CARBON DAY Program Summary

Forest Inventory and Analysis (FIA) Program National Users Group Meeting

April 26, 2018

Albany, California
Credits:

Max Griffis, Henry Clepper Policy Intern at the Society of American Foresters during the summer of 2018, led the development of this booklet, including preparation of the presentation summaries. He was assisted by Dr. Richard Guldin, Senior Research Fellow, Society of American Foresters.

Mark Rosenberg, California Department of Forestry and Fire Protection (CAL FIRE), played a key role in building the agenda for the meeting and inviting local experts to share their science.

Alex Friend, Director of the USDA Forest Service, Pacific Southwest Research Station, hosted the meeting at Station Headquarters and A.J. Duggan, PSW’s Research Planning Director, provided much help on local arrangements, logistics, and security for the meeting.

SAF and NCASI are grateful for the help and support of these individuals because they were vital to making the meeting a success.

Cover Photo: Coastal Redwood Stand, Muir Woods National Monument, Mill Valley, California. Photo taken by DecadeDefector and downloaded under a Creative Commons CC0 license from https://pixabay.com/en/redwoods-muir-woods-forest-nature-14422141/.

Muir Woods National Monument was the site of a field trip on Tuesday morning, April 24, 2018.

Recommended Citation:

# Table of Contents

ABBREVIATIONS ...................................................................................................................................... iv
PREFACE ..................................................................................................................................................... v

## INTRODUCTION AND OVERVIEW
Introduction to Carbon Day
Linda Heath – USDA Forest Service, R&D, IMAR ................................................................................ 1
Overview of California’s Interest in Carbon
Mark Rosenberg – California Department of Forestry and Fire Protection ........................................ 1
Panel Discussion:  Shelby Livingston – California Air Resources Board; Matt Dias – California Board of Forestry; and Russ Henly –California Natural Resources Agency .................................................. 2
Greenhouse Gas Emissions and Removals on Forest Land of the United States
Grant Domke – USDA Forest Service, Northern Research Station .................................................. 3

## NATURAL AND WORKING LANDS INVENTORY
California Air Resources Board Natural and Working Lands Inventory Overview
Klaus Scott – California Air Resources Board ................................................................................. 4
California Forest and Rangeland Inventory Methods
John Battles – University of California, Berkeley ................................................................................. 4

## FOREST OFFSET PROTOCOL INVENTORY AND ACCOUNTING METHODS
California Air Resources Board Offset Protocol:  A Brief Introduction
Barbara Bamberger – California Air Resources Board (CARB) ........................................................ 5
FIA/ARB/CAR Baseline for Offset Protocol
Olaf Kuegler – USDA Forest Service, Pacific Northwest Research Station ........................................ 6
Case Study:  Objective Forest Type Assessment for Carbon Baseline Modeling
Zack Parisa – SilvaTerra ....................................................................................................................... 6

## CAL FIRE, NFS, NGHG INVENTORY METHODS
Introducing the California Forest Ecosystem and Harvested Wood Products Carbon Inventory
Nadia Tase – California Department of Forestry and Fire Protection .................................................. 6
California Forest Ecosystem Carbon Inventory:  2006-2015
Glenn Christensen – USDA Forest Service, Pacific Northwest Research Station ................................ 7
California Timber Products Output and Harvested Wood Products Carbon Inventory
Dan Loeffler and Todd Morgan – Univ. of Montana, Bureau of Business and Economics Research.. 7
Uncertainty in Aboveground Biomass Estimates Derived from Small-Footprint Airborne LIDAR
Qing Xu – University of Nevada, Reno .................................................................................................. 8
Estimating Soil Organic Carbon from Forests
Grant Domke – USDA Forest Service, Northern Research Station FIA ............................................. 8

## PROJECTIONS AND ASSESSMENT TOOLS
RPA Assessment Projections and Methods
John Coulston – USDA Forest Service, Southern Research Station .................................................. 9
California Energy Commission Sponsored BIOSUM Project:  The Ever Evolving Policy Angles
Bill Stewart – University of California, Berkeley, Jeremy Fried -USDA Forest Service, Pacific Northwest Research Station, and Carlin Starrs – University of California, Berkeley ........................................ 9

## APPENDIX A
APPENDIX A – Attendees ......................................................................................................................... 11
ABBREVIATIONS

CARB  California Air Resources Board
CABOF  California Board of Forestry
CAL FIRE  California Department of Forestry and Fire Protection
CNRA  California Natural Resources Agency
FIA  Forest Inventory and Analysis
FS  U.S. Department of Agriculture, Forest Service
FVS  Forest Vegetation Simulator Model
GHG  Greenhouse Gas
ICE  Image-based Change Estimation
IMAR  Inventory, Monitoring, and Assessment Research Staff, FS headquarters, R&D mission area
LIDAR  Light Detection and Ranging, most often using pulsating light beams of an oscillating laser
NASF  National Association of State Foresters
NCASI  National Council on Air and Stream Improvement
NJFS  New Jersey Forest Service
NRS  Northern Research Station, U.S. Department of Agriculture, Forest Service
ORNL  Oak Ridge National Laboratory, U.S. Department of Energy
PNW  Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service
PSW  Pacific Southwest Research Station, U.S. Department of Agriculture, Forest Service
RMRS  Rocky Mountain Research Station, U.S. Department of Agriculture, Forest Service
SAF  Society of American Foresters
SRS  Southern Research Station, U.S. Department of Agriculture, Forest Service
TPO  Timber Products Output component of the FIA program
TX A&M  Texas A&M Forest Service
UCB  University of California at Berkeley
UMN  University of Minnesota
UMT BBER  University of Montana, Bureau of Business and Economic Research
UNR  University of Nevada at Reno
WI DNR  Wisconsin Department of Natural Resources
WO  Washington Office, U.S. Department of Agriculture, Forest Service
PREFACE

The Society of American Foresters (SAF) and the National Council on Air and Stream Improvement (NCASI) have jointly organized and convened an annual meeting of users for data generated by the Forest Inventory and Analysis (FIA) program for nearly two decades. The annual meetings have provided many opportunities for users to share with each other how they are using FIA data in their programs and management activities. These meetings have also given FIA national program leaders, station program managers, and researchers opportunities to share their accomplishments and advances for the preceding year with the user community and discuss some of their plans for making further program adjustments.

Users have used several mechanisms over the years to provide feedback to the Forest Service on FIA program performance and outline users’ evolving suite of information needs. In 1992, the Forest Service, in partnership with the National Association of State Foresters and the Forest Biometrics Working Group of NCASI, convened the First Blue Ribbon Commission on the FIA program to hear users’ views. A Second Blue Ribbon Commission was convened in 1997 and issued its report in 1998. Recommendations in this report were transformed into legislative authority and direction in the Agricultural Research, Extension, and Education Reform Act of 1998 (Public Law 105–185), also known as the 1998 Farm Bill. That bill directed the agency to prepare a strategic plan for the FIA program that laid out the programmatic changes needed, implementation schedules for making the changes, and estimates of the costs. The strategic plan for 1999-2003 was heavily influenced by the commission’s report and user feedback. As annual appropriations bills provided increased funding, the FIA program leaders provided accountability and transparency in two ways. First, the program began issuing annual business summaries; the first in 2000. Each summary reviewed progress made in the past fiscal year, partner contributions, and income and expenditure summaries. Second, as the Forest Biometrics Working Group and other users gathered annually to review FIA program reports, Forest Service FIA program leaders began attending to provide oral summaries of accomplishments and plans, answer questions, and hear user feedback.

In recent years, the FIA National Users Group meeting has added a third day of presentations and discussions to give special emphasis to a particular topic or issue. Forest carbon was the special focus for the 2018 meeting. This report summarizes the presentations made on “Carbon Day.”

A companion report is available that covers presentation on the 1.5 day FIA National Users Group Meeting.

Interested readers can access all the individual presentations at http://www.ncasi.org.

SAF and NCASI look forward to continuing their partnership in organizing and convening annual users group meetings to discuss how FIA data are being used to improve management of the nation’s forests.

John Barnwell, Director of Government Relations and External Affairs, SAF
Richard W. Guldin, Senior Research Fellow, SAF
Stephen Prisley, Biometrician and Economist, NCASI
Introduction to Carbon Day

Linda Heath – USDA Forest Service, R&D, IMAR

Forest Inventory & Analysis (FIA) program survey data are the “gold standard” for forest carbon estimates for the United States. For almost 25 years, FIA-based carbon estimates and expertise have held as the benchmarks while continuing to improve, and confidence in the estimates endures and grows. The data have been the basis of operational reporting, from the very first U.S. national forest greenhouse gas inventories reported in response to the requirements of the United Nations Framework Convention on Climate Change in the mid-1990s, to forest carbon entity 1605b voluntary reporting for U.S. Department of Energy, to Montreal Process Criteria and Indicators of sustainability in the National Report on Sustainable Forests. And, these carbon estimates are the “gold standard” for cutting-edge research studies. The fact that FIA data support estimates for a multitude of forest characteristics makes the estimates consistent with other resource areas, such as timber volumes or biomass. The estimates can be associated with ownership, which is often an important consideration.

We are here because California Department of Forestry and Fire Protection (CAL FIRE) was keenly interested in partnering with FIA to hold this Carbon Day to discuss the variety of data, tools, methods, and frameworks available and used for forest carbon accounting, at the national, regional, state, and sub-state levels. Users’ of FIA data are especially interested in this topic in this part of the U.S. because California’s AB 1504 legislation mandates annual carbon inventory reports and requires development of methods to assess if forest sector activity meets current greenhouse gas reduction requirements. The science is complex, and it can be difficult for end users to know which approaches best suits their needs—although all eyes continue to focus on FIA-based estimates and expertise. Today will be a forum for scientists, land managers, and policymakers to think about applicability of different tools for specific needs. We will also be identifying gaps or limitations in the available tools and data to address in the future.

Introduction and Overview

Mark Rosenberg – CAL FIRE

The Little Hoover Commission is California’s independent state oversight agency. In February 2018, the commission issued Special Report #242, “Fire on the Mountain: Rethinking Forest Management in the Sierra Nevada.” In this report, the Commission calls for transformational
culture change in California’s forest management practices. In December 2017, the USDA Forest Service reported that approximately 27 million trees had died statewide on federal, state, and private lands since November 2016. The tally brought to 129 million the number of trees that have died in California forests during years of drought and bark beetle infestations since 2010.

During its review, the Commission found that California’s forests suffer from neglect and mismanagement, resulting in overcrowding that leaves them susceptible to disease, insects, and wildfire. The Commission found commitment to long-lasting forest management changes at the highest levels of government, but that support for those changes needs to spread down not just through the state’s massive bureaucracy and law- and policymaking apparatuses, but among the public as well. Complicating the management problem is the fact that the State of California owns very few of the forests within its borders. Most of California’s forests are owned by the federal government or private landowners.

The report made recommendations to the Governor covering 9 critical areas. It urged the state to take a greater leadership role in collaborative forest management planning at the watershed level. The Good Neighbor Authority granted in the 2014 Farm Bill provides a mechanism for the state to conduct restoration activities on federal land, but state agencies must have the financial and personnel resources to perform this work. As part of this collaborative effort, it called upon the state to use more prescribed fire to reinvigorate forests, inhibit firestorms and help protect air and water quality. Central to these efforts must be a statewide public education campaign to help Californians understand why healthy forests matter to them and elicit buy-in for the much-needed forest treatments.

In his 2018 “State of the State” speech, Governor Jerry Brown called for a task force of scientists and forest management experts to find ways to reduce the wildfire threat in California. "We have to be ready with the necessary fire-fighting capability and the communication systems to warn residents of impending danger. We also have to manage our forests and our soils much more intelligently."

**Panel Discussion**

**Shelby Livingston - CARB, Matt Dias - CABOF, and Russ Henly - CNRA**

The Little Hoover Commission, the California Forest Carbon Plan, and Assembly Bill 32 Scoping all call for increasing the pace and scale of forest management, prescribed fire, and other activities that improve forest resiliency in the face of climate change. Mark Rosenberg asked three panelists—Shelby Livingston (CARB), Matt Dias (California Board of Forestry), and Russ Henly (California Natural Resources Agency)—to discuss the following four questions:
1. What data and metrics are needed to prioritize locations to implement projects?
2. How much area do we need to work and what are the major challenges?
3. What are the risks and rewards to increasing the pace and scale of forest treatments?
4. How do we measure progress towards improved outcomes? How do we know if we’ve gone too far?

The panelists discussed the questions.

**Greenhouse Gas Emissions and Removals on Forest Land in the United States**

*Grant Domke – NRS*

The FIA program provides annual estimates of forest ecosystem carbon sinks and emissions by land use categories: forests that remain forests; land converted to forest from another use; forests converted to another land use; and harvested wood products. Carbon stocks are estimated annually for each of these land use categories and carbon stock changes are estimated by comparing the figures for the current year with figures for the previous year. Estimates are separately developed for each region or State.

Forest carbon stocks are also estimated by pools, such as aboveground and belowground biomass, deadwood, litter, and soils. Stock changes are also estimated for each pool. Carbon emissions from forest fires are a hot issue right now, with so many fires burning. Harvested wood products carbon stocks are estimated using the Woodcarb II model, developed in 2008 by Ken Skog, which is a module of the U.S. Forest Products Model, developed by Peter Ince and others in 2011. The presentation graphics show changes in each of these pools over time.

Several improvements in the estimation procedures are planned for the coming years. These include new carbon pools, such as understory versus overstory trees, woodland carbon stocks (until now counted under the Grasslands land use), and refinements associated with land use changes.

FIA data remains the foundation for U.S. greenhouse gas reporting. We are aware of the growing need for finer resolution in the information reported on emissions from fires and removals. Partnerships with other scientists have been very important to the current capabilities of the FIA program and further collaboration is essential for making the improvements identified.
Natural and Working Lands Inventory

California Air Resources Board (CARB) Natural and Working Lands Inventory
Klaus Scott – CARB

The Global Warming Solutions Act of 2006 (Assembly Bill 32, Nunez, Statutes of 2006, Chapter 488) requires the California Air Resources Board (CARB) to determine a statewide greenhouse gas emissions limit to be achieved by 2020. In January 2007, Assembly Bill 1803 conferred responsibility to CARB for developing and maintaining a statewide greenhouse gas inventory, including the transportation, industrial, electricity generation, commercial, residential, agricultural and forest sectors. In response, CARB, in consultation with state agency and academic partners, has been developing sources and methods for generating spatially and temporally explicit estimates of ecosystem carbon stocks and stock change on forests, grasslands, shrub lands, wetlands, and other lands across the state. Sources include tabular and geospatial datasets, including FIA plot data, reference data from literature, and LANDFIRE products.

In his 2015 State of the State address, Governor Brown established 2030 targets for further GHG reductions and called for policies and actions to foster carbon storage and to reduce GHG emissions from natural and working lands, including forests, rangelands, farms, wetlands, and soils. The passage of Senate Bill 1386 (Wolk, Chapter 535, Statutes of 2015-16) codifies this policy and emphasizes the important role natural and working lands play in the State’s climate strategy. CARB’s land carbon and GHG inventory efforts are designed to help support the state’s land-based strategies.

California Forest and Rangeland GHG Inventory Methods
John Battles – UCB, and Klaus Scott - CARB

Collaborators included Patrick Gonzales, David Saah, David Bell, and Robert Kennedy

The data we need present the challenge of scale. The models we use present the challenge of validity. Remote sensing imagery presents the challenge of interpretability. We follow some basic design principles for our analyses:

- Inventories are based on data-driven estimates of carbon stocks, emphasizing live vegetation, use defensible protocols, and follow IPCC guidelines
- Changes are measured with reliable biophysical methods
- Scale: temporally, hopefully less than a decade; spatially, at least state-wide, hopefully smaller.

We’ve tested imagery from the MODIS sensor (250 m), LANDSAT (30 m), and QuickBird (0.6 m). We use the LANDFIRE model to make some of our estimates, by vegetation type class.
Examples of analytical outputs were shown. Two other presentations are included in the slide deck. The first, by Bell, Gregory, and Roberts, shows forest biomass imputation, using FIA data and LandTrendr. The second, by Huang and 9 others, is a case study of county-scale biomass mapping for Sonoma county. It shows how LIDAR and FIA data can be integrated.

**Forest Offset Protocol Inventory and Accounting Methods**

*California Cap and Trade Program: The Role of Carbon Offsets in California*

Barbara Bamberger – CARB

California’s Compliance Offset Protocol for U.S. Forests was introduced, along with information about trends in participation amongst forest landowners throughout the United States. Many types of landowners are participating, including small private landowners and land trusts, Tribal Governments, Alaska Native Corporations, universities, ministries, hunting clubs, and botanical gardens. Forest landowners participate in the California Cap and Trade Program by developing a forest offset project that complies with all requirements as set forth within the Compliance Offset Protocol – U.S. Forests. The project is then reviewed and verified by a third-party verification body accredited by the Air Resources Board. Assembly Bill 32, the California Global Warming Solutions Act, was passed by California’s legislature in 2006. It required the State to reduce its GHG emissions to 1990 levels by 2020. Toward this effort, CARB was tasked with adopting regulations to achieve this requirement and to do so in a manner that was technologically feasible and cost-effective. CARB developed a plan that included a suite of GHG emission reduction measures. One of the primary measures—and the topic of the presentation to the FIA National User Group—is the California Cap and Trade Program and its forest offsets program within it. In 2016 the legislature extended California’s GHG reduction targets, with a 2030 interim goal of 40% below 1990 levels by 2030; and a bill was passed last year that supports CARB to continue to use the Cap-and-Trade Program to achieve post-2020 emissions reductions goals. Graphics in the slide deck depict California’s 1990 level greenhouse gas emissions and emission reduction targets. Trend graphs show that CARB is on track to meet the 2020 target. California emitted 431 million metric tons of carbon dioxide equivalent in 1990; and that is our 2020 target. Another chart showed where projects were located and the number of credits that have been issued to forest project operators. 80 million forest offset projects have been issued to date. For more information, please contact the presenter or Greg Mayeur, Offsets Manager, at CARB.
**FIA/ARB/CAR Baseline for Offset Protocol**

**Olaf Kuegler – PNW**

The PNW-FIA unit started work with the Climate Action Research (CAR) in 2006. CAR had developed a *voluntary* protocol and chose to work with FIA data because it was objective, unbiased, standardized, and widely available. Originally collaboration was limited to California, Oregon, and Washington, but has since been expanded to the lower 48 states. Some offset project types were identified, followed by a detailed example of one project type—improved forest management. FIA data are used to define the “common practice” statistics for forest types across the lower 48.

**Case Study – Objective Forest Type Assessment for Carbon Baseline Setting Using CARB Protocol**

**Zack Parisa – SilvaTerra**

Assessing objective forest type (defined by species present in the forest) is important to set a carbon baseline because identifying carbon baseline helps one identify how to identify creditable carbon stock. To determine possible forest types, one can choose from different stratification methods to help them derive the data that they need. This is an objective and reproducible process. After the forest type data are determined, an accuracy assessment can be carried out to determine if the data are acceptable.

Utilizing FIA data to understand objective forest type will allow forest managers a way to derive more specific data concerning carbon stock as well as species composition. As FIA data’s use is expanded, its value will ultimately increase, providing incentive to increase its quality. Understanding carbon stocks at a more focused level is very important for the field of forestry. The quality of data concerning carbon in forests can be handily improved by this modeling method.

**CAL FIRE, NFS, NGHGI Inventory Methods**

**Introducing the California Forest Ecosystem and Harvested Wood Products Carbon Inventory (AB 1504)**

**Nadia Tase, CAL FIRE**

This presentation provided California forest carbon policy context for the following two presentations on the forest ecosystem and the harvested wood product portions of the California Assembly Bill 1504 carbon inventory by Christensen and Tase (see http://bof.fire.ca.gov/board_committees/ab_1504_process/ab_1504_presentations/final_1504)
A variety of legislation exists in California requiring greenhouse gas emissions reductions overall, as well as specific contributions to carbon sequestration by forests. The FIA program provides a robust, repeatable, ground-based, direct-measurement approach to evaluate and monitor progress on California’s forest carbon sequestration goals. Through an agreement with the USDA Forest Service Pacific Northwest Research Station, the California Board of Forestry and Fire Protection, and the California Department of Forestry and Fire Protection, the first full AB 1504 Forest Ecosystem and Harvested Wood Product Carbon Inventory and associated erratum using 2015 FIA data and a 2016 FIA data update and summary were completed. Finally, the 2017 full inventory will be completed in late 2018 and through an additional agreement with the University of Montana-Bureau of Business and Economic Research, the harvested wood product portion of the inventory will be included for the first time.

**California Forest Ecosystem Carbon Inventory 2006-2015**

**Glenn Christensen – PNW**

Collaborators include Andy Gray and Olaf Kuegler from PNW-FIA and Nadia Tase and Mark Rosenberg from CAL FIRE.

The PNW-FIA unit has completed an analysis establishing an initial baseline of carbon stock estimates in support of the AB 1504 legislation. California had been waiting until PNW-FIA had measured 50 percent of the California plots in 2015 to move this work forward. Fresh national Growth-Removal-Mortality analyses had also been completed. Details were presented about data sources and types of pools estimated. For example, two-thirds of California’s forest carbon stocks are found on public forests, and of that total, 80 percent is on national forests. The remaining third of the forest carbon is on corporate forests (16 percent) or non-corporate forests (18 percent).

**California TPO and Harvested Wood Products Carbon Inventory**

**Dan Loeffler and Todd Morgan – UMT BBER**

Timber Products Output (TPO) data were used to estimate the quantity of carbon stored in harvested wood products (HWP) from California forests. The HWP carbon project is part of a larger forest carbon analysis that PNW-FIA is conducting for CalFire.

An overview of the methods and results was presented. TPO mill surveys and logging utilization studies in California provide timber and primary wood product data used in the HWP carbon model. The model outputs are consistent with requirements in the U.S.A. reports to the Intergovernmental Panel on Climate Change (IPCC).
The presentation helped demonstrate the value of FIA-TPO data in producing consistent and reliable estimates of carbon stored in harvested wood products, which is an often ignored or overlooked component of forest carbon accounting that can impact social recognition and policy decisions related to forest management, timber harvest, wood products industries, and associated state/local economies.

**Uncertainty in Aboveground Biomass Estimates Derived from Small-Footprint Airborne LiDAR**

Qing Xu – UNR

To address uncertainty in biomass estimates across spatial scales, we determined aboveground biomass (AGB) in California using individual tree detection methods applied to small-footprint airborne LiDAR. We propagated errors originating from a generalized allometric equation, LiDAR measurements, and individual tree detection algorithms to AGB estimates at the tree and plot levels. Larger uncertainties than previously reported at both tree and plot levels were found when AGB was derived from remote sensing. On average, per-tree AGB error was 135% of the estimated AGB, and per-plot error was 214% of the estimated AGB. We found that from tree to plot level, the allometric equation constituted the largest proportion of the total AGB uncertainty. The proportion of the uncertainty associated with remote sensing errors was larger in lower AGB forests, and it decreased as AGB increased. The framework in which we performed the error propagation analysis can be used to address AGB uncertainties in other ecosystems and can be integrated with other analytical techniques.

**Soil Carbon on Forest Land in the United States**

Grant Domke – NRS

Carbon in forest soils influences biological, chemical, and physical soil functions. The soils on forest lands also store large amounts of carbon, meaning that the carbon is not emitted into the atmosphere. The contribution of soil carbon in forests has been grossly underestimated in recent national inventory reports in the US. New predictions represent an estimated 40 percent increase in carbon stocks relative to previous estimates. There is also great potential for continued carbon accumulation in soils on reforested land.

Understanding carbon stocks in forest soils is essential to recognize how to better utilize forest landscapes for carbon storage. With accelerating changes in climate conditions around the world that are spurred by increased atmospheric carbon, understanding how to manage carbon is very necessary. FIA data are increasing in versatility. If it can be better used to understand carbon stocks on forest landscapes, it will gain utility. Highlighting that methods to measure
carbon stocks have a large amount of room for improvement is essential to tackle revisions needed in the FIA Program.

**Projections and Assessment Tools**

**RPA Forest Dynamics Projection Methods**

**John Coulston and David Wear – SRS**

The Forest and Rangeland Renewable Resources Planning Act of 1974 mandates a national report on the conditions and trends of renewable resources on all forest and rangelands every ten years. This national report is the Resources Planning Act (RPA) Assessment. The RPA Assessment of 2020 is in progress. Criteria that are used to predict trends to create this assessment include identifying a reasonable range of plausible futures addressing connections among drivers of change and natural resources and a consistent climate/socioeconomic perspective. Climate scenarios in the 2020 RPA are linked to the International Panel on Climate Change’s (IPCC) fifth assessment. The socioeconomic scenarios in the 2020 RPA are developed parallel to the IPCC. New models are being developed to improve sampling for the RPA and this model has an influence on policy as well.

The RPA assessment is important to understand the drivers of change and trends that pertain to forest and rangeland conditions. Improving sampling for the RPA Assessment means improving FIA sampling since FIA is one of the main contributors of data to the assessment. As land managers better understand how to identify trends and the drivers of change on forest lands, lands can be viewed in a clearer manner due to improved data. This will give land managers more insight in planning and active management of forests and rangelands.

**California Energy Commission Sponsored BIOSUM Project: The Ever Evolving Policy Angles**

**Bill Stewart – UCB, Jeremy Fried – PNW, and Carlin Starrs – UCB**

The project goal of the California Energy Commission is developing sustainable feedstocks for low carbon transportation fuels while ensuring the continued role of California’s forests as a significant carbon sink. In using BIOSUM outputs, the commission sought to improve net growth, generate adequate supplies and flows of wood products, and generate cash flow to reinvest in reducing risks to California’s forests.

The BIOSUM model (Bioregional Inventory Originated Simulation Under Management) is a simulation-based analytical application that uses FIA data to predict and summarize consequences of forest management strategies over large landscapes. Management strategies
can be multi-objective, vary among owner groups, evolve over time, and be contingent on targeted sets of specific site and vegetation attributes. BIOSUM tracks harvest and transportation costs based on tree lists, site condition analysis provided by the FIA Program as well as transportation network data.

BIOSUM output can be used to evaluate a variety of policy relevant questions, such as:

- cost and effectiveness of forest health restoration
- potentially sustainable yields of timber and feedstocks for wood biomass energy generation
- most promising locations for building biomass energy facilities
- cost effectiveness of alternative fuel treatments
- implications of stand density and surface fuels management for forest carbon dynamics.
APPENDIX A
ATTENDEES

Tim Adams, SC Forestry Comm.
Barbara Bamberger, CARB
John Barnwell, SAF
John Battles, Univ. California, Berkeley
Jerry Bird, FS Region 5
Jeff Bradley, AF&PA
Dave Bruton, Kansas FS
Glenn Christensen, FS-PNW-FIA
John Coulston, FS-SRS
Grant Domke, FS-NRS-FIA
Alexa Dugan, FS-S&PF-NA
James Ellenwood, FS-R&D-IMAR
Helge Eng, Cal Fire
Jeremy Fried, FS-PNW-FIA
Casey Ghilardi, PotlatchDeltic
Andrew Gray, FS-PNW-FIA
Rich Guldin, SAF
Sean Healey, FS-RMRS-FIA
Linda Heath, FS-R&D-IMAR
Russell Henly, CNRA
Dennis Kepler, MN DNR
Alex Kretchun, Portland State Univ.

Olaf Kuegler, FS-PNW-FIA
Shelby Livingston, CARM
Dan Loeffler, Univ. Montana
Dennis May, FS-NRS-FIA
Duncan McKinley, FS-Policy Analysis
Kevin Megown, FS-RMRS-FIA
Megan Miranda, CARB
Adam Moreno, CARB
Rachel Neuenfeldt, FS-S&PF-NA
Lynette Niebruggen, Marin County
Zack Parisa, SilvaTerra
Esther Parish, ORNL
Ben Parkhurst, Bluesource
Christie Pollet-Young, SCS Global Services
Steve Prisley, NCASI
Greg Reams, FS-R&D-IMAR
Don Roach, North Carolina FS
Mark Rosenberg, CAL FIRE
Klaus Scott, CARB
Dan Siemann, WA DNR
Sharon Stanton, FS-PNW-FIA
Richard Standiford, Univ. California, Berkeley
Carlin Starrings, Univ. California, Berkeley
Bill Stewart, Univ. California, Berkeley
Aaron Stottlemeyer, TX A&M FS
Nadia Tase, CARB
Marcus Taylor, FS Region 5
Matthew Vandervande, FS Region 5
Kayanna Warren, FS Region 5
Jim Westfall, FS-NRS-FIA
Brian Wharton, Mississippi Forest Commission
Sherri Wormstead, FS-S&PF-NA
Qing Xu, Univ. of Nevada, Reno
Andrew Yost, Oregon Dept. Forestry
Alex Yui, CARB
Rebekah Zehnder, TX A&M FS
William Zipse, NJFS