staff, try to avoid making data requests during field season when staff are often out of the office and are extremely busy (e.g., spring-summer, varies by region).
- During every step along the way, perform QA/QC checks on your raw data, processed data, and final emission estimates. This is one of the most important requirements to ensuring an accurate inventory. Also, never have a person perform QA/QC checks on the data that they handled. It is wise to regularly check your own work as much as possible, but reliable QA/QC checks can only be performed by another person. When fatigue sets in, periodically ask someone from outside the inventory team to perform QA/QC checks. This offers a fresh set of eyes and can sometimes point out obvious omissions that those too close to the data would not notice.
- Begin documentation at the start of and throughout your project. For example, as you develop your inventory, begin writing the inventory report, lessons learned, methodologies, and assumptions. In the end, this will save tremendous time, free your memory from the endless details, and help you generate a higher quality product.
- Cultivate a good working relationship with those people who are responsive to your inquiries and are knowledgeable about the information that you need. These “go-to” contacts are crucial to your process. Remember, any requests they respond to are usually being done outside their daily work demands. So, patience on your part and a thank you go a long way. Consider acknowledging their contributions whenever the opportunity arises.
- Before making a data request, spend time upfront determining the exact format in which you prefer to have the data submitted to you. Sometimes you will not be able to obtain the preferred format, but if you are requesting data from multiple Forests or Districts, uniformity among data sets can save substantial time, reduce errors, and facilitate the QA/QC process.

III. INVENTORY SCOPE

Most GHG inventories are conducted to determine the amount of GHGs emitted by specific facilities or operations. Some GHG inventories attempt to assess GHG emissions from all emission sources, including natural sources and carbon sinks. The first step in developing a GHG inventory is to determine the objective of the inventory. This will then tell you the appropriate administrative and geographic scope of your inventory and will help to define boundaries.

In our case, the geographic boundary of the inventory was an ecosystem boundary. This presented challenges because large chunks of some Forests fell outside of the geographic

boundary, thereby making it difficult and sometimes impossible to segregate activity that is located only within or associated with the ecosystem. You will have fewer data challenges if you are able to establish a geographic boundary that matches your administrative unit.

We did not attempt to capture natural GHG emission sources (emissions from wildfires) or carbon sinks (carbon sequestration by forests) in our inventory because it is not required by the EPA Climate Leaders program and the scope of our inventory was limited more to anthropogenic emissions from federal operations. Depending on the purpose of your inventory and future needs, you might want to consider quantifying these emissions.

Finally, carefully consider whether you will include activities that are outside of your agency's operational control. It will likely be much more time consuming to include data from non-agency activities. However, there might be good reason to do this. In our case, we tried to limit the inventory to only those activities that our agency has control over (e.g., we excluded activities by public visitors, concessionaires, special use permit holders, contractors, and permitted facilities).

IV. STATIONARY SOURCES

Stationary sources primarily include fuel used for heating purposes, such as fuel oil, propane, natural gas, and wood. Centralized data for stationary sources is available from NFC for facilities that have their bills sent directly to NFC. For facilities that do not report to NFC, you will have to contact the administrative unit directly (e.g., Forest, District, etc). Depending on how many facilities on a given administrative unit have their bills sent directly to NFC, a sizable amount of stationary source activity can be captured via decentralized data sources that only local Forest Service staff can provide.

- Obtaining data from decentralized data sources, such as Forest or District staff, is usually much more time consuming than centralized data sources, such as from NFC.
- The natural gas use reported by NFC is based on actual use whereas, sometimes, propane use is estimated when the vendor does not report the quantity (e.g., gallons used). If a vendor only provides the total propane cost, then NFC estimates the quantity of propane used based on a national price per gallon for the given year. In such a case, the propane quantity can be less accurate, especially if outdated price per gallon estimates are used.
- Initially, we thought it might not be worth the effort to ask Forests to guestimate their wood use because we assumed that wood use would be minimal. However, wood use can add up to a consequential amount depending on a variety of factors, such as number of facilities using wood, climate, fossil fuel availability in your area, etc. Therefore, make an effort to estimate wood use. Also, be aware that wood use occurs at campsites, rental units, government housing facilities, and regular offices. When you request wood estimates, be sure to specify which facilities you want them for.

- Keep in mind that leases for some buildings used by the Forest Service include heating, cooling, and electricity expenses in the cost of the lease. In these cases, energy and electricity use might be difficult or impossible to determine.
- One unexpected finding from our inventory work: Wood emits methane and nitrous oxide at a much greater rate per thermal energy unit (Btu) than fossil fuels.

V. ELECTRICITY

Electricity activity encompasses electricity purchased for any purpose, such as lighting or heating a building. The type of data required for this source is electricity consumption in kilowatt-hours. The majority of electricity use can be obtained from NFC. For facilities that do not bill directly to NFC, you must obtain their electricity use directly from the respective administrative unit, typically via electric bills or invoices. You should not have to capture or account for renewable electricity generated on-site if it does not emit greenhouse gases (e.g., solar panels or windmills).

- Data obtained from NFC captured most of the emissions for our inventory. Only about 10% of the total electricity emissions were based on Forest level data provided by the Forests. However, this might not be the case on all administrative units in our agency.
- The geographic region where your electricity is generated impacts the nature of emissions from this category due to the unique mix of fuels used to generate the power. The emissions profile of a power generating plant using coal will be much different from one using natural gas or nuclear energy. Keep this in mind when you select emission factors for electricity activity. In our case, we only had to identify the geographic region of our six national forests from a national e-GRID map and enter this regional code into the GHG Calculator Tool.

VI. MOBILE SOURCES

Forest fleet comprise three main types of vehicles: Working Capital Fund (WCF), General Services Administration (GSA), and other Forest-owned vehicles (e.g., snowmobiles, ATVs, lawnmowers, etc). Most WCF and GSA vehicles are on-road vehicles whereas the rest of the Forest fleet, referred to as “Other Mobile Sources,” is primarily off-road vehicles like snowmobiles, lawnmowers, tractors, etc.

- The quality of mobile source data varies depending on the information source. From our experience, the WCF data is of a higher quality than the GSA data. GSA told us that they have more confidence in their fuel use data than the mileage data and encouraged us not to use their fuel use data (gallons used per vehicle each year). Future improvements in GSA mileage data, especially the manner it is reported to GSA, will substantially improve emission estimates for GSA vehicles.

- To generate emission estimates for on-road vehicles, you will likely need all or most of the following: model year, vehicle make, fuel type, miles traveled, fuel consumed, and vehicle weight (emission factors often vary based on vehicle size). For off-road vehicles, you will likely need the general vehicle type (e.g., ATV, backhoe, tractor, etc), fuel type, and fuel consumed (or miles traveled or hours operated).
- In some circumstances you will have to determine the fuel economy for a given vehicle so that you can estimate missing data, such as fuel use. For example, if you only know that a snowmobile was used for 120 hours for the inventory year, you can estimate the fuel use if you are able to identify a typical fuel economy for the given snowmobile or more broadly for a typical group of snowmobiles. In circumstances like this, you need to be resourceful, ensure that you are using reliable fuel economy estimates, and have a third party check your approach, even if you are using a crude estimation method.
- EMIS files usually list the manufacturer's rated fuel economy for any given vehicle, but GSA files do not. However, fuel economy ratings are widely available on the internet. Also, you can always use the fuel economy ratings in the EMIS files as a resource to determine the fuel economy for GSA vehicles.²

A. WCF Fleet

- You can obtain data for WCF vehicles from each Regional Fleet Manager. WCF data is stored in the Equipment Management Information System (EMIS). It is very important to talk to a seasoned fleet employee about the relevant data fields in each EMIS file. You will need to obtain a legend or definition table to tell you what each data field means. This is extremely important so that you can properly interpret the data.
- EMIS reports odometer readings in "miles" or "hours" depending on the vehicle type. This is not evident from looking at the EMIS file. Unfortunately, not all regions classify vehicle types in the same manner. Therefore, it is important to determine for which vehicle types your region classifies and reports activity as "hourly" versus by "mileage." For example, the column heading that says "od10/1" in an EMIS file represents the odometer reading at the start of the federal fiscal year (October 1st). For vehicles classified as non-hourly, this represents "miles" traveled but for vehicles classified as hourly, this represents "hours" of operation. If someone only told you in general terms that this column reported the odometer reading or mileage, you could easily and incorrectly assume that all of the values under the "od10/01" heading were miles traveled whereas in reality, most of the values are "miles" but a minority of them are actually "hours." Construction equipment and other off-road vehicles tend to be

² Whenever possible, we used the fuel economy ratings listed in the EMIS files to determine the fuel economy of GSA vehicles. Although it was not necessary to use this approach, it helped ensure internal consistency in our mobile data. If you use fuel economy ratings from a website source, try to cite the actual document that you use rather than just the website in case the website or the methods used by the website source changes.

reported in “hours” of operation. The regional fleet manager can provide a table differentiating which vehicle classes are reported in hours or miles.

- Calculating miles traveled or hours operated: 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. In a nutshell, EMIS reports only represent a snapshot in time. This is why it is very important that you understand the data and ensure that the data serve your intended purpose
- For EMIS reports, NITC automatically changes the odometer readings of every vehicle on October 1st by rolling over the odometer reading for each vehicle from September 30th so that it becomes the odometer reading at the beginning of the next fiscal year.
- In the earlier stages of this effort, the inventory team found it impossible to obtain one convenient EMIS file for each Forest or Region that shows each vehicle’s starting and ending odometer reading for FY 2007. EMIS files always show each vehicle’s starting odometer reading for the start of the fiscal year for the given report, but the odometer reading at the end of the fiscal year would only be captured in the same report if it was extracted from the EMIS database at a specific time very close to the end of the year. Keep in mind that it is Forest Service practice in most regions for Forest staff to enter odometer readings twice a month.

Regional staff told the inventory team that prior year data are wiped out and not readily available. After contacting dozens of people, the inventory team discovered that prior year data, even for FY 2007, is stored on microfiche, which is difficult to obtain. The inventory team spoke regularly with a number of Albuquerque Service Center staff for two months hoping to obtain a file that would show both the start and ending odometer readings. ASC was unable to provide the requested file because they were having difficulty with the FOCUS software used to extract information from NFC-based EMIS files.

- At the time of this writing, ASC indicates that prior year EMIS reports containing starting and ending odometer readings can now be readily obtained in one electronic file via a formal request.³ File your request at the very beginning of your inventory efforts! Also, even though the data will be submitted in one file, you will still need to do additional data processing, especially adjustments to account for errors that will inevitably result when ASC extracts the EMIS data.
- The only way to readily obtain one convenient file showing the start 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. It would be very wise to alert fleet managers of your data needs as far in advance so that they can extract the necessary files from EMIS. Hopefully with enough advance notice, they can provide you with a

³ Contact ASC for prior year EMIS reports: Pat Weinbrecht, WCF Supervisor (505-563-7117); Theresa Cyfers-Perry, Team Lead for WCF Fleet (505-563-7373); or Bart Chinnici, Systems Accountant (505-563-7124).

single file that contains all of the necessary data. Otherwise, you must request prior year EMIS files from ASC (see prior bullet above).

- You will need to perform considerable data manipulation to extract the necessary activity data from EMIS files if you are unable to obtain one EMIS file that contains both the starting and ending odometer readings for each vehicle. To calculate the total miles traveled by each vehicle in one fiscal year, we had to use Access database software to combine two sets of EMIS files (one that provides the starting odometer reading and another that provides the ending odometer reading for each vehicle) into one master file.
- EMIS files from the current fiscal year are available electronically via Lotus Notes.⁴ This database is a very convenient resource to quickly determine what EMIS reports are readily available electronically. To access EMIS files manually, go to Lotus Notes and do the following:
 1. Click [File](#).
 2. Click [Database](#).
 3. Click [Open](#).
 4. Set the Server to [ENTDATA03](#) by using the drop down box. If you do not see this in the list of servers, select Other and in a few moments a complete listing of Notes Servers will come up. Then select [ENTDATA03](#).
 5. Double click on the yellow [Ffiles](#) folder in the Database window.
 6. Double click on the [Unit](#) folder.
 7. Double click on the [Fleet](#) folder.
 8. Double click on the [National](#) folder.
 9. Double click on [National EMIS Data](#).
 10. After reading the introductory page in the pop-up window, click on [Close](#) to view the EMIS data.
- EMIS files are automatically named according to the date that the reports were run. Therefore, a report named 08-01-07 represents data from October 1, 2006 through July 2007. Keep in mind that an EMIS file might be one month delayed in reporting actual activity.
- Processing and performing quality checks on the mobile data is very time consuming, especially when you encounter data gaps and errors.
- Trailers, such as flatbed or horse trailers, show up in the EMIS data files but can be excluded from your inventory because they do not have engines and do not use fuel.
- A vehicle might be assigned to one administrative unit (i.e., SO or Ranger District) but actually be used full-time on another administrative unit within the same Forest. Also,

⁴ (Wendy Visser, who plans to retire in Spring 2009, created this database to make the files more readily accessible to Forests).

a vehicle can be reassigned to a different administrative unit during its tour with the agency.

- Not all fleet personnel are well versed in EMIS data reporting, which can result in misinformation, misinterpretation, and misreporting of data. Therefore, you should speak with multiple fleet personnel to better understand the nuances of EMIS data. Most importantly, ask, clarify, and re-ask when you need to confirm pertinent information. Also, keep in mind that without discussing the data with a fleet manager or expert in person or over the phone, you might not discover pertinent and sometimes critical details about your data.

B. GSA Fleet

- You can obtain GSA data by contacting the GSA representative for the GSA region where your Forest is located. The GSA contact can provide you an Excel file of GSA vehicles used by the Forest Service.
- GSA reports each vehicle's activity as "miles traveled" and "fuel used." However, as explained earlier, GSA considers the "miles traveled" data less reliable and in many cases, it is outright wrong and should not be used.
- Unlike the WCF data, the GSA data did not include the fuel economy for each vehicle. The inventory team extrapolated annual miles traveled for each vehicle based on GSA's reported fuel usage and an estimated fuel economy for each vehicle (see footnote 2). 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 and vehicle class. This more limited information for each vehicle made the estimation of miles traveled more time consuming 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.
- GSA can provide you with the vehicles assigned to each Forest, but not each Ranger District. The unique identifier for each vehicle is its license plate number. Therefore, if you need to quantify emissions at the Ranger District level, you can determine which GSA vehicles are assigned to a given Ranger District by asking Ranger District (or Forest) staff to provide the license plate numbers for their GSA vehicles. Vehicles that have been transferred to another Ranger District during the fiscal year will continue to show up on the list of the originating Ranger District until the next fiscal year.
- You might see a "region" listed in GSA files. Keep in mind that GSA Regions do not correlate with Forest Service Regions.

C. Other Mobile Sources

Forests will have limited data for the “other mobile sources” such as off-road vehicles that are not part of the WCF or GSA fleet (ATVs, snowmobiles, etc) and hand-held machines (chainsaws, lawnmowers, etc). Forests usually know the total number of vehicles that they operate for each major class of vehicle (ATV, tractors, snowmobiles). They might have actual mileage for some of the vehicles. Oftentimes, Forests can only provide their best guesstimate of the hours operated or amount of fuel used by each vehicle. Some Forests will be able to provide more precise data depending on the availability of detailed data and the quality of their recordkeeping.

- Many Forests use a large fuel tank commonly referred to in the agency as a “convault” to regularly supply fuel to these “other mobile sources.” This practice makes it impossible to accurately determine how much fuel is used in any given mobile source. However, obtaining records of the total fuel purchased for the convault can at least provide a ballpark sense of the amount of fuel likely used collectively by these smaller mobile sources. In some cases, the convault might occasionally be used to fuel on-road vehicles, which makes validation of your numbers ever more difficult or impossible.
- In some cases, the convault data might be your only source of reliable data to estimate emissions from “other mobile sources.” If so, you should only use this data if all or most of the vehicles or machines that used fuel from the convault have a common or similar emission factor (emit similar amounts of GHG per gallon of fuel). Ideally, you should consult with EPA Climate Leaders staff to determine whether such an approach would be reliable and sound.

VII. MISCELLANEOUS SOURCES

A. Refrigerant Use

Most refrigerants are used by our agency for air conditioning units, refrigerators, and freezers. Refrigerant data is not readily available. At best, Forests can provide the number of units (refrigerators, A/C units, etc) and sometimes repair data.

- R-22 is the refrigerant most commonly used in air conditioning units at Forest Service facilities. EPA Climate Leaders partners do not have to inventory R-22, which is currently being phased out because it is an ozone depleting substance.⁵ However, in the future, R-22 will be replaced with a refrigerant that has a much greater GHG impact and will therefore need to be carefully inventoried.
- Most of the fire extinguishers used by the Forest Service emit no greenhouse gases; however, there could be exceptions on some administrative units, such as research stations.

⁵ <http://www.epa.gov/ozone/title6/phaseout/22phaseout.html>

B. Employee Commuting

Employee commuting is an optional category under the EPA Climate Leaders program. We considered this category as more of a placeholder to further refine for future inventories than a reliable estimate of emissions. However, some interesting lessons emerged from attempting to tackle this category.

- Forests have no useful records for this category. Forest staff can, at best, guesstimate the number of miles each employee commutes to work. However, counts of permanent and seasonal employees are available.
- Be forewarned – ASC’s reporting of the total numbers of employees varied wildly from those reported by the Forests. In the end, we relied on the employee counts provided by the Forests.
- Segregate seasonal and permanent employees because seasonal employees often have substantially shorter commutes than permanent staff, especially if they live in government housing, which is at or close to their workplace.
- Consider inquiring about how many employees work a non-standard work week (e.g., 3-4 days a week) to determine whether you need to further segregate your commuting estimates into employee subcategories.
- Any employee survey would likely have privacy implications. You will need to obtain advance approval to survey employees. We did not conduct an employee survey and instead relied on Forest staff to provide us their best guesstimates of commute distances.

C. Business Air Travel

Business travel can include a variety of transportation modes taken by employees for official work travel, including commercial airplane, rental car, train, subway, taxi, personal vehicle, etc. For our inventory, we were only able to obtain data for commercial air travel. Therefore, all other travel modes were not inventoried. This category excludes travel in agency vehicles because that is captured by the mobile source category.

- The emission estimates for this category are very reliable with only minor caveats.
- At first, several agency contacts said that there were no easily accessible records or that the team would have to contact each traveler’s supervisor to obtain records. Ultimately, we discovered that there is no single “go-to” person, but the information is readily available if you manage to locate the right person. In our case, the following variety of contacts assisted us: Administrative Center for Excellence in R1, the Forest Engineer in R2, and several budget officers for R4.

- Some of the flight itineraries included cities that do not have airports. We were usually able to determine the source of the error and make corrections (e.g., a typo or the nearest major city, but not the airport city is listed).
- Most, but not all Forests, submitted their business air travel in the same format. A few itineraries only listed a destination city and no return city. In such a case, it was difficult to determine whether this was an error or the trip was indeed a one-way flight (versus roundtrip).

VIII. QUALITY ASSURANCE/QUALITY CONTROL

Establishing sound QA/QC procedures is essential to developing any inventory. For example, implement safeguards to protect data and establish protocols for naming files. Have those people who provided you with data to review your inventory for accuracy. Develop a review checklist for reviewers to fill out to confirm the accuracy and completeness of your inventory (see an example of a checklist in Appendix E of the report, “Greenhouse Gas Inventory for the National Forests in the Greater Yellowstone Area, April 2009”).

- Limit the number of people who can modify your data to only team members who are absolutely critical for accomplishing the work.
- Be vigilant about ensuring that you are using the latest version of any given file, especially as your team members create updated versions to core datasets.
- Establish a QA/QC system that the entire team can readily follow. Make it simple, efficient, and smart.
- Be aware and sensitive to team fatigue. When necessary and possible, have team members step away from the process for a few days or even a few weeks to recharge and return with a fresh set of eyes.

IX. SKILLS NEEDED TO DEVELOP A GHG INVENTORY

A team approach is most ideal for conducting a GHG inventory, especially one that is complex and large in scope or magnitude. Recruit people who are enthusiastic about the inventory or process and limit the actual data processing to only a few core people who you think would work well together.

- Ideally, you should have more than one person develop the inventory. A second or third set of eyes is critical to ensuring proper interpretation and processing of data. One person alone should not perform QA/QC checks. Also, the same person who processes the data should never QA/QC their own work. Of course, it is always good practice for a team member to regularly check their own work before passing it on to another person who will perform the QA/QC checks.

- Seek team members who are analytical, patient, excellent communicators, organized, and very detail oriented. These skills are absolutely critical.
- Be prepared to fine-tune your people skills. Recognize that some people respond to email better than voice messages and vice versa. You will also discover that the approach you use in requesting data can make or break the turn around time and even the level of interest. Be sensitive and aware that many of our fellow agency colleagues are under stress, less interested in your inventory than you, have other priorities, and might be on the edge of becoming testy if they receive another agency request for data. So, be sure you have the authority to request the data and be prepared to explain in a 15 second sound byte why you need the data.
- Team members must be well versed in Excel because they will need to create formulas for calculations, generate charts/tables, and analyze the data in multiple formats/scenarios.
- Depending on the format of the data, you might need someone who can manipulate data with Access database software.

X. PEOPLE TO INCLUDE IN YOUR PROCESS

At a minimum, you should include in your inventory process those key people from the administrative unit that you are inventorying (e.g., Ranger District, Forest, Washington Office, etc.). These personnel will vary depending on the scope of your inventory, the data sources used, staff availability, and employee interest. These contacts will be able to explain operational nuances, quickly notice any data aberrations, and provide review input on your final inventory.

- Consider inviting outsiders into your process, especially anyone who has conducted a GHG inventory. Although this can take more of your time, in the end, it can save you time. Third party participants or reviewers can help prevent team tunnel vision, promote broader scale problem solving, and offer novel approaches to challenging tasks.
- If your inventory is formally associated with the agency's efforts under the EPA Climate Leaders program, then be sure to work closely with EPA Climate Leaders staff and the contractor assigned to our agency.

XI. RECOMMENDATIONS FOR AGENCY-WIDE CONSIDERATION

Below are key recommendations to facilitate the development of future GHG inventories throughout the Forest Service. These recommendations are intended primarily for Forest Service national leadership. Although GHG reporting is not yet mandatory for federal agencies, these recommendations are presented with an eye toward future mandatory reporting requirements.

1. Assess the level of financial and staff resources needed to conduct an agency-wide GHG inventory pursuant to EPA Climate Leaders requirements.
2. Develop a national strategy establishing how GHG inventories will be used to reduce greenhouse gases in the short and long term. Issues that will need to be addressed as part of this strategy include, but are not limited to: (a) how to develop inventories that can best inform GHG reduction strategies while having minimum impact on staff; (b) what level of detail, accuracy, and completeness that is considered adequate for an inventory; (c) how often inventories will be conducted; (d) how GHG reporting should be integrated with other reporting requirements; (e) when and how the agency will balance inventory development and reduction strategies such that inventories are merely used to track progress; and (f) whether and how to track cost savings associated with GHG reduction efforts.
3. Establish the scope for future inventories (e.g., geographic scope, operational control, base year, etc) so that all administrative units approach GHG inventory work consistently. Provide guidance for the inclusion of land based carbon sinks and emission sources in future inventories (e.g., wildfires or forest sequestration).
4. Carefully evaluate a variety of emissions estimation software tools and determine which tool would be most appropriate for developing future inventories.
5. Determine how to integrate future GHG inventory work into the agency's Environmental Management Systems process as well as any other environmental reporting requirements (e.g., Executive Order 13423, Energy Independence and Security Act of 2007, etc). These multiple reporting requirements and efforts should be fully integrated across all levels of the agency so that reporting is kept to a minimum while still painting a comprehensive picture of our environmental footprint. GHGs are an important part of our footprint but they represent only one aspect of sustainability.
6. Evaluate how existing data reporting and storage systems can be improved to facilitate the development and quality of GHG inventories.
7. Determine how each Region classifies its WCF vehicles and consider a nationally standardized system.
8. Work with GSA to determine whether and how GSA data quality can be improved, especially better tracking each vehicle's mileage and identifying the Ranger District that each vehicle is assigned to.
9. To dramatically save time for future inventories, regional fleet managers should save annual EMIS reports at the end of each fiscal year. At a minimum, these reports should include annual mileage or the start and end odometer reading for each vehicle in one electronic file.
10. Each Region should consider storing all business air travel records in an easily accessible location.

LIST OF ACRONYMS

ASC	Albuquerque Service Center
ATV	All-terrain vehicles
Btu	British thermal unit
CH₄	Methane
CO₂	Carbon dioxide
e-GRID	Emissions & Generation Resource Integrated Database (EPA data program)
EMIS	Equipment Management Information System
EPA	United States Environmental Protection Agency
FOCUS	Software used by ASC to extract EMIS data
FY	Fiscal year
GHG	Greenhouse gas
GSA	General Services Administration
GYA	Greater Yellowstone Area
N₂O	Nitrous oxide
NFC	National Finance Center
NITC	National Information Technology Center
QA/QC	Quality Assurance/Quality Control
R1	Region 1 of the Forest Service
R2	Region 2 of the Forest Service
R-22	Refrigerant R-22
R4	Region 4 of the Forest Service
SO	Supervisor's Office
USDA	United States Department of Agriculture
WCF	Working Capital Fund