Is the Forest Service a Carbon Source or a Carbon Sink?

prepared by Josh Trapani, Policy Analysis

Summary—Heat, power, and motor vehicle usage by the Forest Service result in emissions of about 360,000 metric tons of carbon dioxide (units used throughout) each year. Understanding of the agency's operational footprint could be improved by enhanced data collection; data were not available for some operational categories, such as office supplies and aircraft use, which would increase the agency's footprint. The Forest Service's operational footprint is considerable, but small when compared to estimates of natural sequestration (about 150 million to 200 million metric tons) and fire emissions (likely about 47 million to 56 million tons, but possibly up to 125 million tons) on NFS lands. Considering all these factors, the Forest Service currently remains a carbon sink, but the balance could be tipped under altered fire/sequestration regimes.

Background—To determine whether the Forest Service constitutes a source or a sink for carbon, this analysis looks at emissions from agency operations (heat, power, and motor vehicle usage), and carbon flux on NFS lands (natural sequestration and emissions from fire).

- Operations: Reducing the agency's operational carbon footprint will be important in meeting the requirements of Executive Order 13423, reducing costs, and becoming more environmentally-friendly. Some important operational factors were not included in this analysis because data were not available. Where data were available, in many cases more detailed information would facilitate more precise assessment and identification of areas or operations where footprint can be most efficiently reduced.
- Sequestration, fire, and other factors: The agency's operational footprint, while considerable, is small compared to other factors on NFS lands. If these factors are included in an assessment of overall agency footprint, the balance between sequestration and fire emissions is key.

Natural Sequestration—Estimates of natural carbon sequestration on NFS lands vary between about 150 million and 200 million metric tons of carbon dioxide. For context, U.S. forestlands sequester an amount equivalent to about 10 percent of U.S. carbon dioxide emissions; NFS lands are responsible for between 20 to 35 percent of this sink. ***Note that 150 to 200 million tons is a net sequestration figure and incorporates fire emissions.***

Operations—Total Forest Service carbon footprint from heat, power, and motor vehicles was estimated at about 360,000 metric tons of carbon dioxide. For context, this is approximately equivalent to the annual electricity usage of 45,000 households.

- *Heat and Power*–An analysis by McNeil Technologies, Inc., based upon FY2003 data, found that Forest Service heat and power usage resulted in the emission of 276,000 metric tons of carbon dioxide, broken down as follows:
  - Electricity: 202,000 tons
  - Natural Gas: 22,000 tons
  - Propane: 36,000 tons
  - Fuel Oil: 14,000 tons
  - Coal: 2,500 tons
- *Motor vehicles*–Estimates of emissions associated with Forest Service motor vehicle usage, based upon the average between FY2005 and FY2006, were derived two ways: using miles driven and fuel usage. These two methods produced similar estimates of around 84,000 and 89,000 tons of carbon dioxide, respectively.

Other Operational Factors—Several potentially important sources of carbon emissions are not included in this analysis because data were not available. These include: office supplies;

emissions associated with contracted work, such as stewardship contracting and timber harvesting on NFS lands; aircraft use in firefighting; and airline travel for agency business.

Emissions from Fire—There are significant uncertainties associated with estimates of fire emissions. Wildfire emissions vary annually as well as by forest type and by fire intensity, and methods used to produce estimates may involve characterization of vegetation type, fuel loading, fire extent, fuel consumption, and emission rates.

- *Ground-based methods*: Two methods – one following IPCC protocols and one following EPA protocols – were used to estimate emissions.
    - Wildfire emissions: Estimates were made for emissions from the 10-year average of acres burned on NFS lands (1,033,646 acres) and for acres burned on NFS lands during the 2006 fire season (1,896,071 acres). For the 10-year average, the IPCC method estimated emissions of 33 million metric tons, and the EPA method estimated 54 million metric tons. For the 2006 fire season, the IPCC method estimated 60 million metric tons, and the EPA method estimated 100 million metric tons.
    - Prescribed fire emissions: Utilizing the IPCC and EPA methods lead to emissions estimates of around 22 and 36 million metric tons, respectively, for both the 10-year average of acres burned on NFS lands (1,090,937 acres) and for acres burned on NFS lands during the 2006 season (1,091,714 acres).
- *Satellite imagery*: MODIS (Moderate Resolution Imaging Spectroradiometer) satellite data may provide more accurate fire emissions estimates than ground-based methods. For 2006, MODIS data estimate emissions on NFS lands (1,270,000 acres affected) of between 47 and 56 million metric tons of carbon dioxide (wildfire and prescribed fire combined).

Fire Effects on Sequestration—Wildfires and prescribed fires have carbon effects beyond emissions during combustion. Both types of fire initially release carbon, typically from soil surface and understory vegetation pools. However, prescribed fire treatments typically result in increased productivity of remaining vegetation due to effects on soil temperature and nutrient and moisture availability, resulting in overall improvement in sequestration rates over time. The timing of these effects is influenced by fire intensity and frequency. Such treatments also result in a greater proportion of carbon ending up in longer labile pools, such as wood. In contrast, in high severity wildland fires, site productivity can be detrimentally impacted through removal of trees and other vegetation and loss of nutrients from the site through volatilization and erosion.

Other Factors—Other disturbances, such as drought, insects, and disease, will affect carbon storage on NFS lands. Data on current carbon effects from these factors were not available. This paper has also not considered emissions associated with use of our lands for recreation and other purposes; with more than 200 million visits annually, these are likely substantial.

Conclusions and Next Steps—This paper provides rough estimates of carbon sequestration and emissions on NFS lands. The Forest Service's operational footprint is substantial, and would likely be considerably larger if more detailed and complete data were available. Such data would also help point to places were the operational footprint could most easily be reduced. Though small relative to sequestration and fire emissions (Forest Service operations, as estimated here, are equivalent to emissions from an 8,000–10,000 acre wildfire), operations contribute fossil fuels to the atmosphere, where sequestration and fire draw from the natural pool of carbon. If sequestration and fire are included in analyses of whether the agency constitutes a source or sink for carbon, then these factors swamp the operational footprint. Connecting our actions to those of our users is an additional way to reduce the footprint associated with National Forests.