FOREST SERVICE AND CARBON

NFS, OFFICE OF SUSTAINABILITY AND CLIMATE

DUNCAN MCKINLEY, AURORA CUTLER, LAUREN ONOFRIO, BEN SODERQUIST, AND JACOB DEAL

R&D, ROCKY MOUNTAIN RESEARCH STATION

SEAN HEALEY

INTRODUCTORY REMARKS

Jamie Barbour

Acting Director

Office of Sustainability and Climate

Linda Heath

Director

Inventory, Monitoring & Assessment Research

SPEAKER

Duncan McKinley

Natural Resource Specialist

Office of Sustainability and Climate

OUTLINE

- What's the interest in forest carbon?
- "Carbon System" and key concepts
- Rangeland carbon
- Forest Service experience and policy
- How carbon is estimated
- How the Forest Service influences carbon through vegetation management
- How we deliver science for decision making
- Energy development on NFS lands
- Sustainable operations – your role
- How we can help you

SPEAKER

Ben Soderquist

ORISE Fellow

Office of Sustainability and Climate

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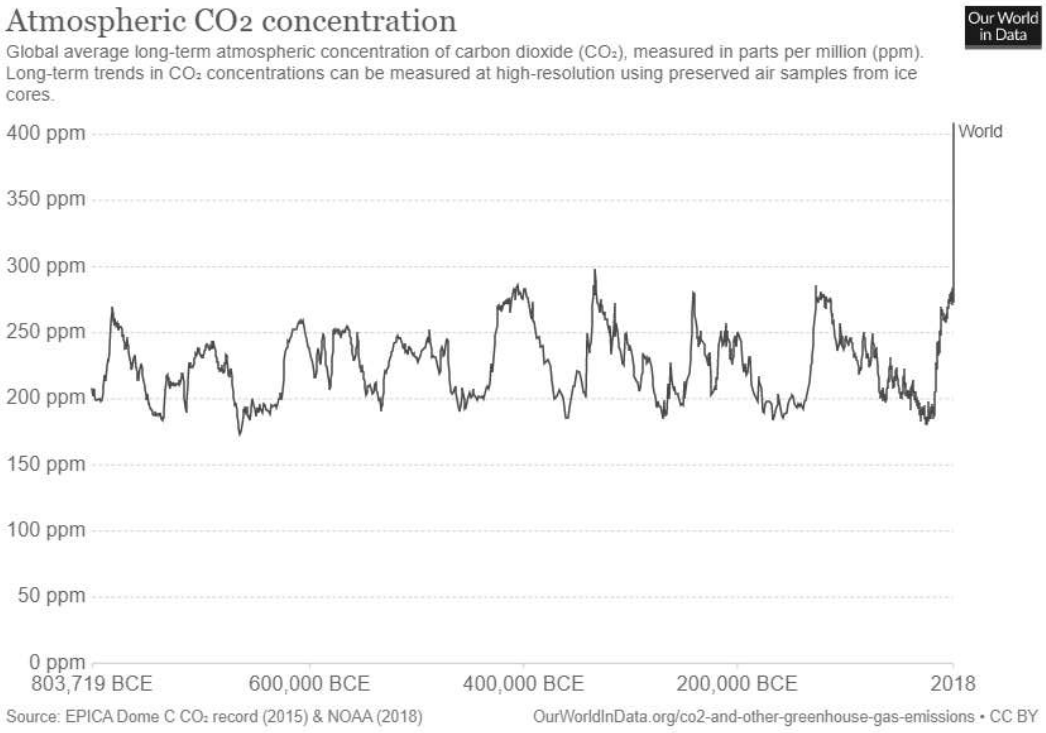
WHY IS THE PUBLIC INTERESTED?

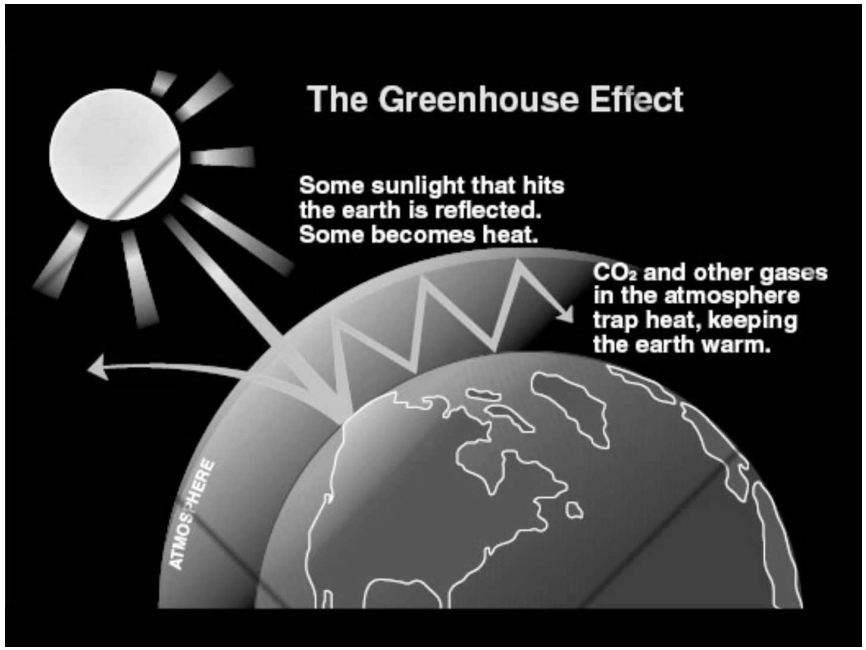
1. Concerned about carbon emissions and effects on climate
2. Interest in using management to sequester carbon (i.e. Mitigation) and reduce carbon loss where appropriate (i.e. Adaptation)

- ***Further reading:***
  - *Issues in Ecology* – Ryan et al. 2010 ESA synthesis for policy and managers (available:www.esa.org/science_resources/issues.php)
  - McKinley, Duncan C.; Ryan, Michael G.; Birdsey, Richard A.; Giardina, Christian P.; Harmon, Mark E.; Heath, Linda S.; Houghton, Richard A.; Jackson, Robert B.; Morrison, James F.; Murray, Brian C.; Pataki, Diane E.; Skog, Kenneth E. 2011. A synthesis of current knowledge on forests and carbon storage in the United States. Ecological Applications. 21(6): 1902-1924.

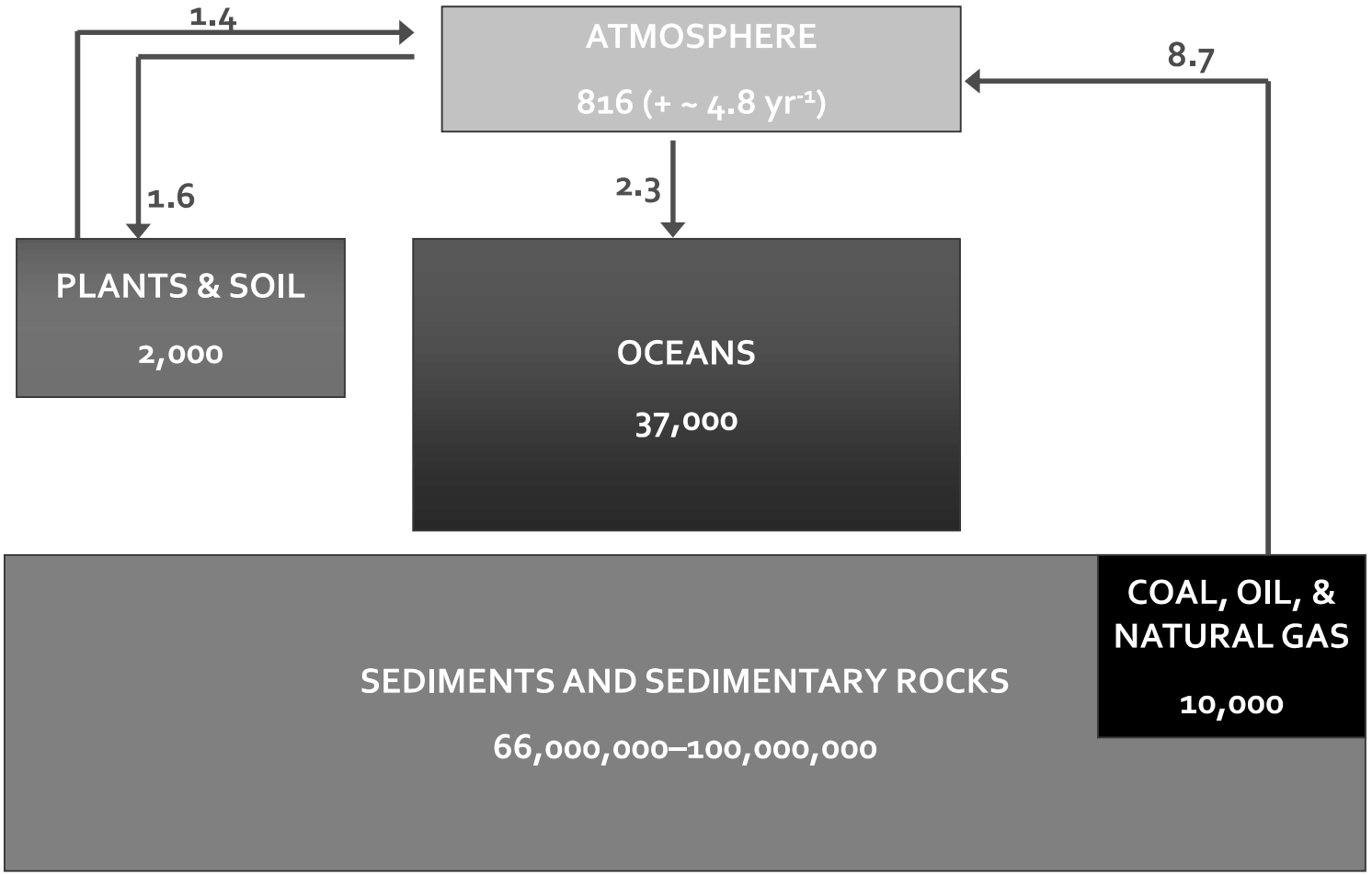
CARBON 101

HOW GREENHOUSE GASES ACT IN THE ATMOSPHERE



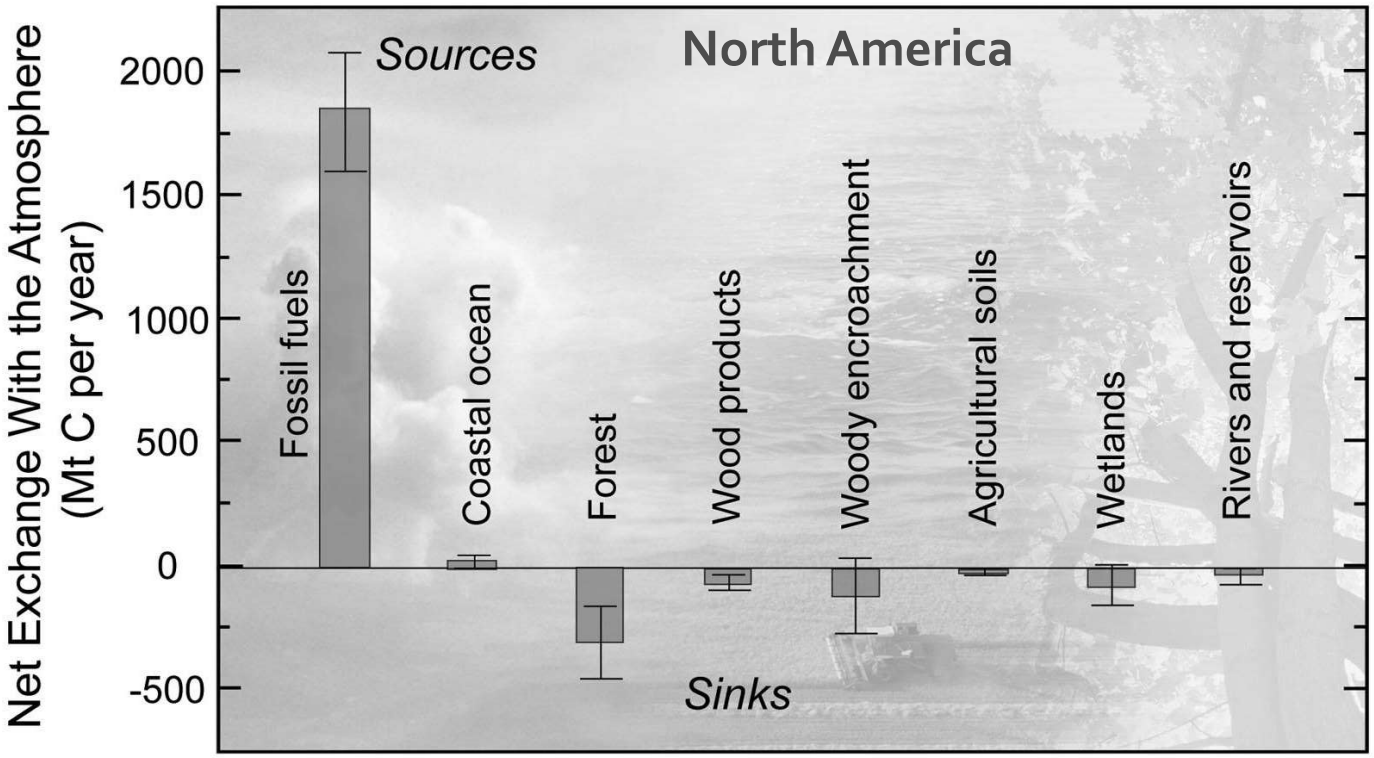


GLOBAL STOCKS AND FLOWS OF CARBON



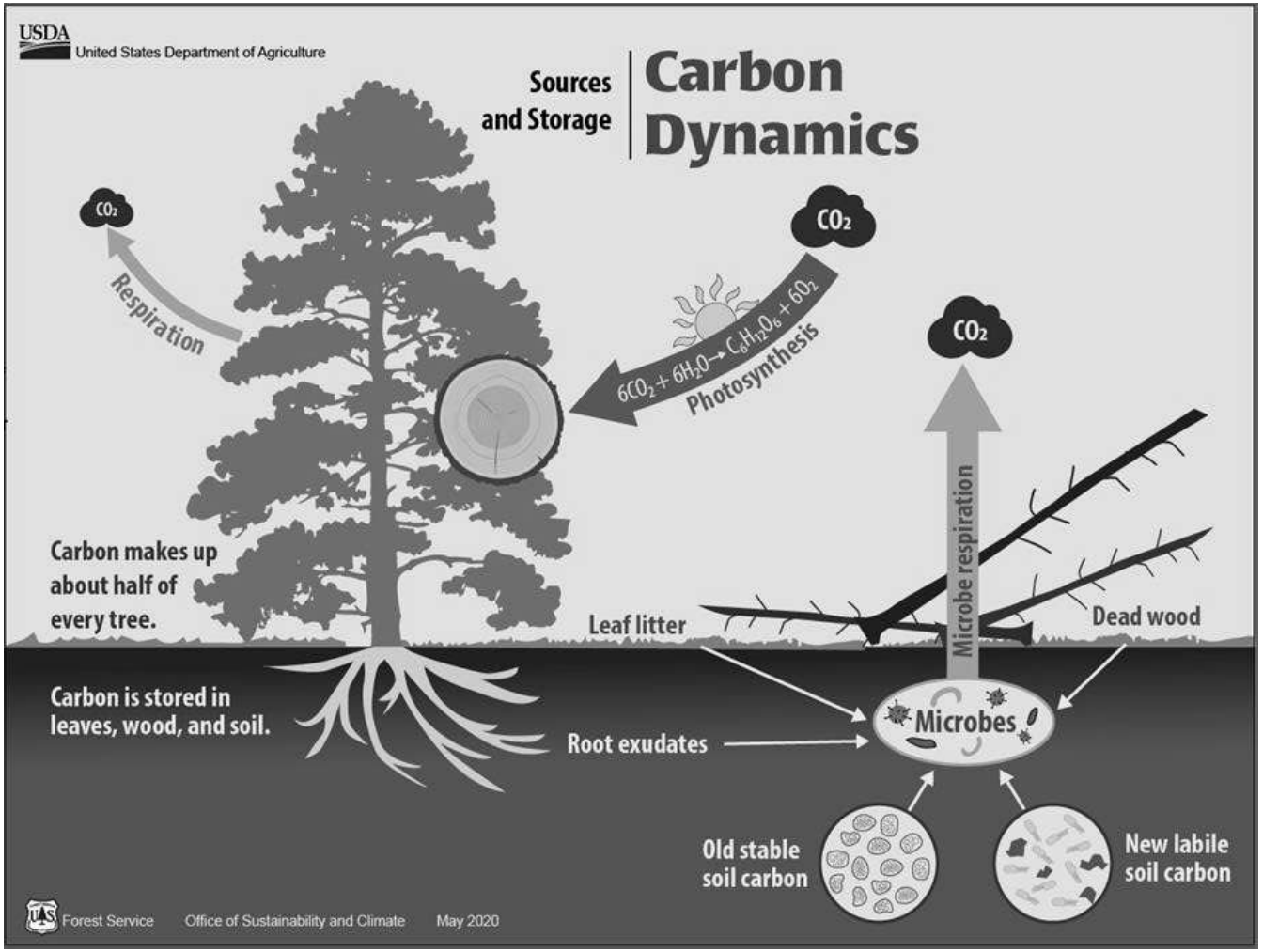
McKinley et al. 2011

U.S. FORESTS AND WOOD PRODUCTS CARBON SINKS ARE EQUIVALENT TO 12%–19% OF U.S. FOSSIL-FUEL EMISSIONS



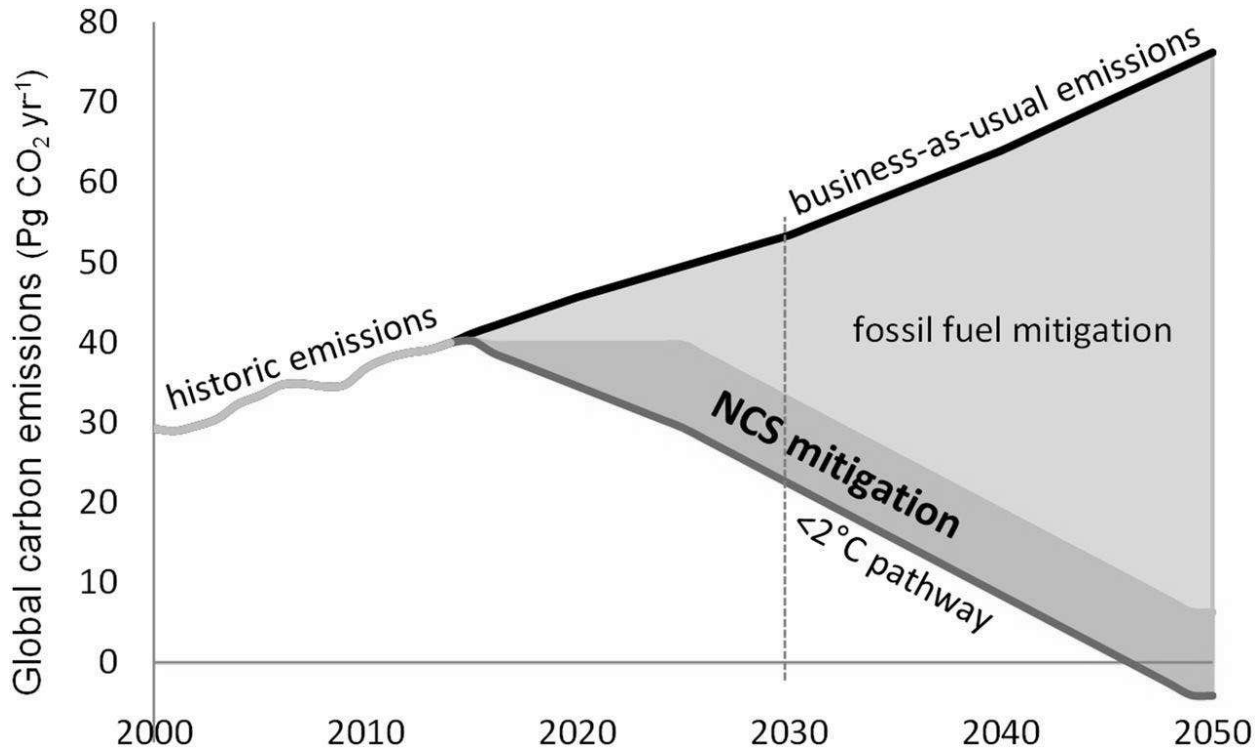
CCSP, 2007. *The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle*.

From SOCCR Report: http://www.climatescience.gov


USDA
United States Department of Agriculture
Sources and Storage
Carbon Dynamics
CO_2
Respiration
CO_2
$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
Photosynthesis
CO_2
Microbe respiration
Carbon makes up about half of every tree.
Leaf litter
Dead wood
Carbon is stored in leaves, wood, and soil.
Root exudates
Microbes
Old stable soil carbon
New labile soil carbon
Forest Service
Office of Sustainability and Climate
May 2020

FORESTS AS A 'NATURAL CLIMATE SOLUTION'

- Natural Climate solution, includes:
  - Restoration
  - Improved forest management
  - Conservation



Griscom et al. 2017 PNAS

FOREST MANAGEMENT CAN PRODUCE CARBON BENEFITS

But how?

TWO DIFFERENT WAYS…

1) Increase carbon stocks/sequestration in forest ecosystems

2) Increase carbon storage in harvested wood products and displace use of fossil fuels

CONSERVATION: AVOIDED DEFORESTATION

- Development, conversion to agricultural use. Important for U.S., not just tropics
- Large potential, low risk, but difficult to credit
- Many co-benefits

*156,000 million tonnes of C have been released globally due to land use change (1850-1998)

*Globally, deforestation releases 1,400-2,000 million tonnes of C per year

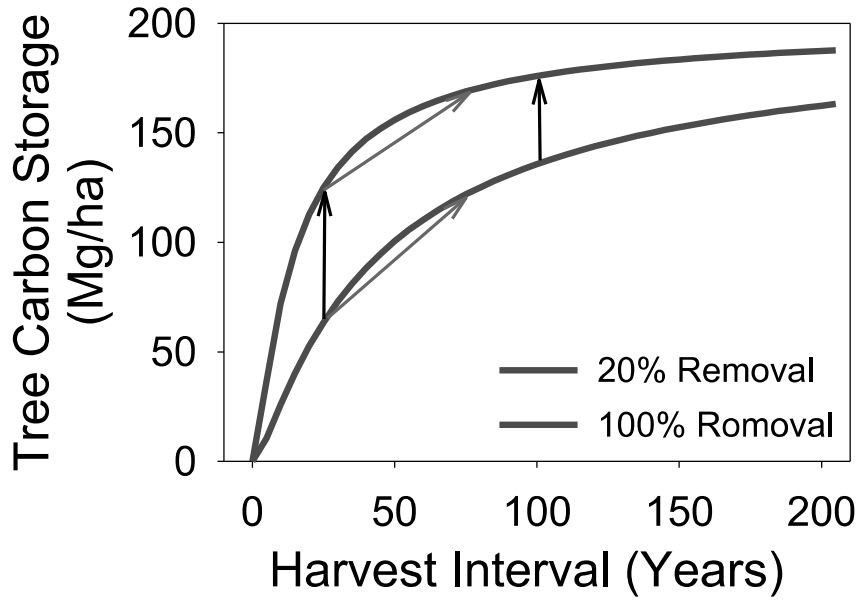
RESTORATION: REFORESTATION AND AFFORESTATION

- Moderate potential, low risk
- Benefits - Increased biodiversity and soil erosion control
- More water use, Loss of ag. production
- Uncertainties low when re-establishing forests

Bugwood,Org

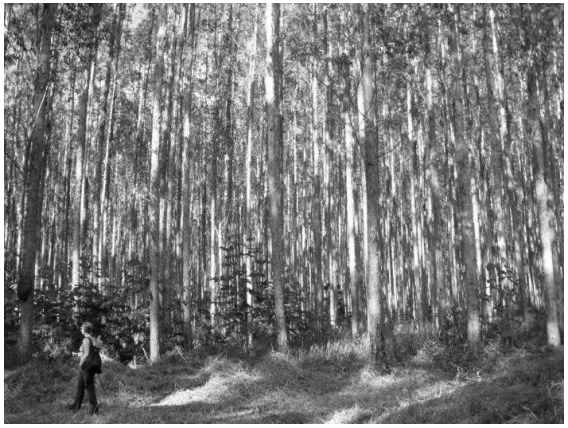
IMPROVED FOREST MANAGEMENT:
DECREASE OUTPUTS (INCREASE ROTATION, DECREASE REMOVALS)

- Large potential in areas with active forest management, moderate risk
- Increase structural and biodiversity
- Increased risk of disturbance loss



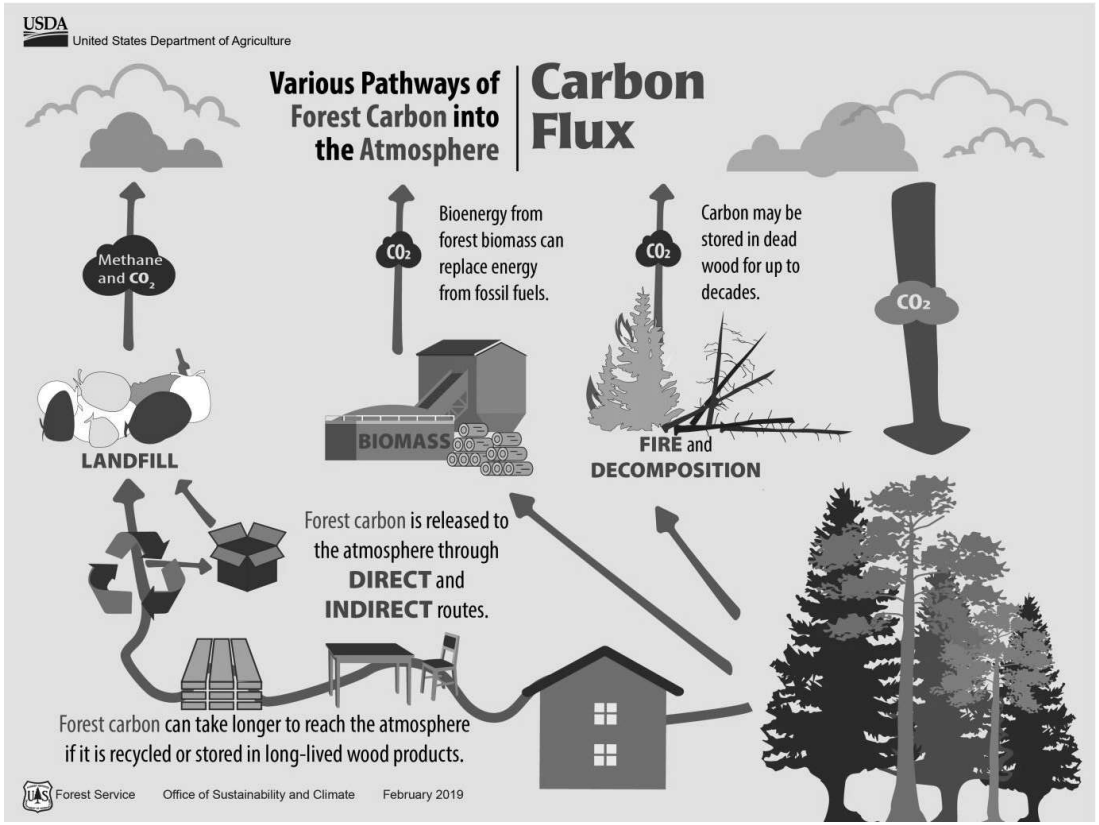
IMPROVED FOREST MANAGEMENT: INCREASE INPUTS (INCREASE GROWTH)

- Reforestation/regeneration, fertilization, genetics, silviculture, species selection
  - High potential, moderate risks:
    - full GHG accounting
    - potential maladaptation
  - Increased wood production, keeps forests as forests
  - Lower biodiversity, lower water yield and quality



*Combinations of fertilization, genetics, and vegetation control in operational plantations in the southern U.S. can increase wood growth by as much as **4X** compared to unmanaged naturally regenerated secondary growth.

HARVESTED WOOD PRODUCTS AND BIOMASS ENERGY SHOULD ALSO BE CONSIDERED



IMPROVED FOREST MANAGEMENT: FUEL TREATMENTS

- Thinning to reduce crown fire risk
- Low potential:
  - Landscape treatment, but C benefits only on site
- Co-Benefits:
  - Lower fire risk, potential for biofuels, potential for restoration, lower potential for forest conversion

Hurteau et al. 2011

*39-290 million metric tonnes of carbon per year is the range of emissions from wildfires in the conterminous U.S. since 1990 per year

SPEAKER

Aurora Cutler

Information and Education Specialist

Office of Sustainability and Climate

OUTLINE

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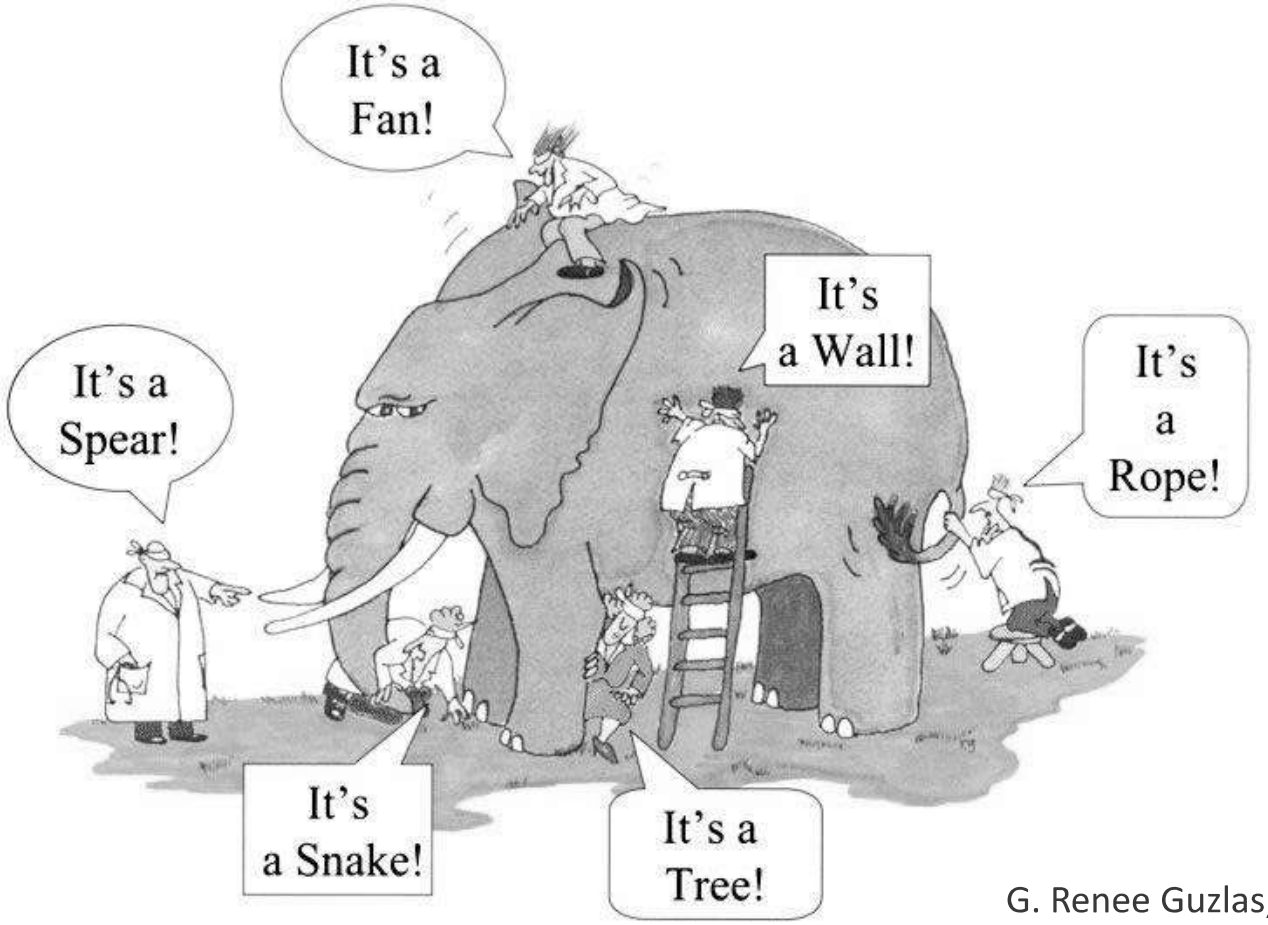
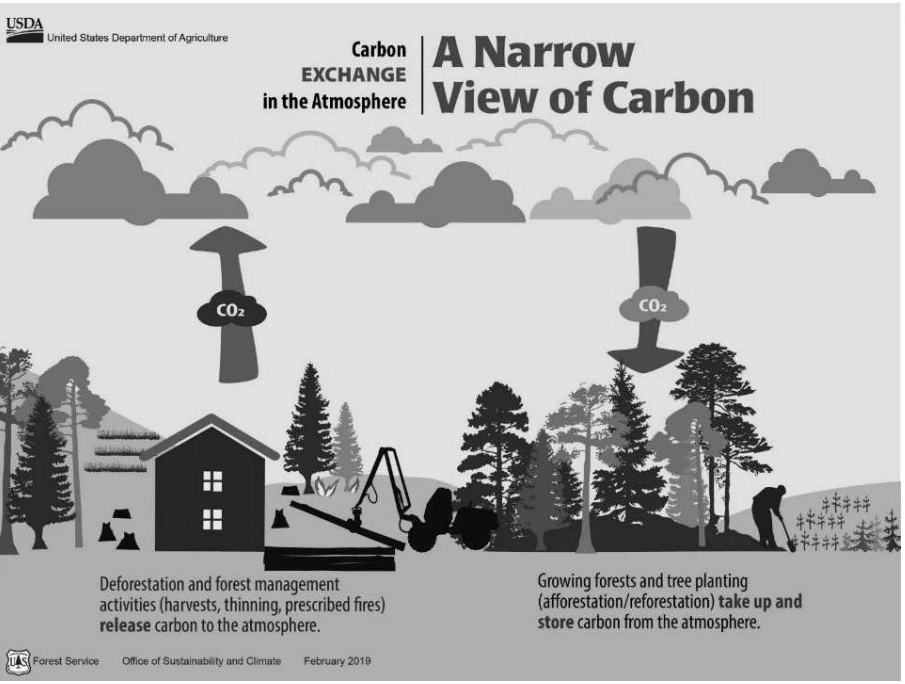
Differing perspectives on how to conceptualize the forest system is the greatest source of confusion.

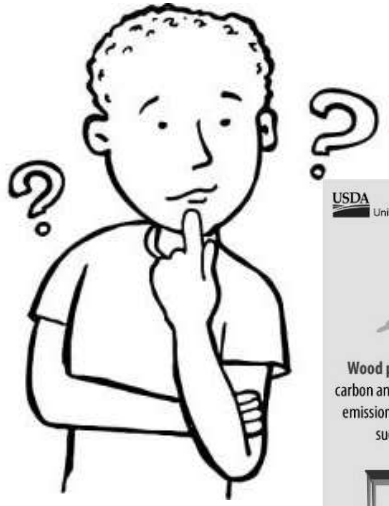
Sometimes you make the wrong conclusions when you can't see the whole…

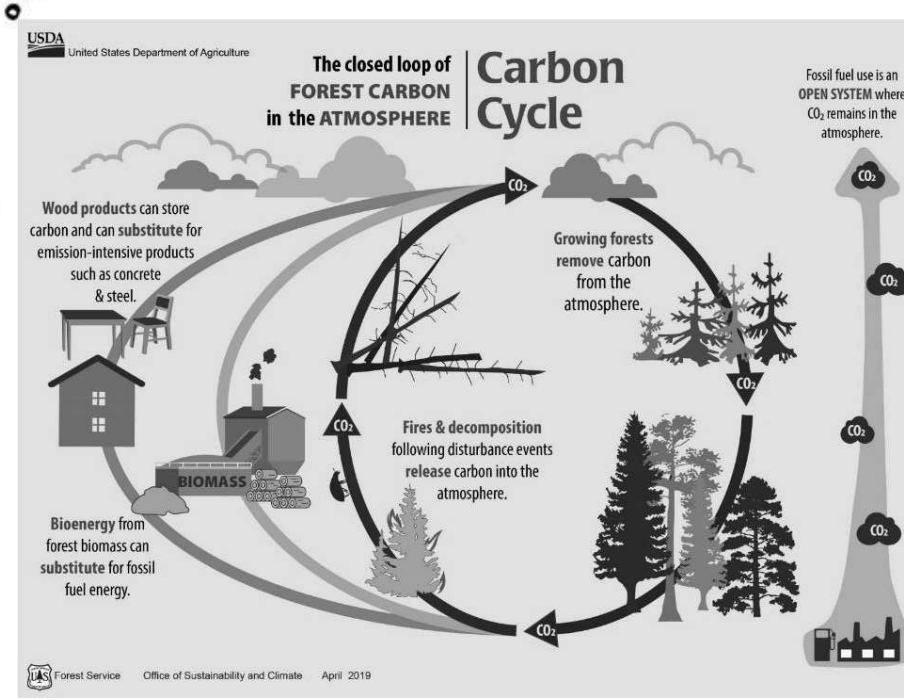


G. Renee Guzlas, artist

Challenges: Competing views

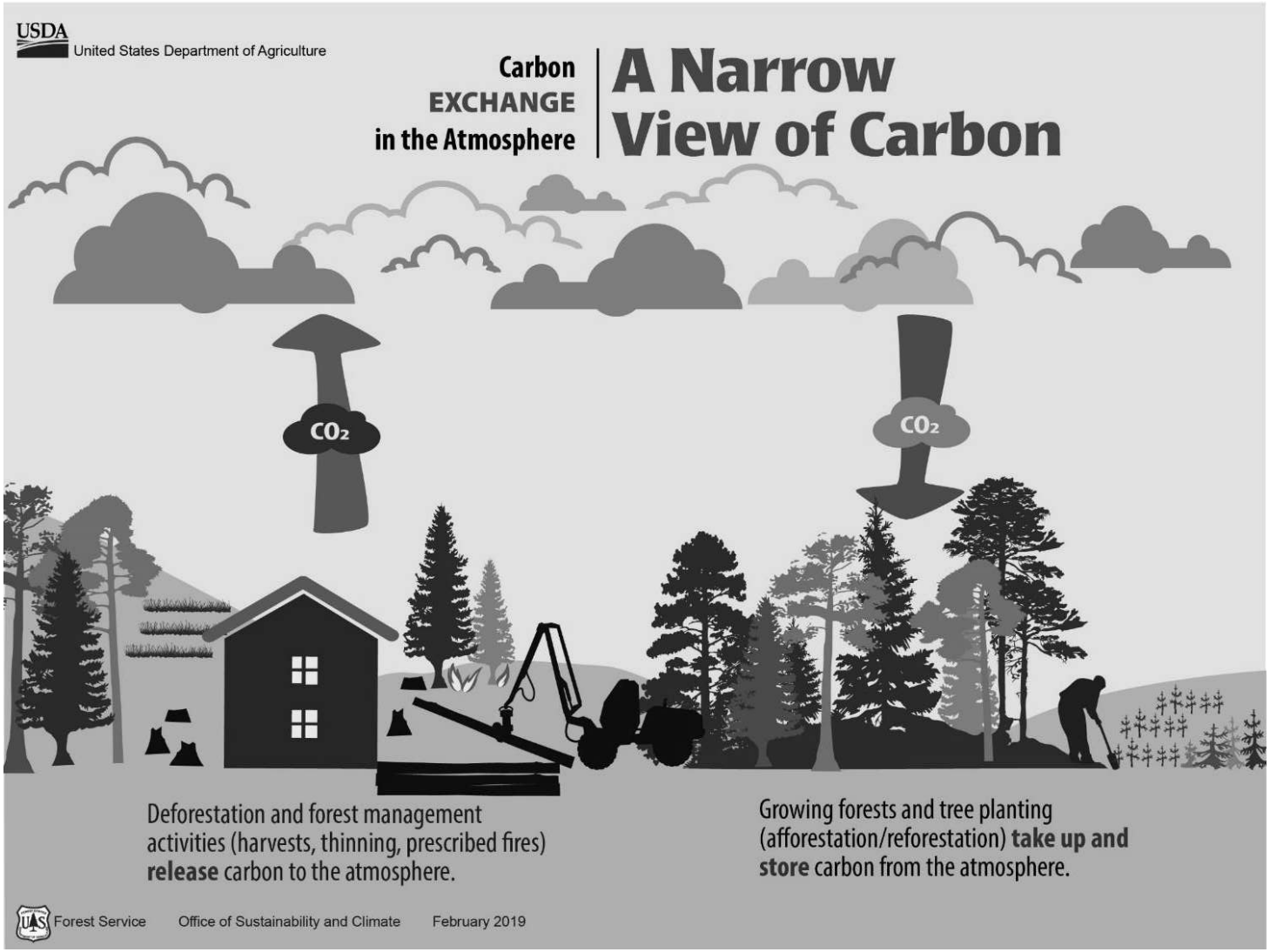




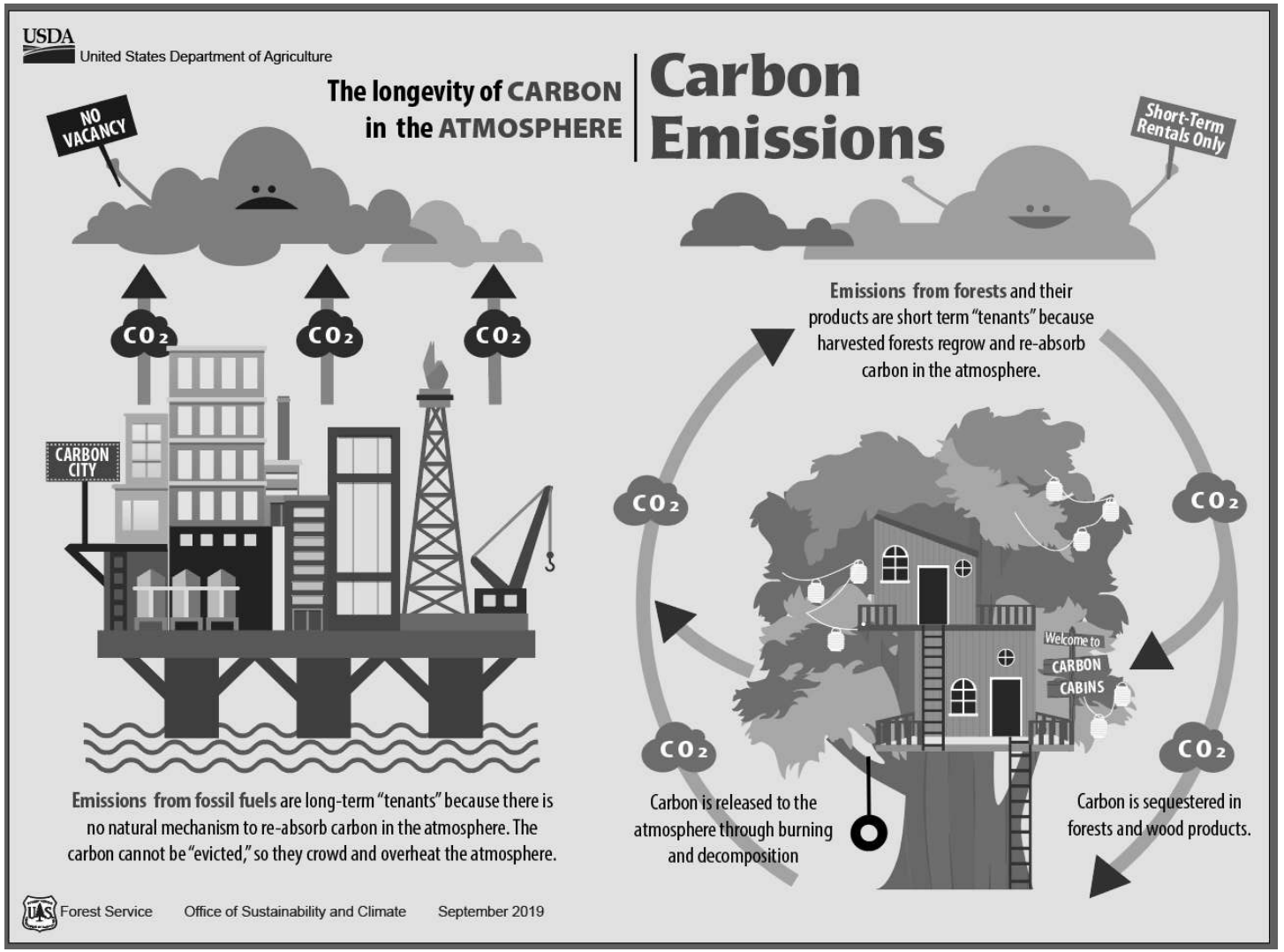


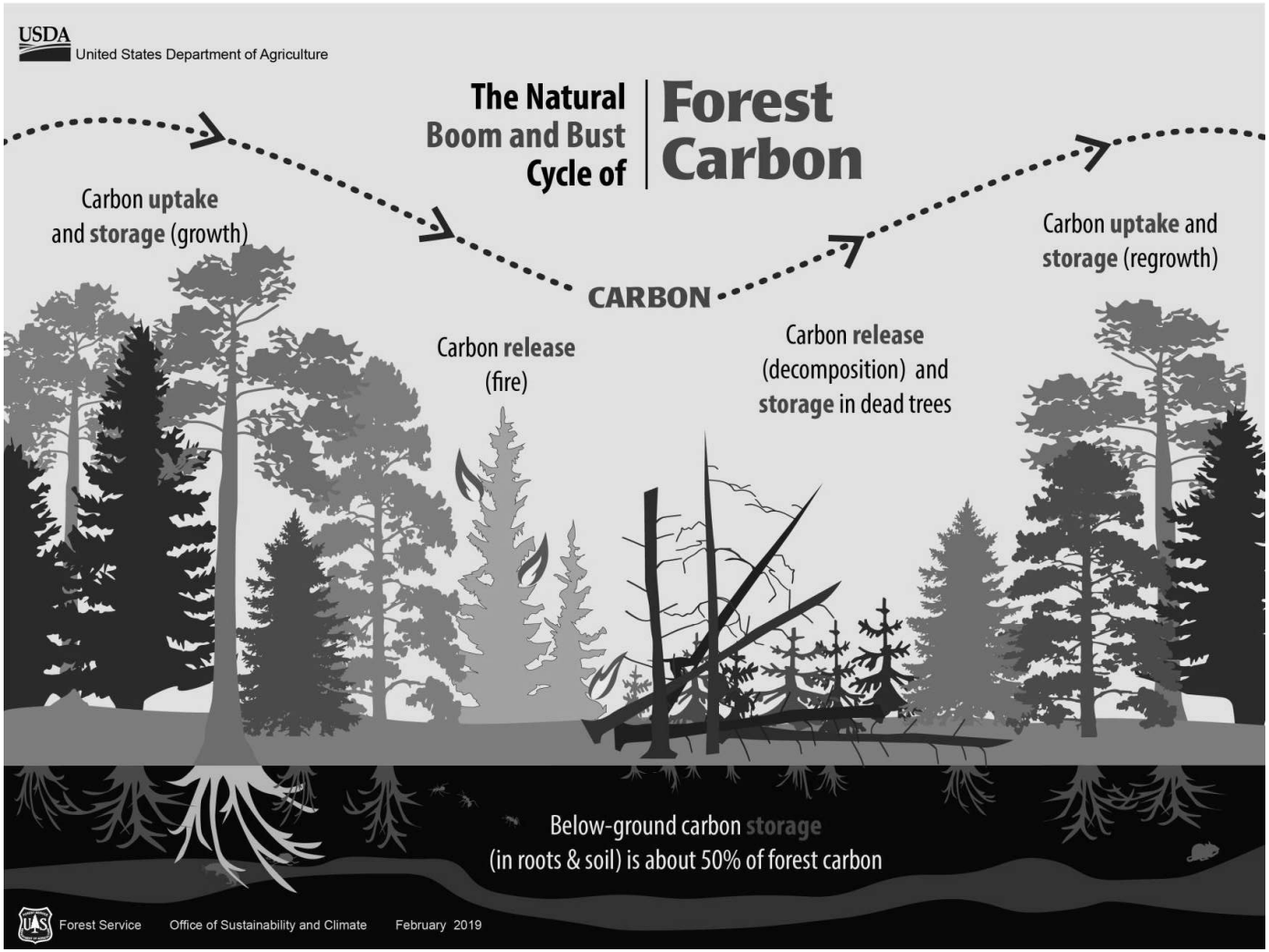
Differing perspectives on how to conceptualize the forest system is the greatest source of confusion and conflict!

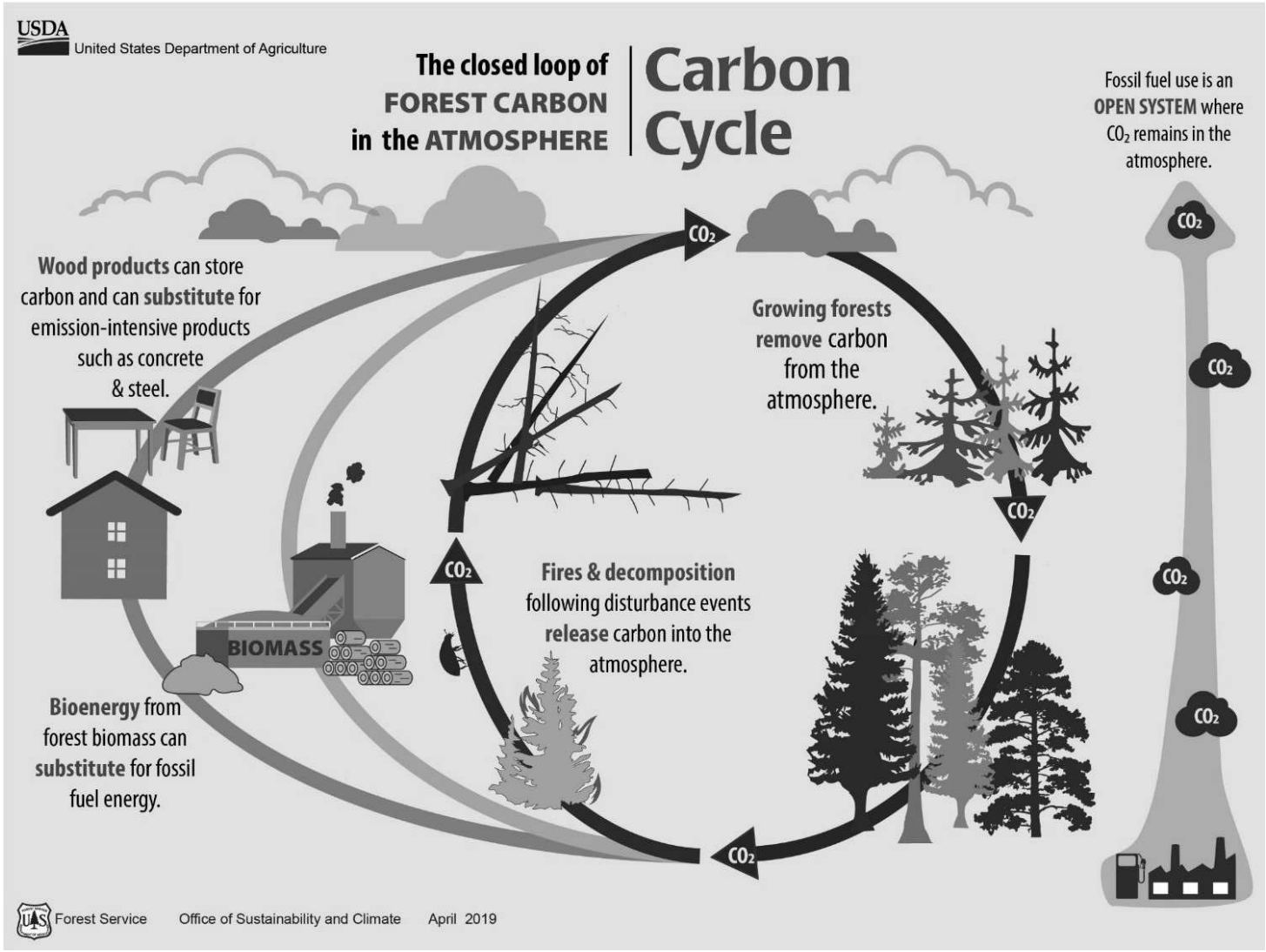
How most people view the forest system…

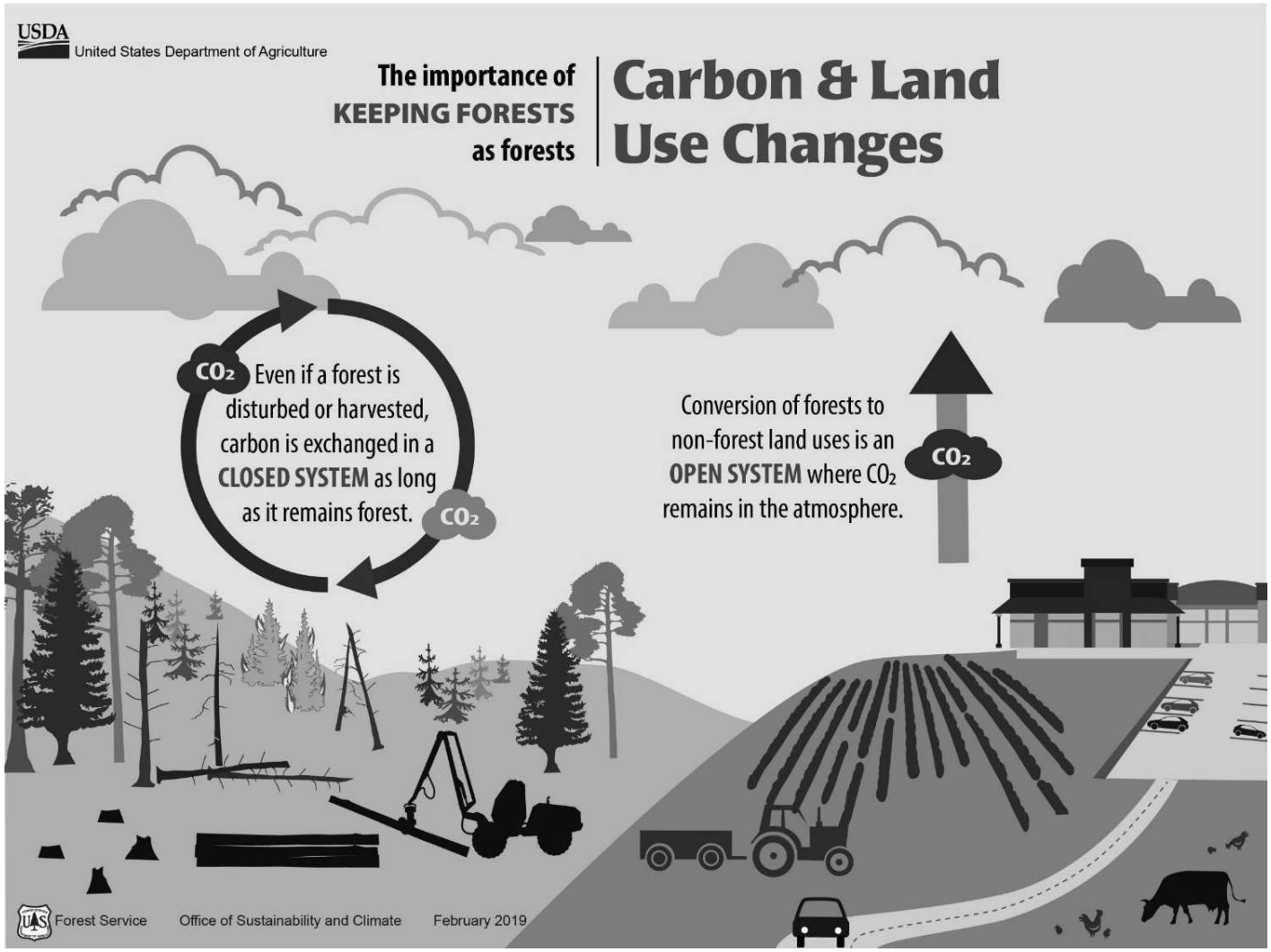


But, we know there is A LOT more to the story…


USDA
United States Department of Agriculture
The longevity of CARBON in the ATMOSPHERE
Carbon Emissions
NO VACANCY
Short-Term Rentals Only
CO2
CO2
CO2
CARBON CITY
Emissions from forests and their products are short term "tenants" because harvested forests regrow and re-absorb carbon in the atmosphere.
CO2
CO2
CO2
CO2
Welcome to
CARBON CABINS
Emissions from fossil fuels are long-term "tenants" because there is no natural mechanism to re-absorb carbon in the atmosphere. The carbon cannot be "evicted," so they crowd and overheat the atmosphere.
Carbon is released to the atmosphere through burning and decomposition
Carbon is sequestered in forests and wood products.
Forest Service
Office of Sustainability and Climate
September 2019


USDA
United States Department of Agriculture
The Natural Boom and Bust Cycle of
Forest Carbon
Carbon uptake and storage (growth)
CARBON
Carbon release (fire)
Carbon release (decomposition) and storage in dead trees
Carbon uptake and storage (regrowth)
Below-ground carbon storage (in roots & soil) is about 50% of forest carbon
Forest Service
Office of Sustainability and Climate
February 2019

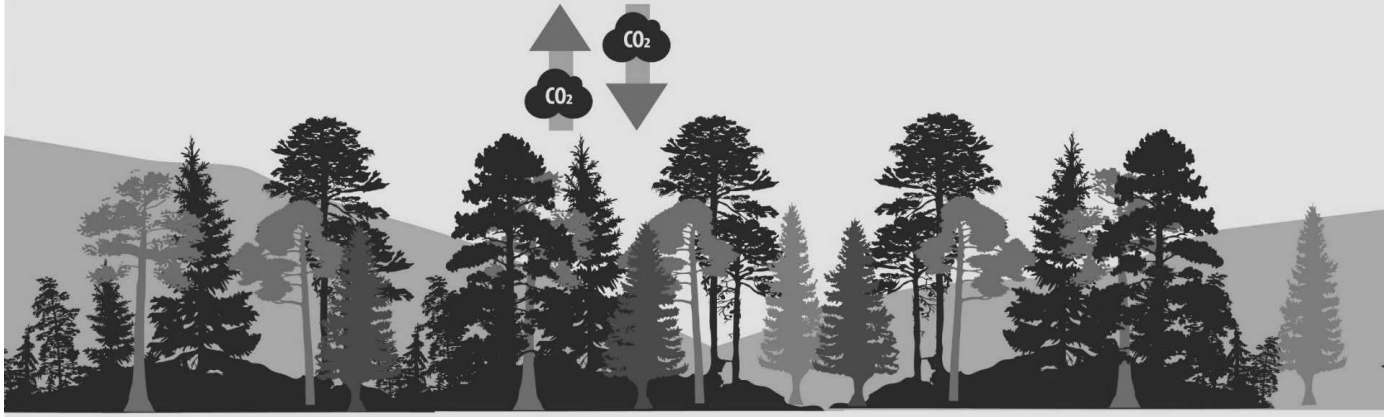

USDA
United States Department of Agriculture
The closed loop of
FOREST CARBON
in the ATMOSPHERE
Carbon Cycle
Fossil fuel use is an OPEN SYSTEM where CO_2 remains in the atmosphere.
Wood products can store carbon and can substitute for emission-intensive products such as concrete & steel.
Growing forests remove carbon from the atmosphere.
Fires & decomposition following disturbance events release carbon into the atmosphere.
BIOMASS
Bioenergy from forest biomass can substitute for fossil fuel energy.
CO_2
Forest Service
Office of Sustainability and Climate
April 2019


USDA
United States Department of Agriculture
The importance of
KEEPING FORESTS
as forests
Carbon & Land
Use Changes
CO_2
Even if a forest is disturbed or harvested, carbon is exchanged in a CLOSED SYSTEM as long as it remains forest.
CO_2
Conversion of forests to non-forest land uses is an OPEN SYSTEM where CO_2 remains in the atmosphere.
CO_2
Forest Service
Office of Sustainability and Climate
February 2019

Differing perspectives on how to conceptualize the forest system is the greatest source of confusion.

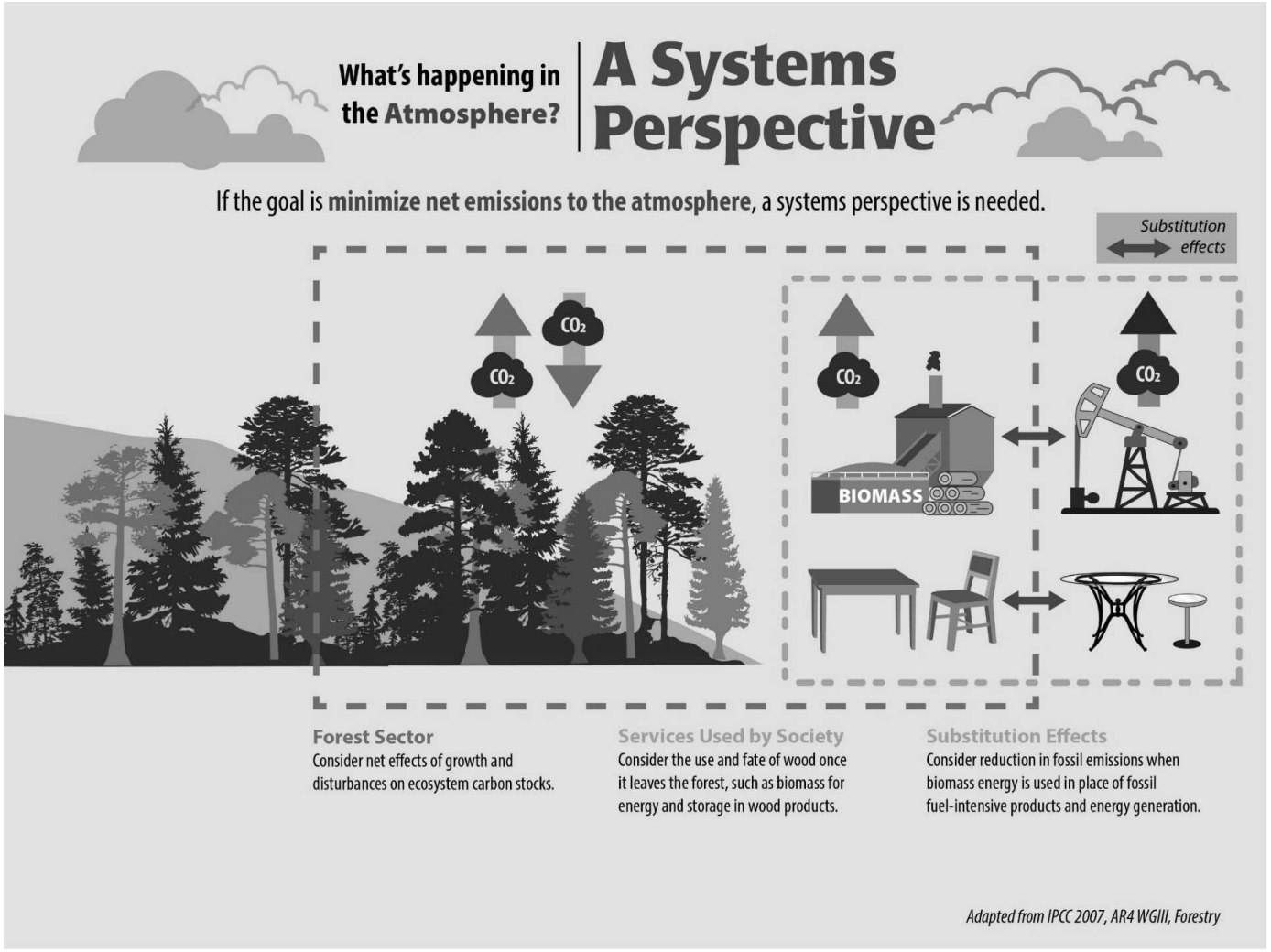
What's happening in the Atmosphere? A Systems Perspective

If the goal is **minimize net emissions to the atmosphere**, a systems perspective is needed.



Forest Sector
Consider net effects of growth and disturbances on ecosystem carbon stocks.

Adapted from IPCC 2007, AR4 WGIII, Forestry


What's happening in the Atmosphere?
A Systems Perspective
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Substitution effects
CO2
CO2
CO2
CO2
BIOMASS
Forest Sector
Consider net effects of growth and disturbances on ecosystem carbon stocks.
Services Used by Society
Consider the use and fate of wood once it leaves the forest, such as biomass for energy and storage in wood products.
Substitution Effects
Consider reduction in fossil emissions when biomass energy is used in place of fossil fuel-intensive products and energy generation.
Adapted from IPCC 2007, AR4 WGIII, Forestry

What's happening in the Atmosphere? | A Systems Perspective

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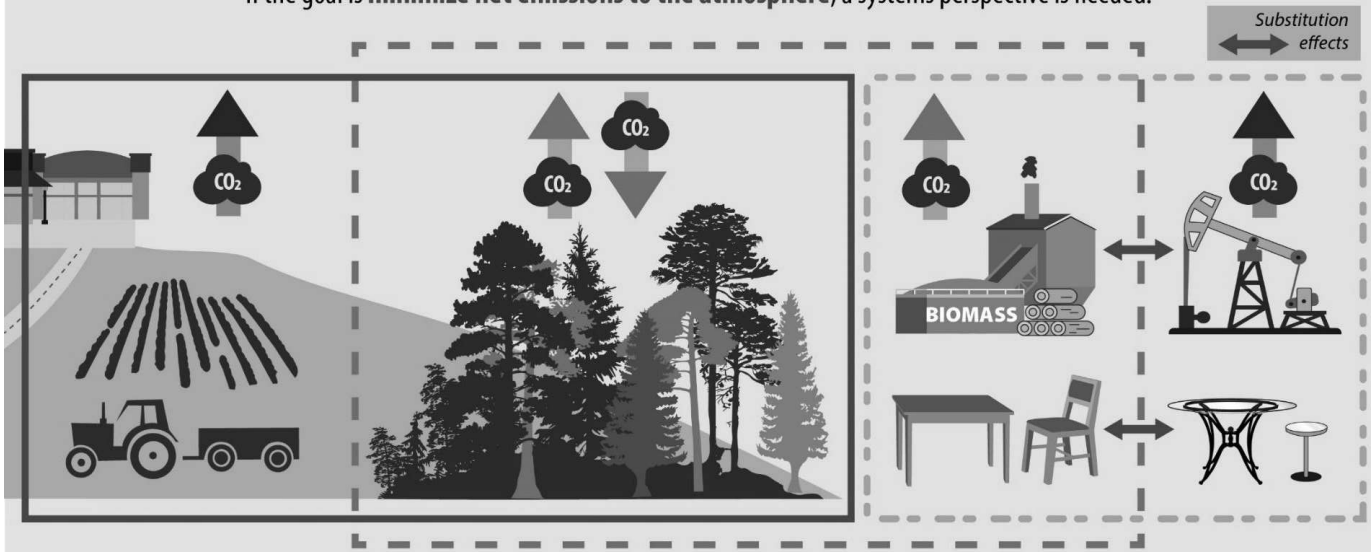

Land Use Sector
Consider loss or gain of forested land.

Forest Sector
Consider net effects of growth and disturbances on ecosystem carbon stocks.

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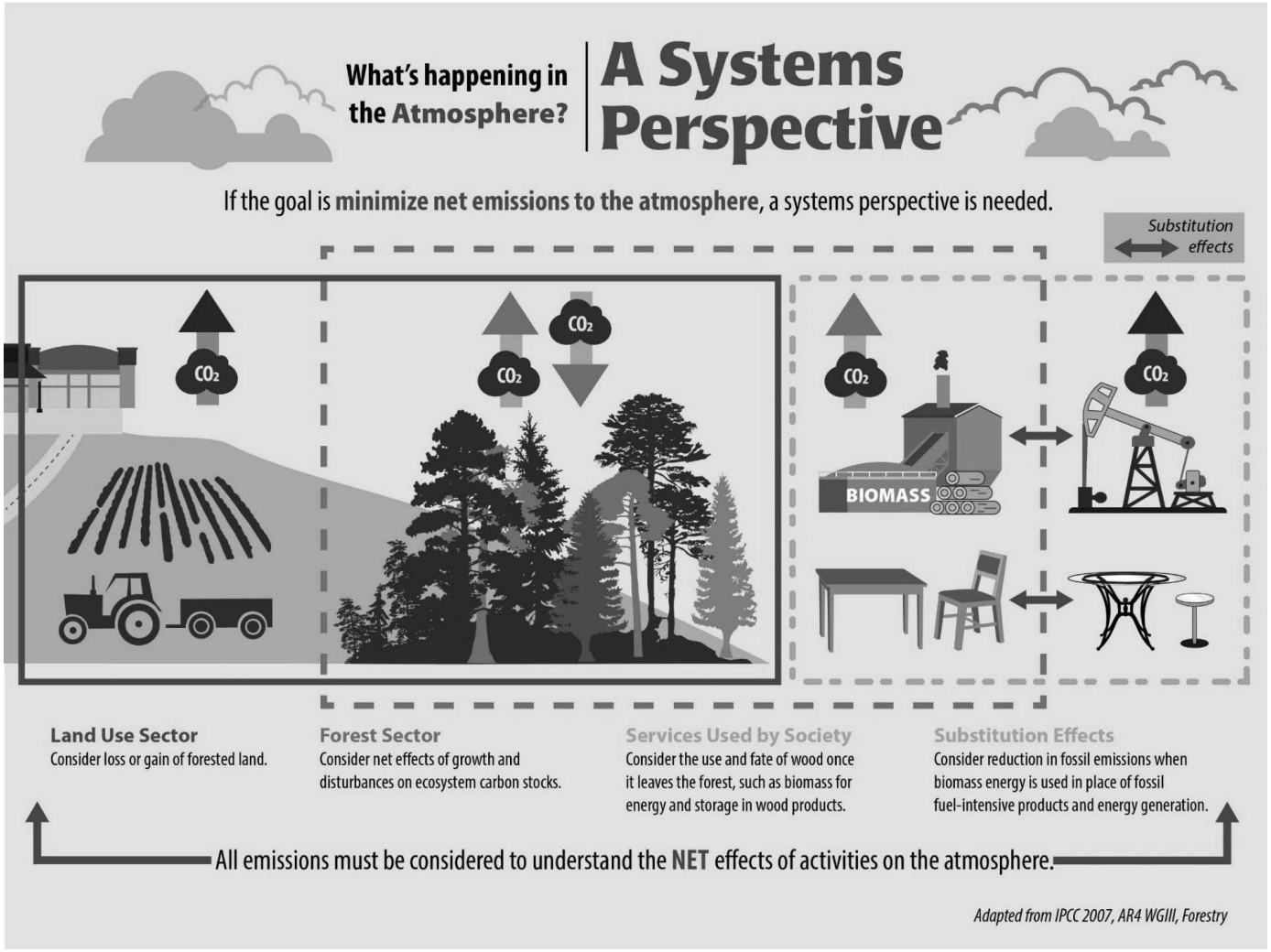
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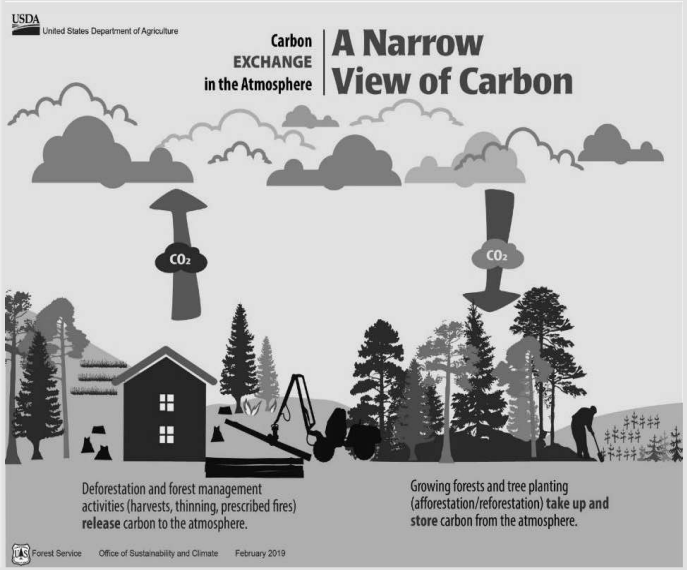
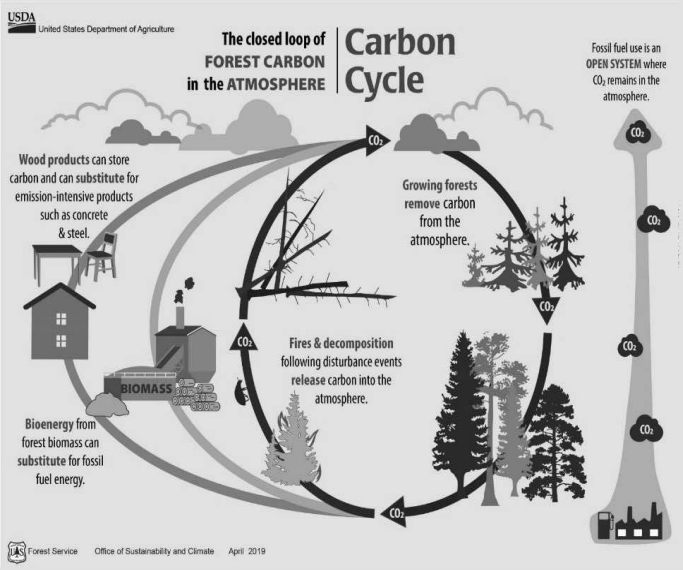
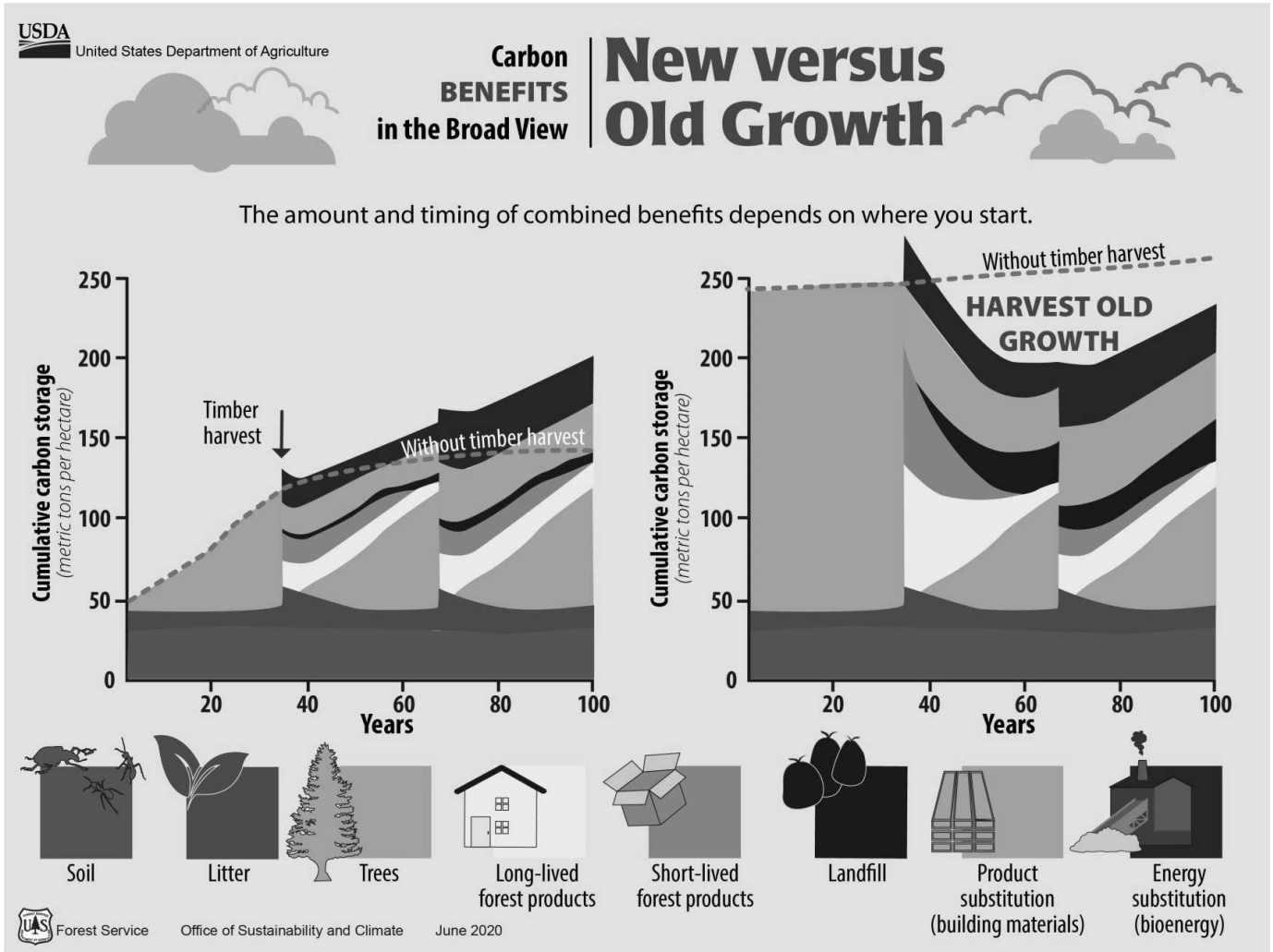
Substitution Effects
Consider reduction in fossil emissions when biomass energy is used in place of fossil fuel-intensive products and energy generation.
All emissions must be considered to understand the NET effects of activities on the atmosphere.
Adapted from IPCC 2007, AR4 WGIII, Forestry

USDA United States Department of Agriculture

Carbon BENEFITS in the Broad View | How Carbon Stacks Up






USDA
United States Department of Agriculture
Carbon
BENEFITS
in the Broad View
New versus
Old Growth
The amount and timing of combined benefits depends on where you start.
Cumulative carbon storage
(metric tons per hectare)
250
200
150
100
50
0
Timber
harvest
Without timber harvest
20
40
60
80
100
Years
Without timber harvest
HARVEST OLD
GROWTH
Soil
Litter
Trees
Long-lived
forest products
Short-lived
forest products
Landfill
Product
substitution
(building materials)
Energy
substitution
(bioenergy)
Forest Service
Office of Sustainability and Climate
June 2020

SPEAKER

Duncan McKinley

Natural Resource Specialist

Office of Sustainability and Climate

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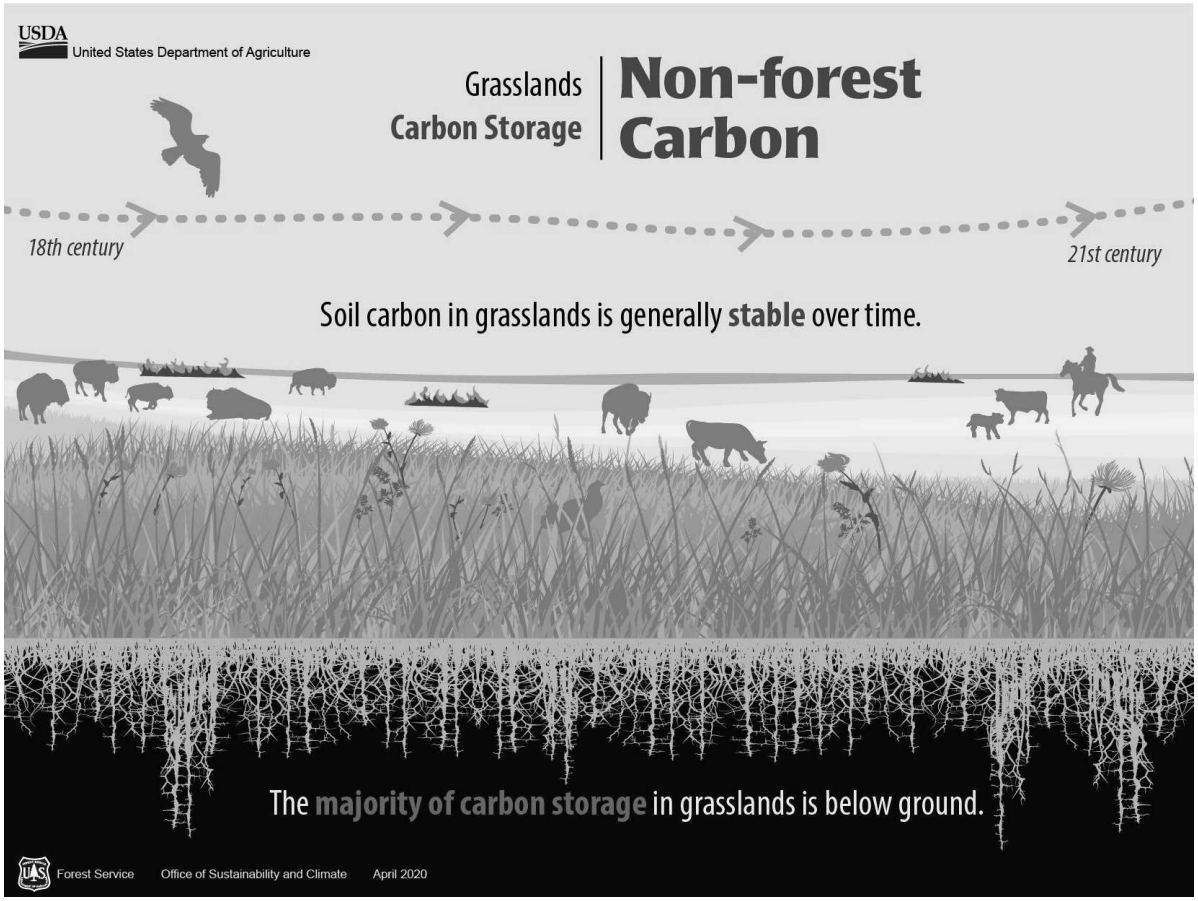
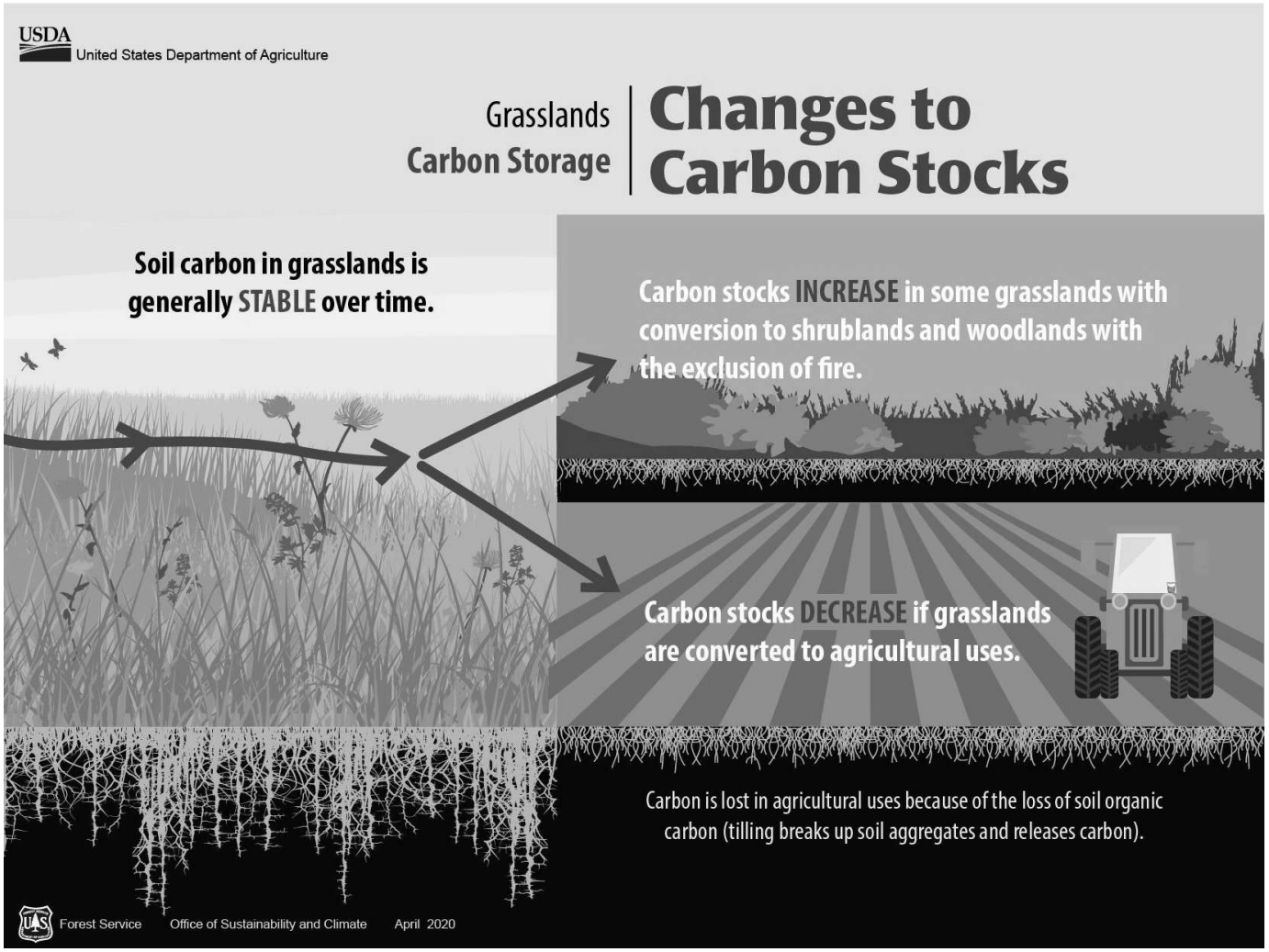
CONCEPTS THAT APPLY TO FORESTS APPLY TO GRASSLANDS AND RANGELANDS




USDA
United States Department of Agriculture
Grasslands
Carbon Storage
Changes to Carbon Stocks
Soil carbon in grasslands is generally STABLE over time.
Carbon stocks INCREASE in some grasslands with conversion to shrublands and woodlands with the exclusion of fire.
Carbon stocks DECREASE if grasslands are converted to agricultural uses.
Carbon is lost in agricultural uses because of the loss of soil organic carbon (tilling breaks up soil aggregates and releases carbon).
Forest Service
Office of Sustainability and Climate
April 2020

FOREST SERVICE AND CARBON

VEGETATION MANAGEMENT
ENERGY DEVELOPMENT
SUSTAINABLE OPERATIONS

Carbon timeline – an evolving vision for federal forests

- **2005-2009: focus on "markets for ecosystem services"**
  - Voluntary carbon markets
    - Offset credits
    - Carbon reserves
    - Carbon insurance

- **2010 FS Climate Change Roadmap:**
  - managing carbon stocks
    - Reforestation after disturbance
    - Conserve working forests
    - Tech assistance to increase carbon thru afforestation, reforestation, and forest health
    - Retain greenspace and plant trees in cities
  - Demo projects for development of markets for carbon (private lands)

- **2014 -2018 USDA Strategic Plan (GHG 17% below 2005 level by 2020):**
  - *Help achieve Clean Power Plan*
  - "help maintain forests as a carbon sink"
    - Plant trees
    - Minimize deforestation
    - Land acquisitions
    - Conservation easements

- **2015 USDA Building Blocks (GHG 26-28% below 2005 level by 2025):**
  - *Help achieve Paris Agreement*
  - "… Stewardship of federal forests Building Blocks are designed to recover, maintain, and enhance resilience of the carbon sink… through restoration/reforestation"
    - Reforest post-disturbance NFS lands Fuel treatments in WUI
    - Sustain or restore watershed function and resilience

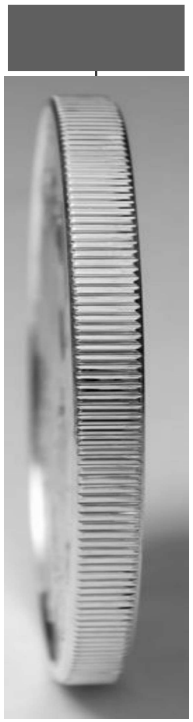
?

CURRENT POLICY

2012 PLANNING RULE (FSH 1909.12,4-4.2)

- Assessment of Carbon Stocks:
  - Role of forests in sequestering carbon
  - Effects of Disturbances & Management on carbon stocks
  - How carbon might be influenced by management
- Identifying Carbon Pools
- Assessing the Plan Area Influences on Carbon Stocks

Focused on carbon stocks

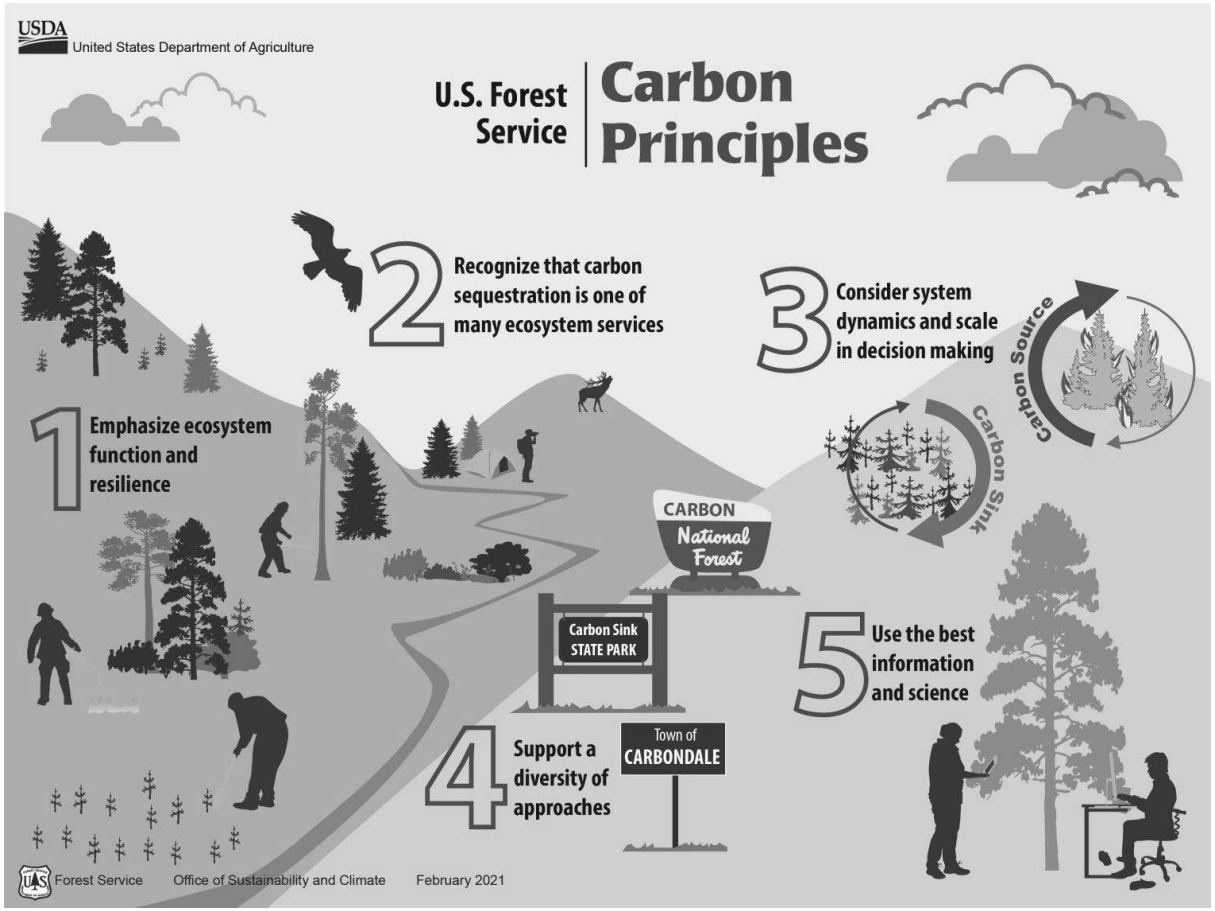


CEQ NEPA GUIDANCE AND CASE LAW

- Consider climate change effects:
  - Effects of projects on climate (*carbon*)
  - Effects of climate on projects

Focused on carbon emissions

CARBON PRINCIPLES



Gen. Tech. Rep. WO-95.

SPEAKER

Sean Healey

Research Ecologist

Rocky Mountain Research Station

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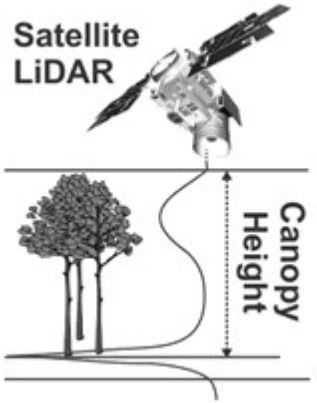
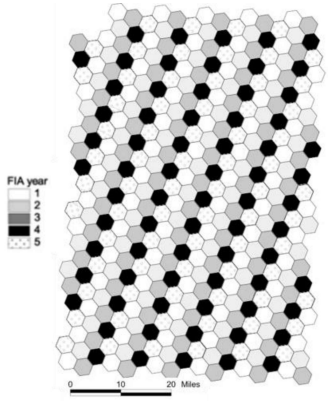
HOW ARE CARBON STOCKS MEASURED?

- Plot-level/ Stand:
  - Use mathematical approaches to calculate tree biomass from simple measurements, such as DBH
  - Belowground can be done through coring



- Landscape scale:
  - Remote sensing, such as radar and Lidar
  - Aerial images
- Forest Inventory and Analysis (FIA) uses field plots combined with remotely sense changes in forest age, cover types, and disturbances.
  - Regional gaps in inventory are often addressed using remotely sensed data combined with modeling



THE SCIENCE FOUNDATION: CARBON INFORMATION FOR *EVERY* NATIONAL FOREST!!!

Stocks/Stock Change

Baseline Estimates of Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units

Northern Region

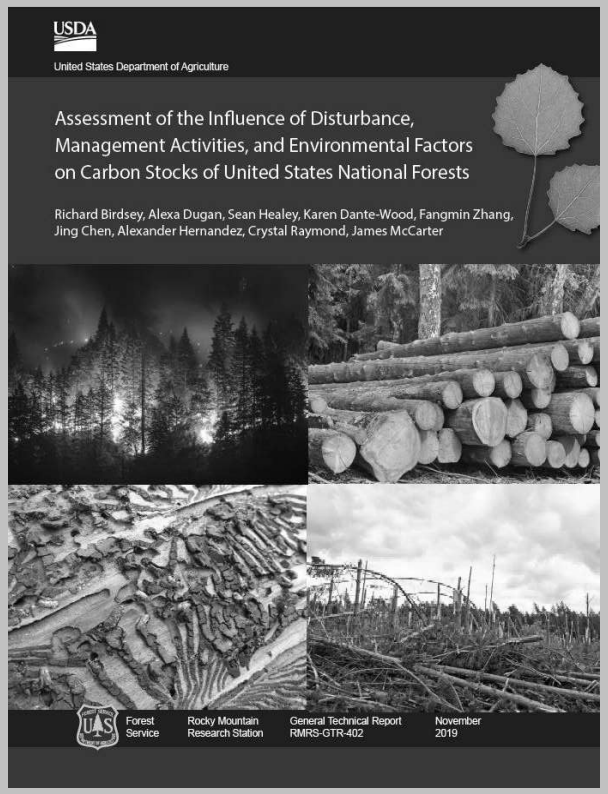
Climate Change Advisor's Office
Office of the Chief

March 6, 2015

USDA United States Department of Agriculture
Forest Service

Citation: USDA Forest Service. 2015. Baseline Estimates of Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units; Northern Region. 43 pp. Whitepaper.
http://www.fs.fed.us/climatechange/documents/NorthernRegionCarbonAssessment.pdf

Impact of Management and Disturbance

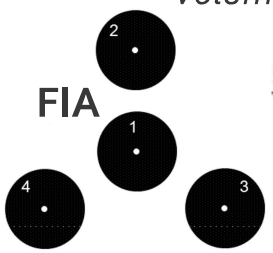


Description of the primary forest carbon models used to conduct carbon assessments

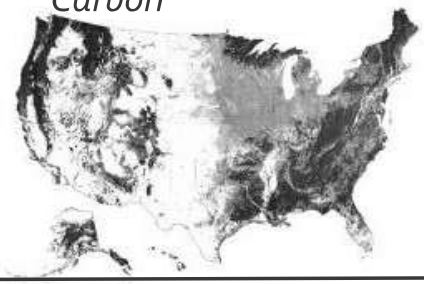
Carbon Calculation Tool (CCT)

Allometric Models:

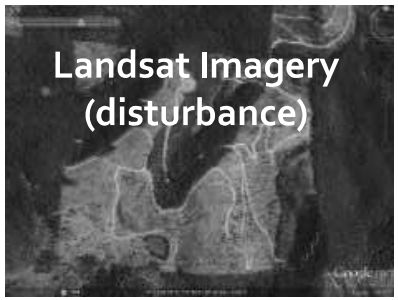
Volume → *Biomass* → *Carbon*



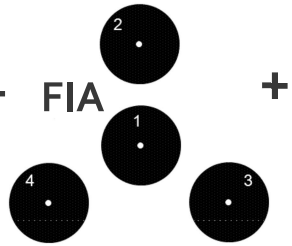
$$y_i = \exp\left(\beta_0 + \beta_1 \cdot \frac{dbh}{dbh + \beta_2}\right).$$

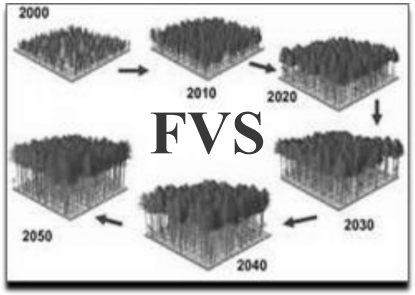


Forest Carbon Management Framework (ForCaMF)

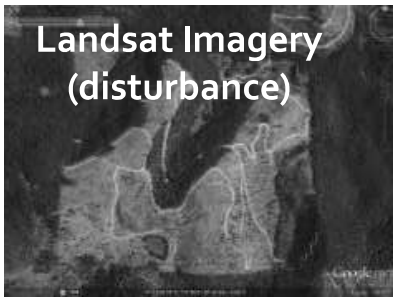


+ FIA +

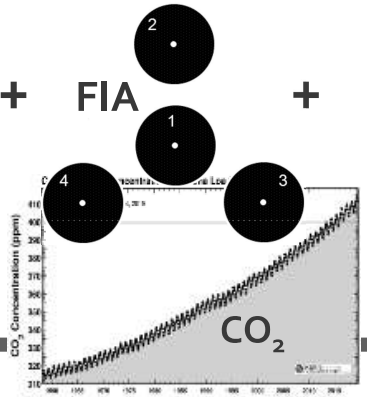




Integrated Terrestrial Ecosystem Carbon (InTEC) model



+ FIA +



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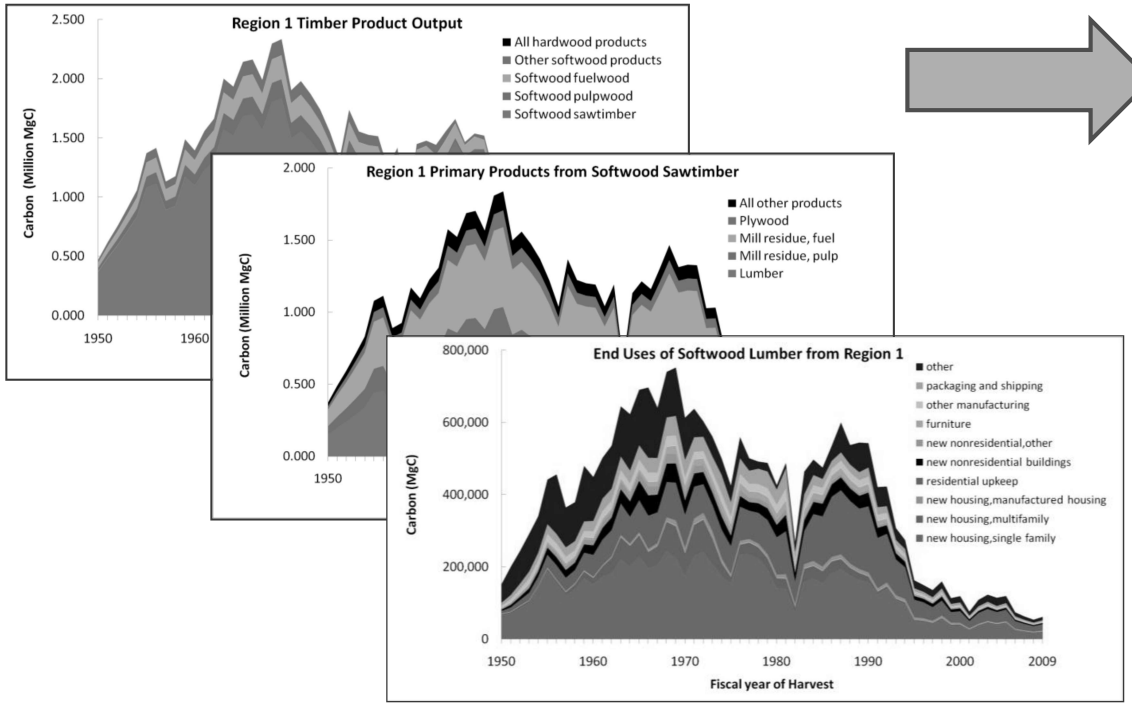
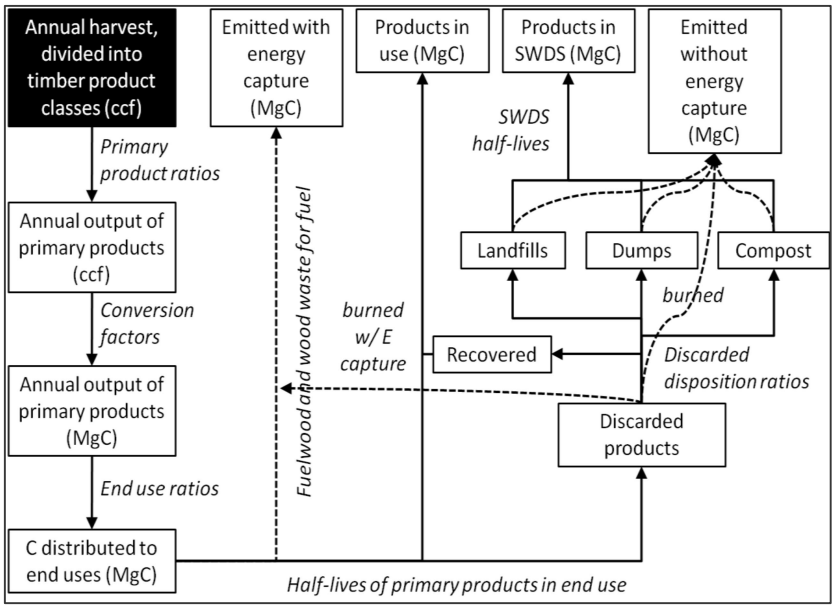
HARVEST WOOD PRODUCTS IPCC PRODUCTION APPROACH CARBON STORAGE AND EMISSIONS ESTIMATION TOOL

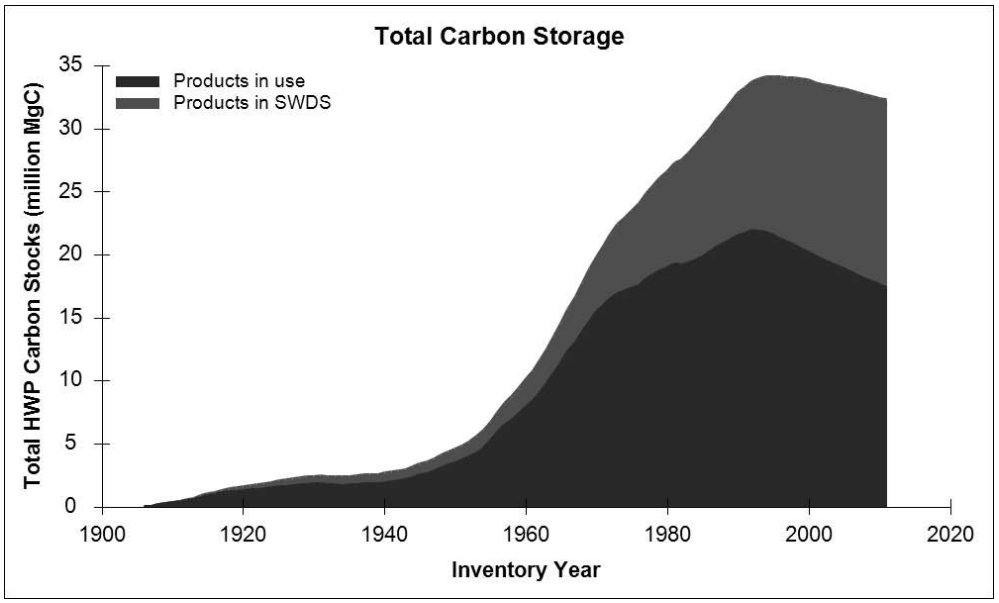
Applying cut sold data from each national forest

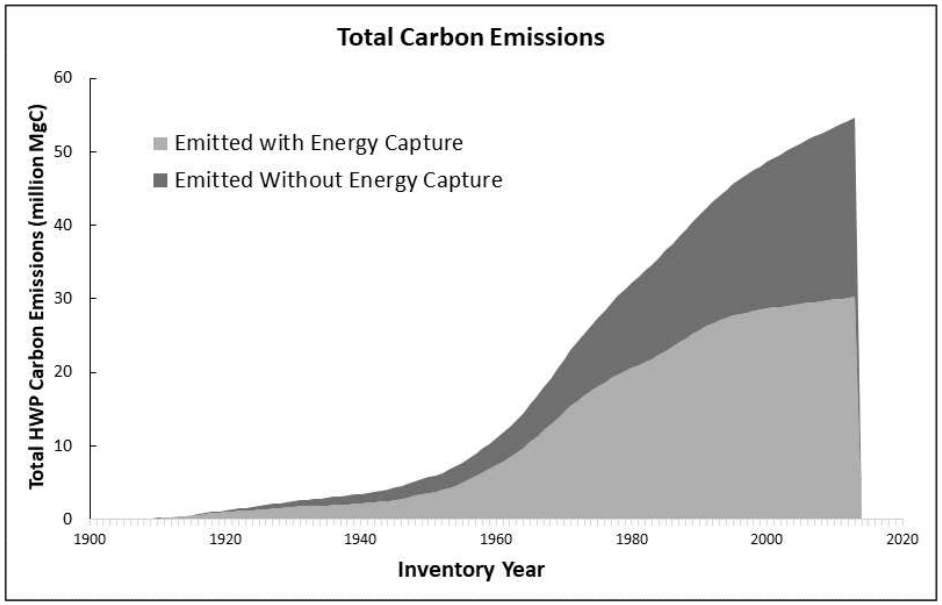




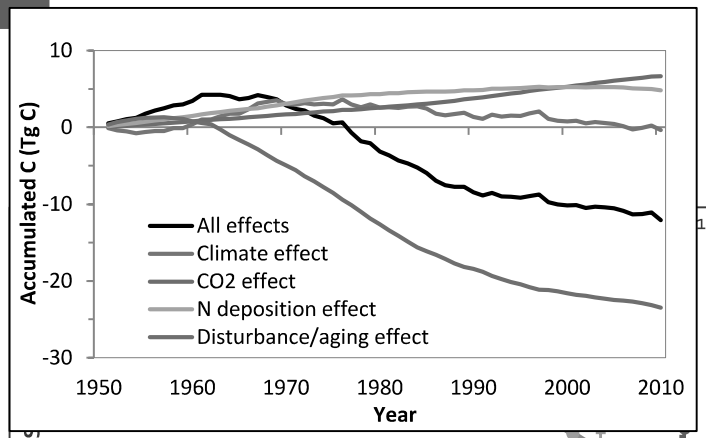
- historical product distributions ratios
- carbon conversion factors
- primary product half-lives
- disposition ratios

ESTIMATE CUMULATIVE STORAGE AND EMISSIONS AND ANNUAL CHANGES FROM THE START OF HARVESTING UNTIL 2020.





TOOLS IN THESE REPORTS CAN ANSWER RELEVANT QUESTIONS



InTEC → *How does the effect of management and disturbance compare with atmospheric and climatic changes?*

ForCaMF → *How has management and disturbance affected total carbon?*

Product C → *How much total carbon on the landscape / in product pools?*

FIA/CCT → *How much total carbon on the landscape / in product pools?*

nuity of Monitoring Data

SPEAKER

Duncan McKinley

Natural Resource Specialist

Office of Sustainability and Climate

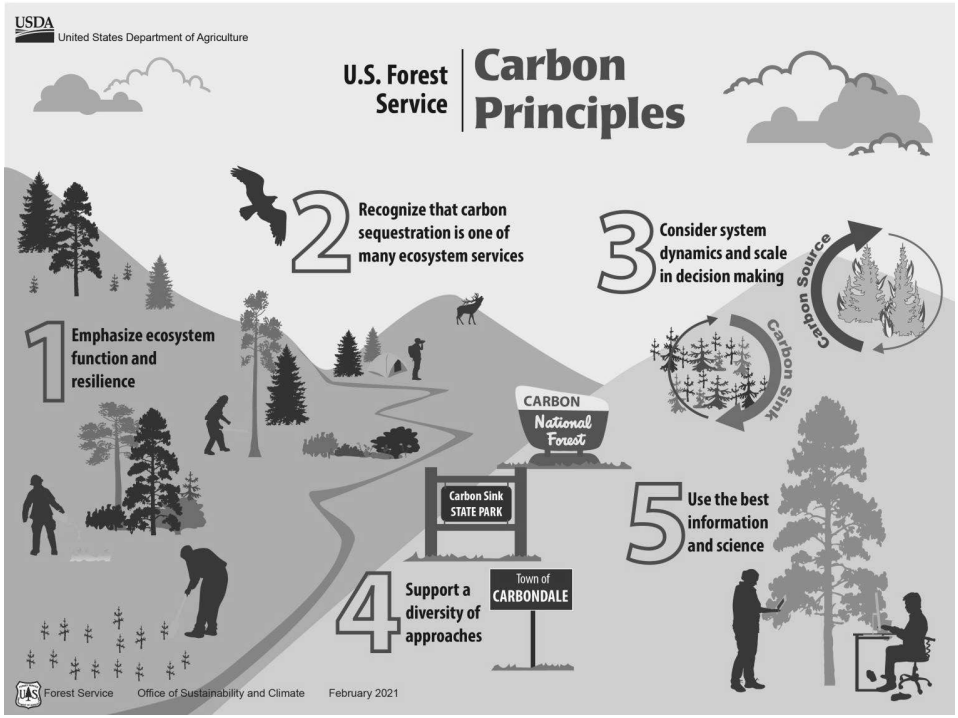
OUTLINE

- What's the interest in forest carbon?
- "Carbon System" and key concepts
- Rangeland carbon
- Forest Service experience and policy
- How carbon is estimated
- How the Forest Service influences carbon through vegetation management
- How we deliver science for decision making
- Energy development on NFS lands
- Sustainable operations – your role
- How we can help you

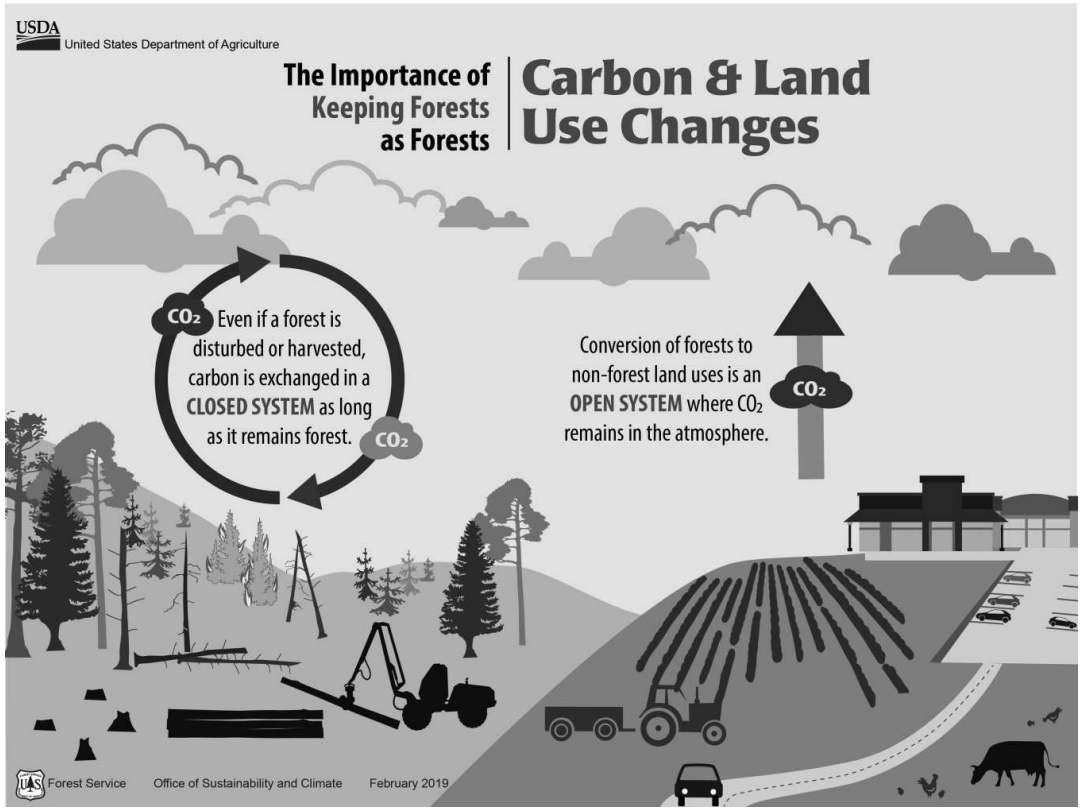
SOME WAYS THE FOREST SERVICE INFLUENCES CARBON

On NFS lands:

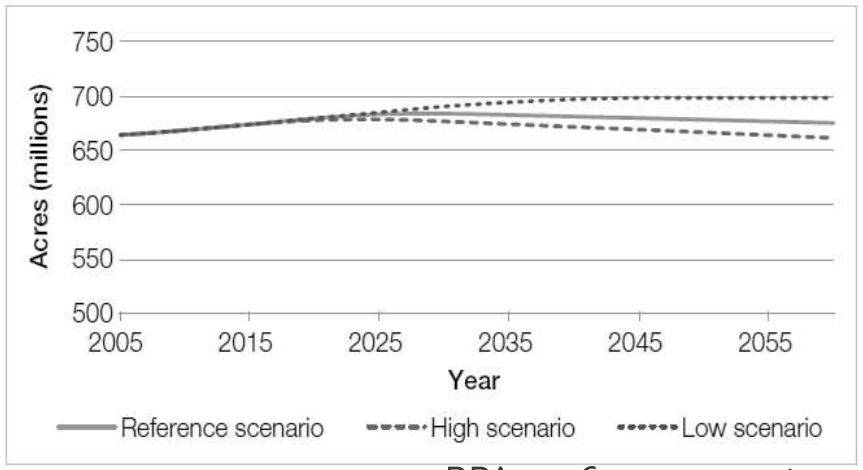
"We manage the carbon in forests, not manage the forests for carbon"



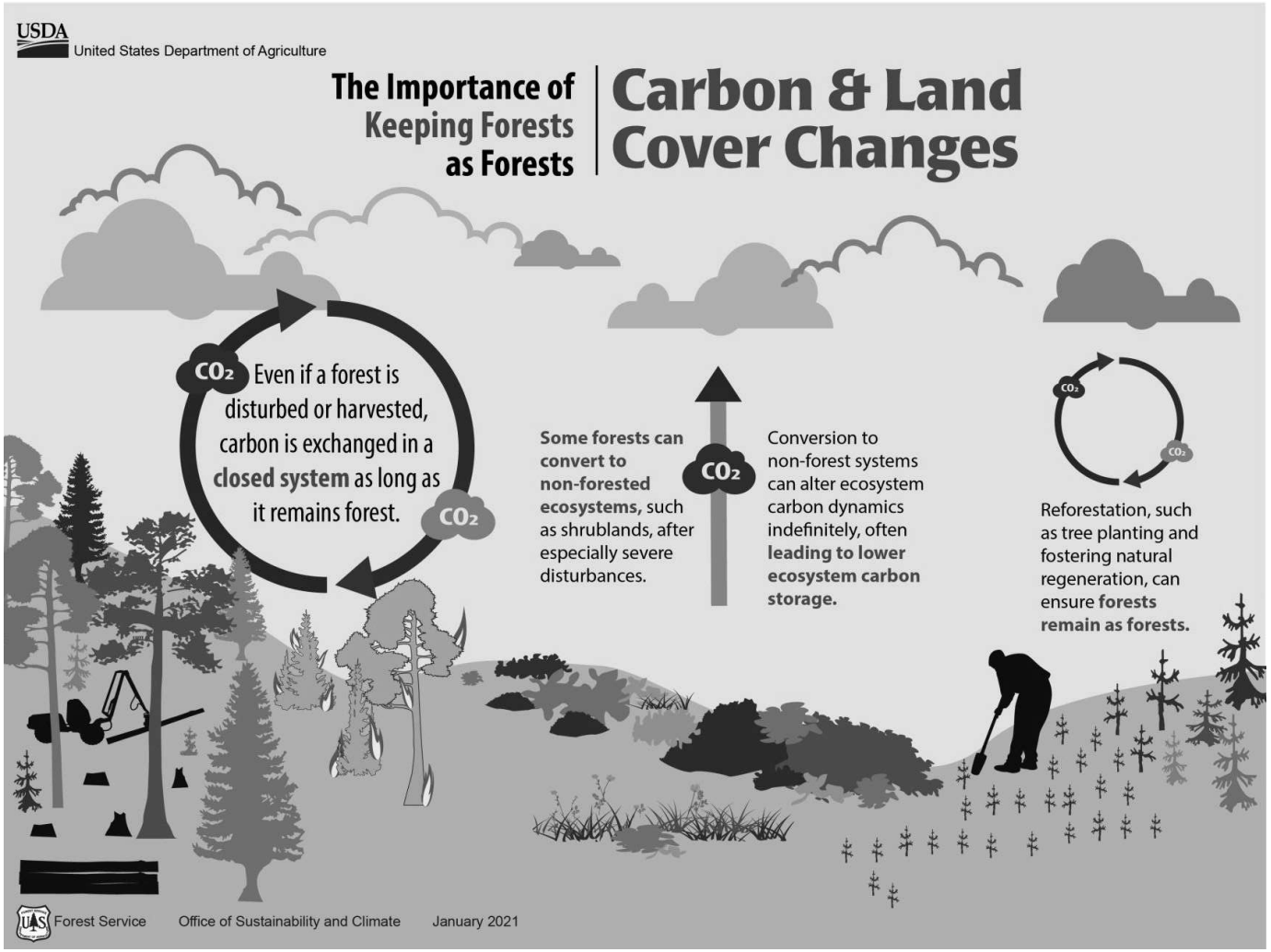
KEEPING FORESTS AS FORESTS IS THE MAJOR CONCERN WITH RESPECT TO CARBON IN THE US

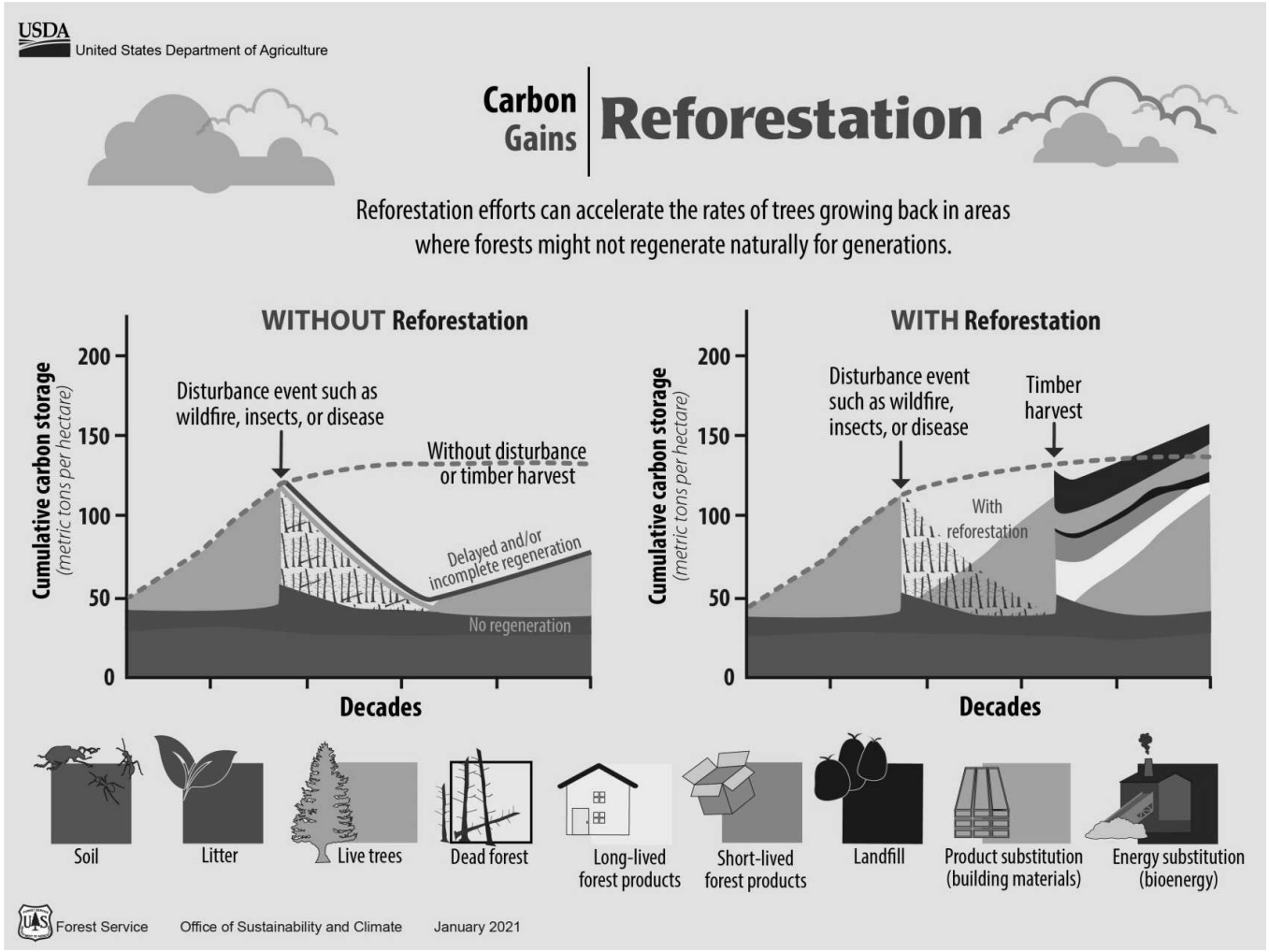


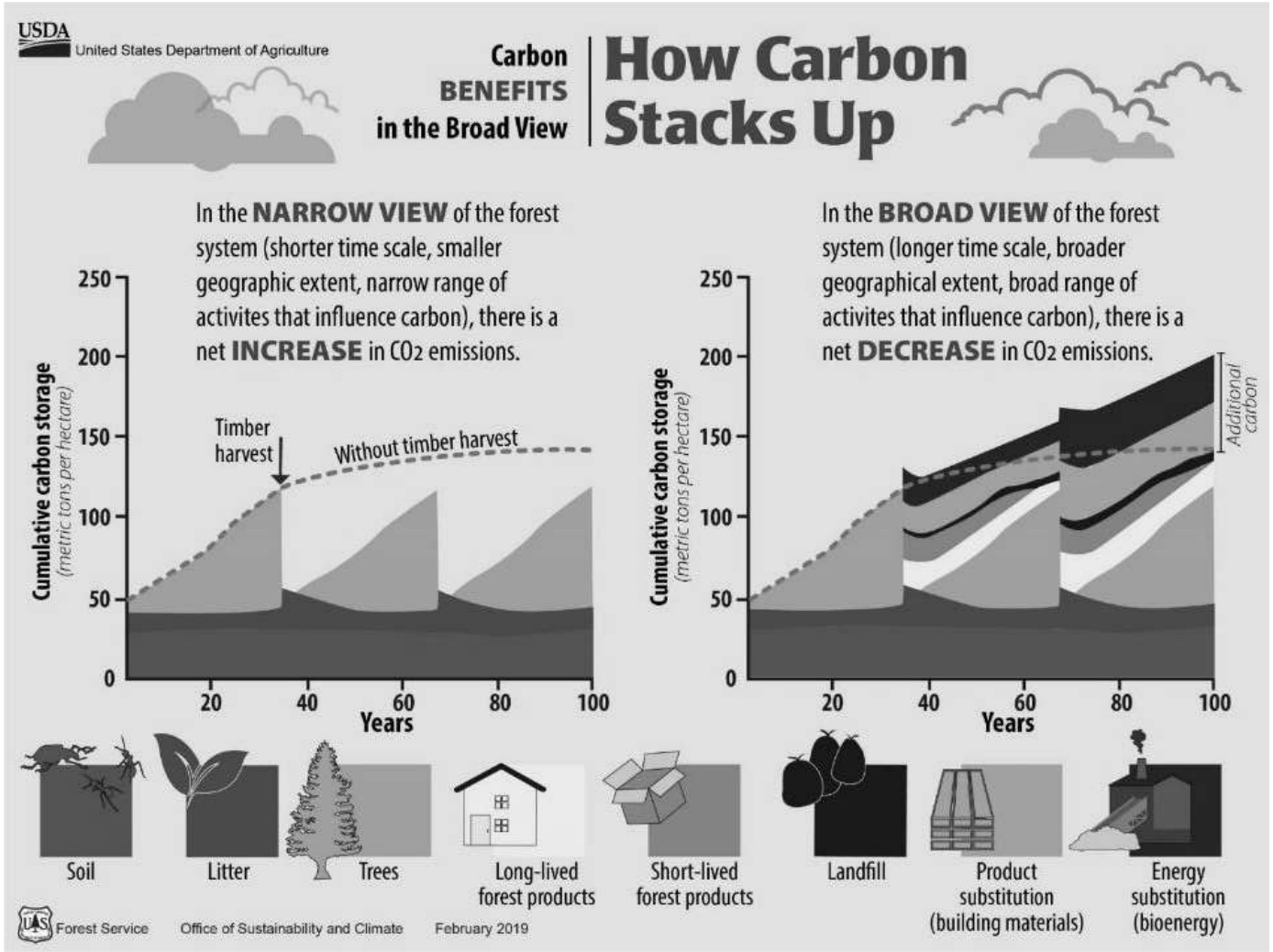
Area of U.S. forest land use

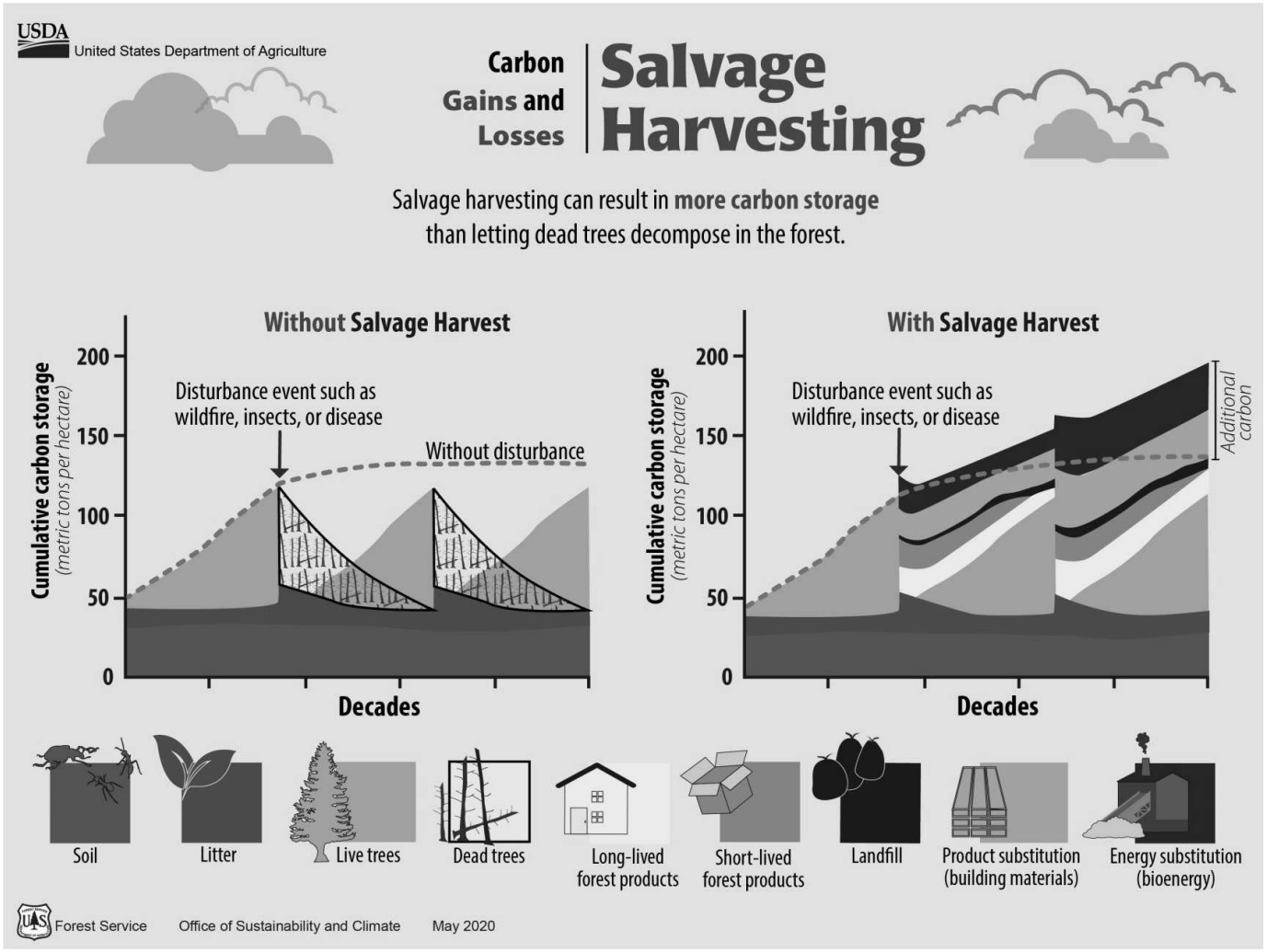


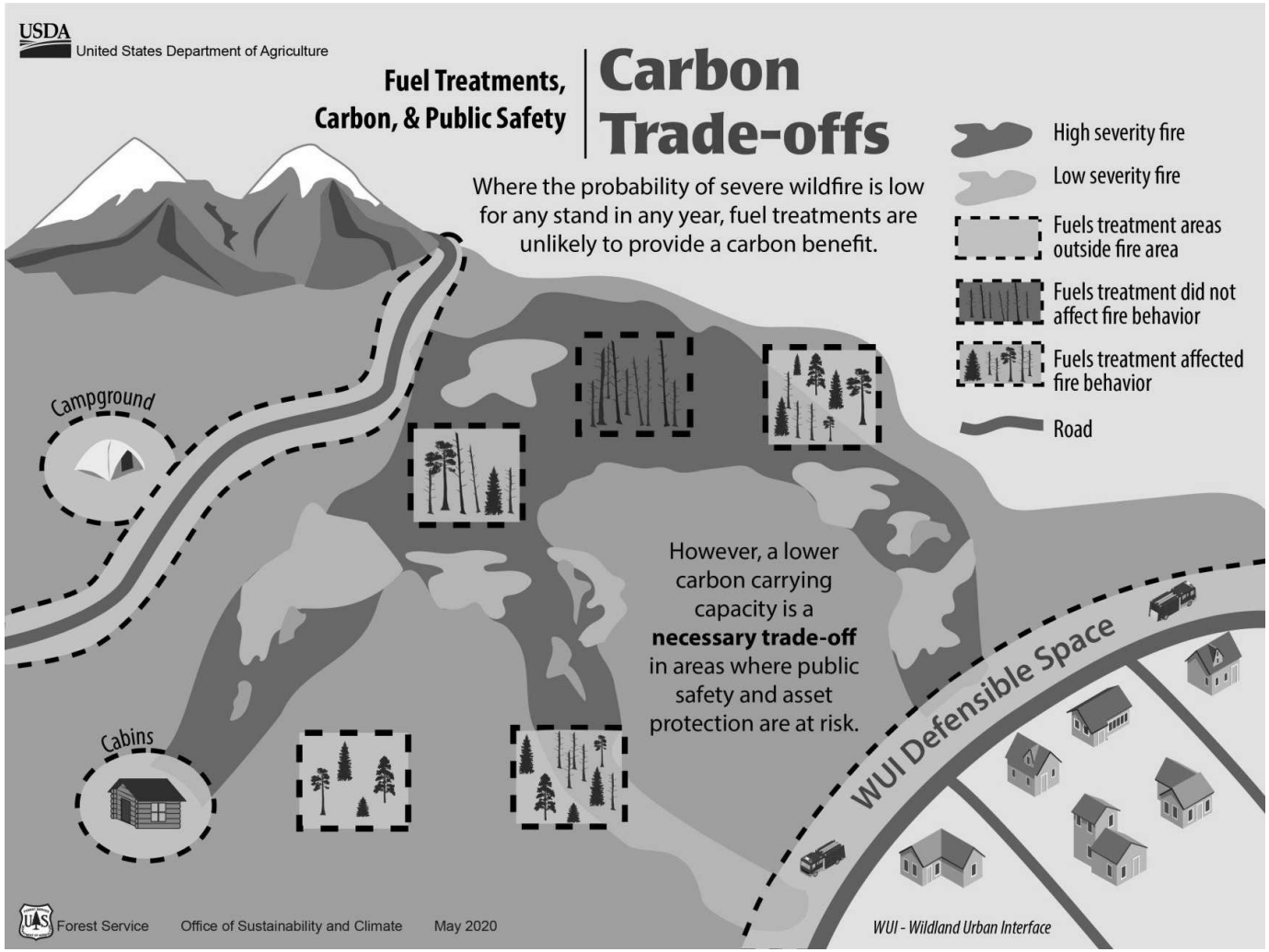
RPA 2016 assessment

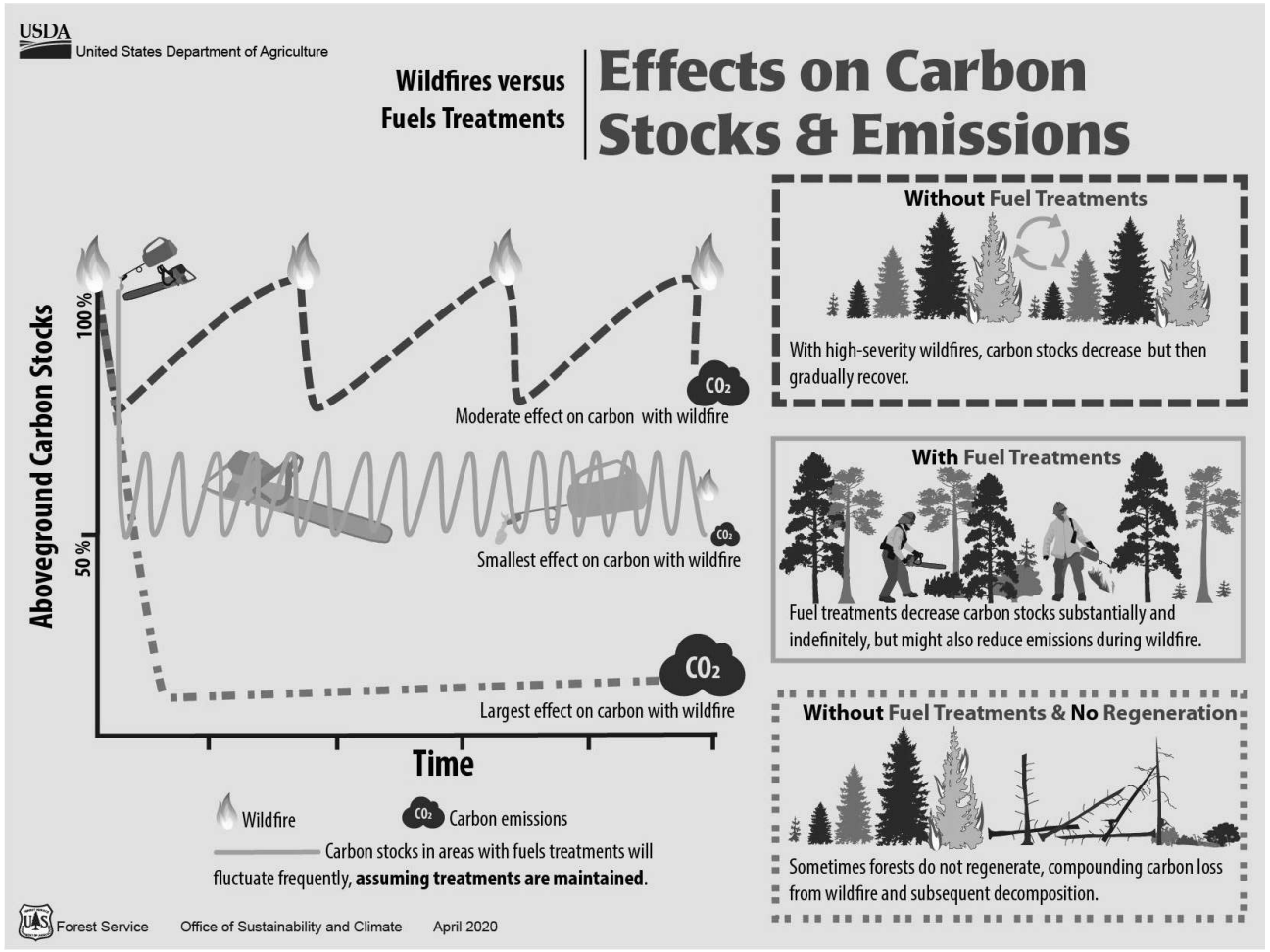

USDA
United States Department of Agriculture
The Importance of Keeping Forests as Forests
Carbon & Land Cover Changes
CO_2
Even if a forest is disturbed or harvested, carbon is exchanged in a closed system as long as it remains forest.
CO_2
Some forests can convert to non-forested ecosystems, such as shrublands, after especially severe disturbances.
CO_2
Conversion to non-forest systems can alter ecosystem carbon dynamics indefinitely, often leading to lower ecosystem carbon storage.
CO_2
CO_2
Reforestation, such as tree planting and fostering natural regeneration, can ensure forests remain as forests.
Forest Service
Office of Sustainability and Climate
January 2021


USDA
United States Department of Agriculture
Carbon Gains
Reforestation
Reforestation efforts can accelerate the rates of trees growing back in areas where forests might not regenerate naturally for generations.
WITHOUT Reforestation
Cumulative carbon storage (metric tons per hectare)
200
150
100
50
0
Disturbance event such as wildfire, insects, or disease
Without disturbance or timber harvest
Delayed and/or incomplete regeneration
No regeneration
Decades
WITH Reforestation
Cumulative carbon storage (metric tons per hectare)
200
150
100
50
0
Disturbance event such as wildfire, insects, or disease
Timber harvest
With reforestation
Decades
Soil
Litter
Live trees
Dead forest
Long-lived forest products
Short-lived forest products
Landfill
Product substitution (building materials)
Energy substitution (bioenergy)
Forest Service
Office of Sustainability and Climate
January 2021


USDA
United States Department of Agriculture
Carbon
BENEFITS
in the Broad View
How Carbon Stacks Up
In the NARROW VIEW of the forest system (shorter time scale, smaller geographic extent, narrow range of activites that influence carbon), there is a net INCREASE in CO2 emissions.
In the BROAD VIEW of the forest system (longer time scale, broader geographical extent, broad range of activites that influence carbon), there is a net DECREASE in CO2 emissions.
Cumulative carbon storage
(metric tons per hectare)
250
200
150
100
50
0
Timber harvest
Without timber harvest
Additional carbon
20
40
60
80
100
Years
Soil
Litter
Trees
Long-lived forest products
Short-lived forest products
Landfill
Product substitution (building materials)
Energy substitution (bioenergy)
Forest Service
Office of Sustainability and Climate
February 2019


USDA
United States Department of Agriculture
Carbon Gains and Losses
Salvage Harvesting
Salvage harvesting can result in more carbon storage than letting dead trees decompose in the forest.
Without Salvage Harvest
Cumulative carbon storage
(metric tons per hectare)
200
150
100
50
0
Disturbance event such as wildfire, insects, or disease
Without disturbance
Decades
With Salvage Harvest
Cumulative carbon storage
(metric tons per hectare)
200
150
100
50
0
Disturbance event such as wildfire, insects, or disease
Additional carbon
Decades
Soil
Litter
Live trees
Dead trees
Long-lived forest products
Short-lived forest products
Landfill
Product substitution (building materials)
Energy substitution (bioenergy)
Forest Service
Office of Sustainability and Climate
May 2020


USDA
United States Department of Agriculture
Fuel Treatments, Carbon, & Public Safety
Carbon Trade-offs
Where the probability of severe wildfire is low for any stand in any year, fuel treatments are unlikely to provide a carbon benefit.
High severity fire
Low severity fire
Fuels treatment areas outside fire area
Fuels treatment did not affect fire behavior
Fuels treatment affected fire behavior
Road
Campground
However, a lower carbon carrying capacity is a necessary trade-off in areas where public safety and asset protection are at risk.
Cabins
WUI Defensible Space
Forest Service
Office of Sustainability and Climate
May 2020
WUI - Wildland Urban Interface


USDA
United States Department of Agriculture
Wildfires versus Fuels Treatments
Effects on Carbon Stocks & Emissions
Aboveground Carbon Stocks
100 %
50 %
Time
Moderate effect on carbon with wildfire
Smallest effect on carbon with wildfire
Largest effect on carbon with wildfire
Wildfire
Carbon emissions
Carbon stocks in areas with fuels treatments will fluctuate frequently, assuming treatments are maintained.
Without Fuel Treatments
With high-severity wildfires, carbon stocks decrease but then gradually recover.
With Fuel Treatments
Fuel treatments decrease carbon stocks substantially and indefinitely, but might also reduce emissions during wildfire.
Without Fuel Treatments & No Regeneration
Sometimes forests do not regenerate, compounding carbon loss from wildfire and subsequent decomposition.
Forest Service
Office of Sustainability and Climate
April 2020

SPEAKER

Lauren Onofrio

RAP Intern

Office of Sustainability and Climate

OUTLINE

- What's the interest in forest carbon?
- "Carbon System" and key concepts
- Rangeland carbon
- Forest Service experience and policy
- How carbon is estimated
- How the Forest Service influences carbon through vegetation management
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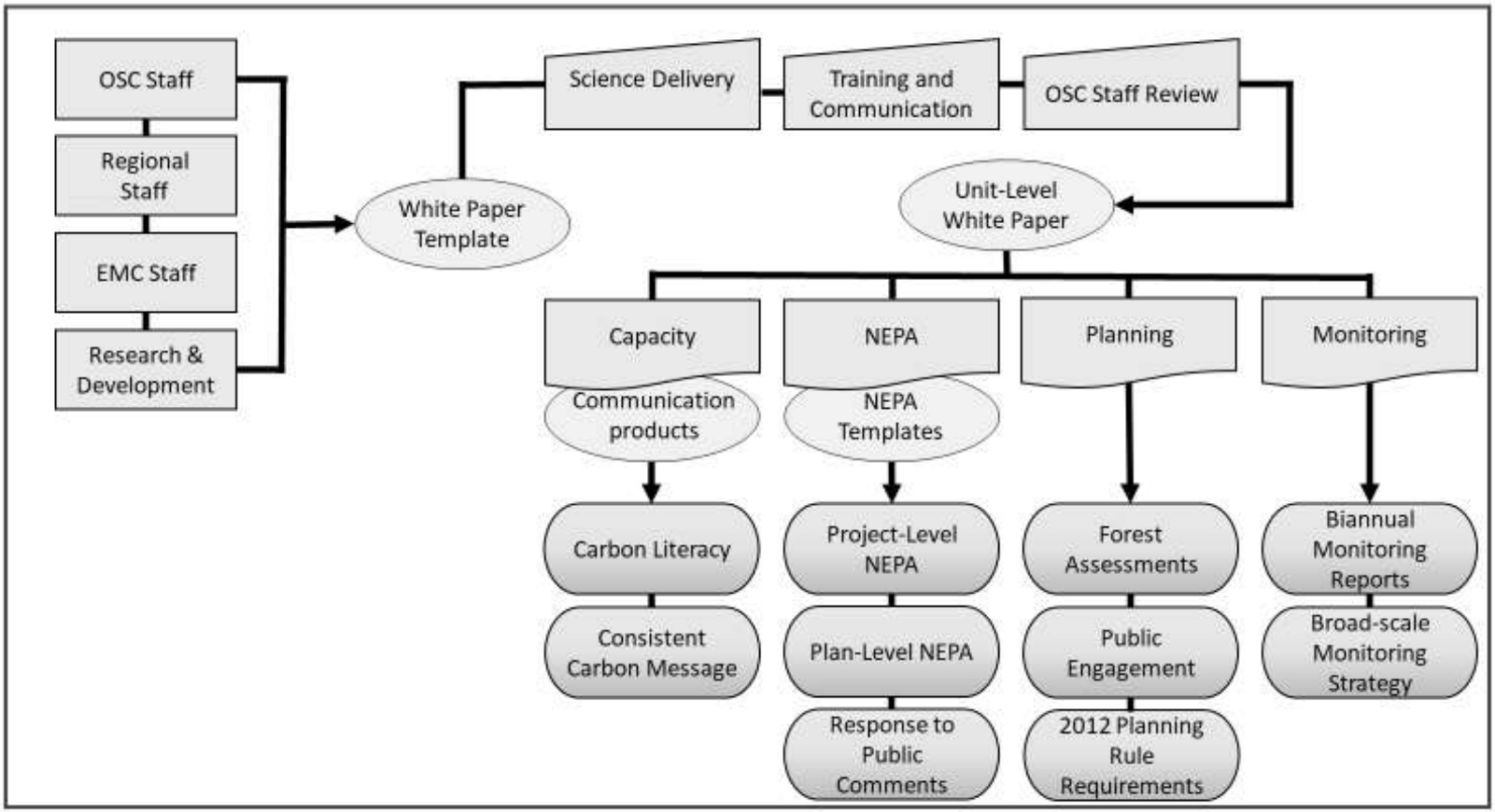
- Sustainable operations – your role
- How we can help you

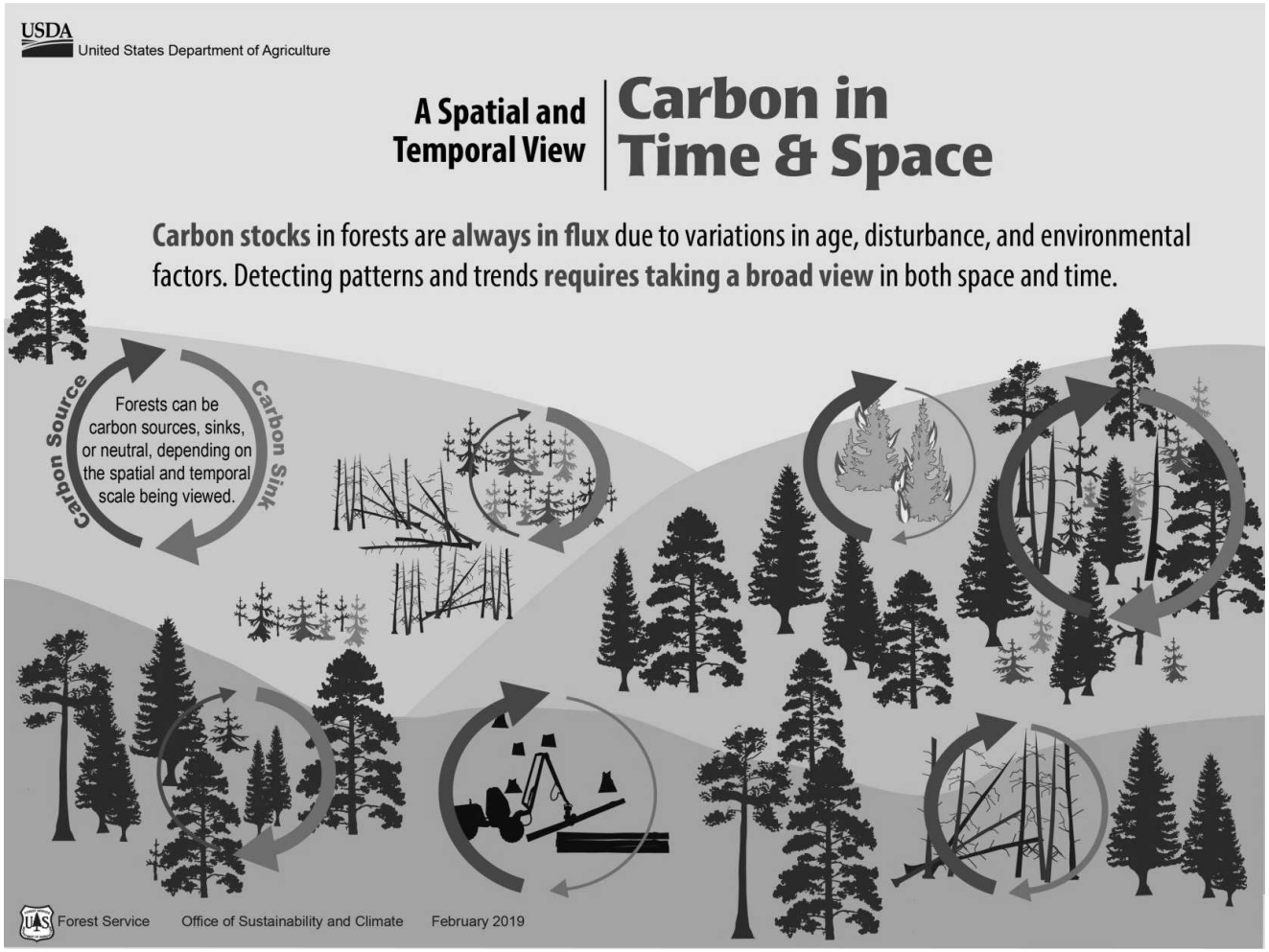
OUR GOALS IN DELIVERING SCIENCE ACROSS OUR NATIONAL FORESTS…

- Develop information and approach that's consistent and transferable among all National Forests
- Based on the best available science
- Ensure information "answers" to policy needs
- Reduces burden to individual National Forests while improving quality of information for decision makers and the public

THE TEMPLATE-BASED APPROACH



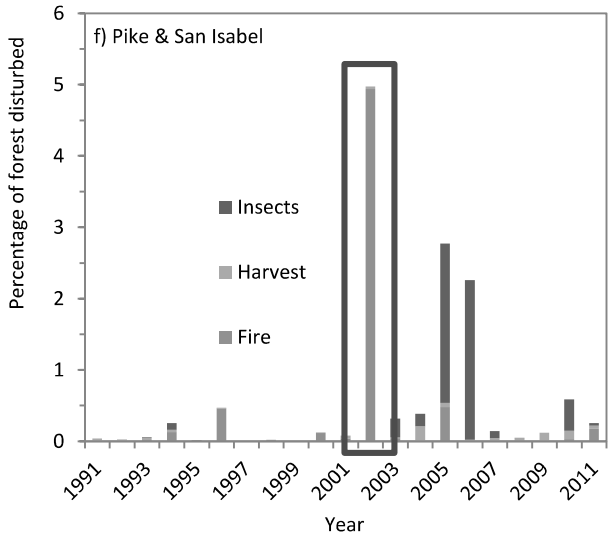

NATIONAL APPROACH CAN PROVIDE RELEVANT CONTEXT



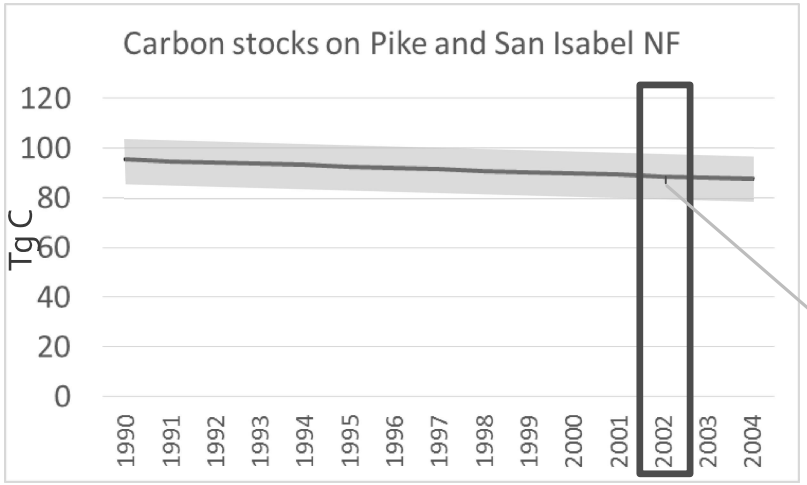
Time and space

DETECTING CHANGES IN CARBON STOCKS AFTER LARGE DISTURBANCES: "HAYMAN FIRE"

- Burned about 135,000 acres (211 sq. miles) in the Pike & San Isabel National Forest, largest fire in CO state's history
- Although stunning visually, only about 4.9 percent of the total forested area was affected by fire.
- Assuming high severity fire on all acres burned, about 1.76 Tg C could have been volatilized during wildfire.
- In 2013, total carbon stocks were 82.7 Tg C ± 8 Tg C
- Consistent downward trend since 1990, suggests broad-scale change



Disturbance assessments

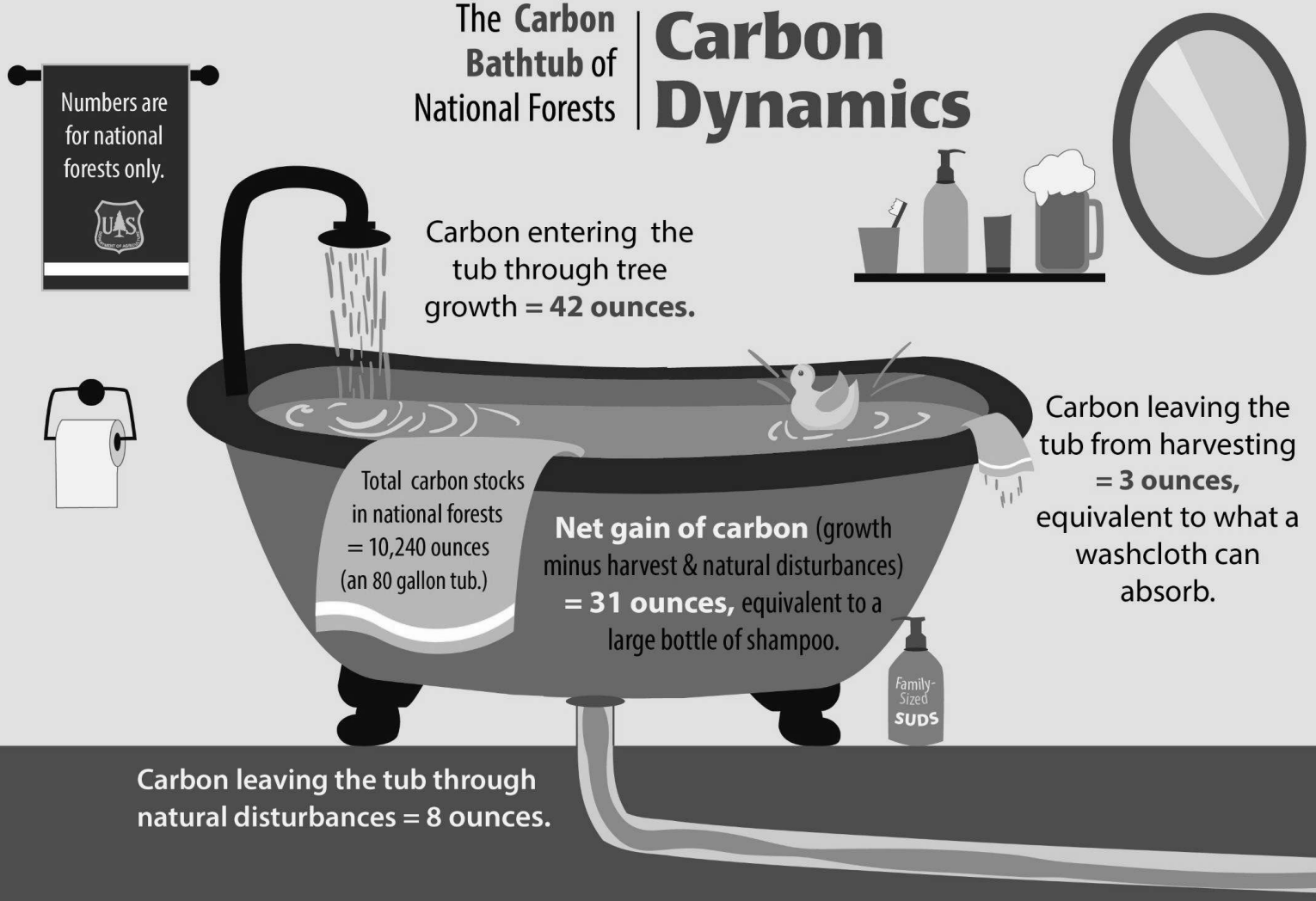


Baseline assessments

Approximate immediate impact of wildfire on carbon stocks

USDA
United States Department of Agriculture

The Carbon Bathtub of National Forests | Carbon Dynamics



SPEAKER

Jacob Deal

ORISE Fellow

Office of Sustainability and Climate & R8

OUTLINE

- What's the interest in forest carbon?
- "Carbon System" and key concepts
- Rangeland carbon
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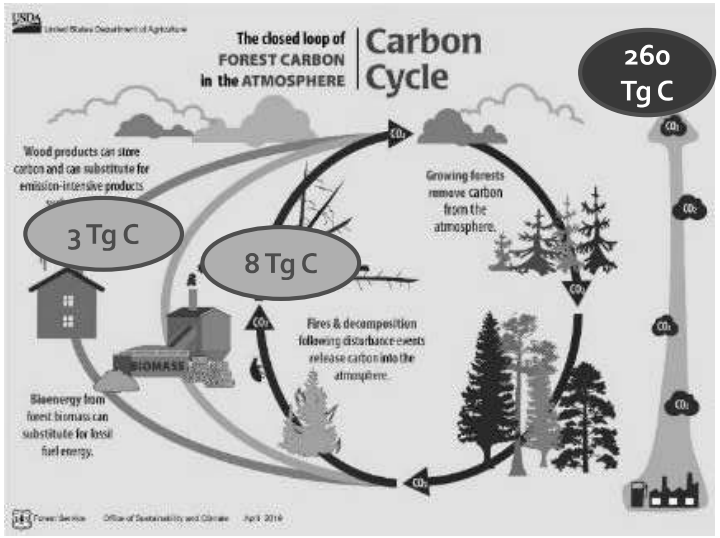
- How we can help you

GREENHOUSE GAS EMISSIONS FROM OIL, GAS, AND COAL DEVELOPMENT

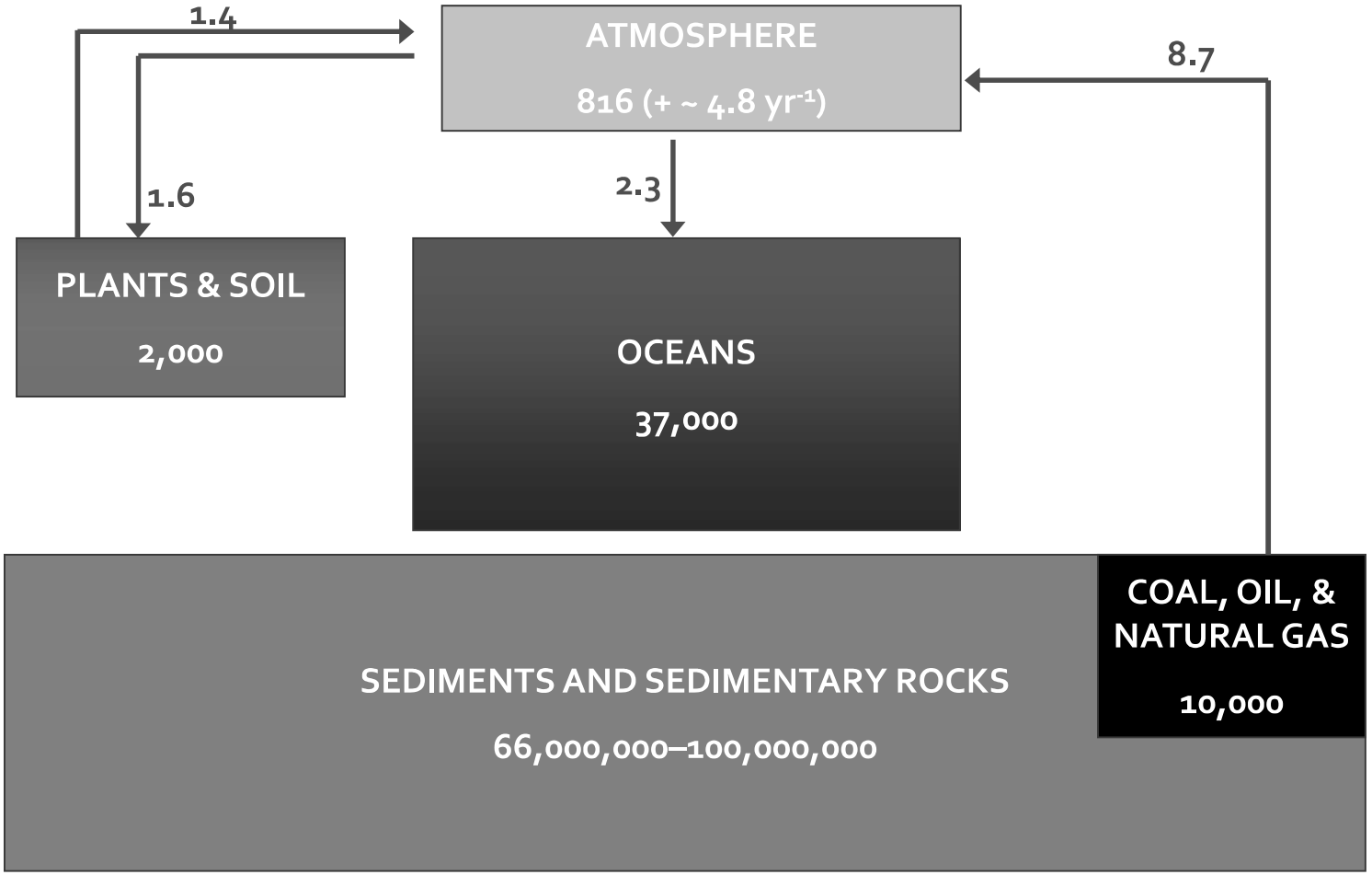
In Context: Comparing Carbon Emissions from Coal Energy Use

- A 1000 Megawatt (MW) plant, servicing about 500k people, consumes 9,000 metric tonnes of coal per day
  - That's 90 train cars – each carrying 100 metric tonnes
  - Assuming Anthracite coal is used – 1 train car every ~16 minutes
    - That's 220 lbs of coal every second!
    - In terms of carbon, that's about 100 lbs!
- There are about 308 coal power plants nationwide
- Results in about 260 Tg C annually

(https://www.eia.gov/tools/faqs/faq.php?id=77&t=11)

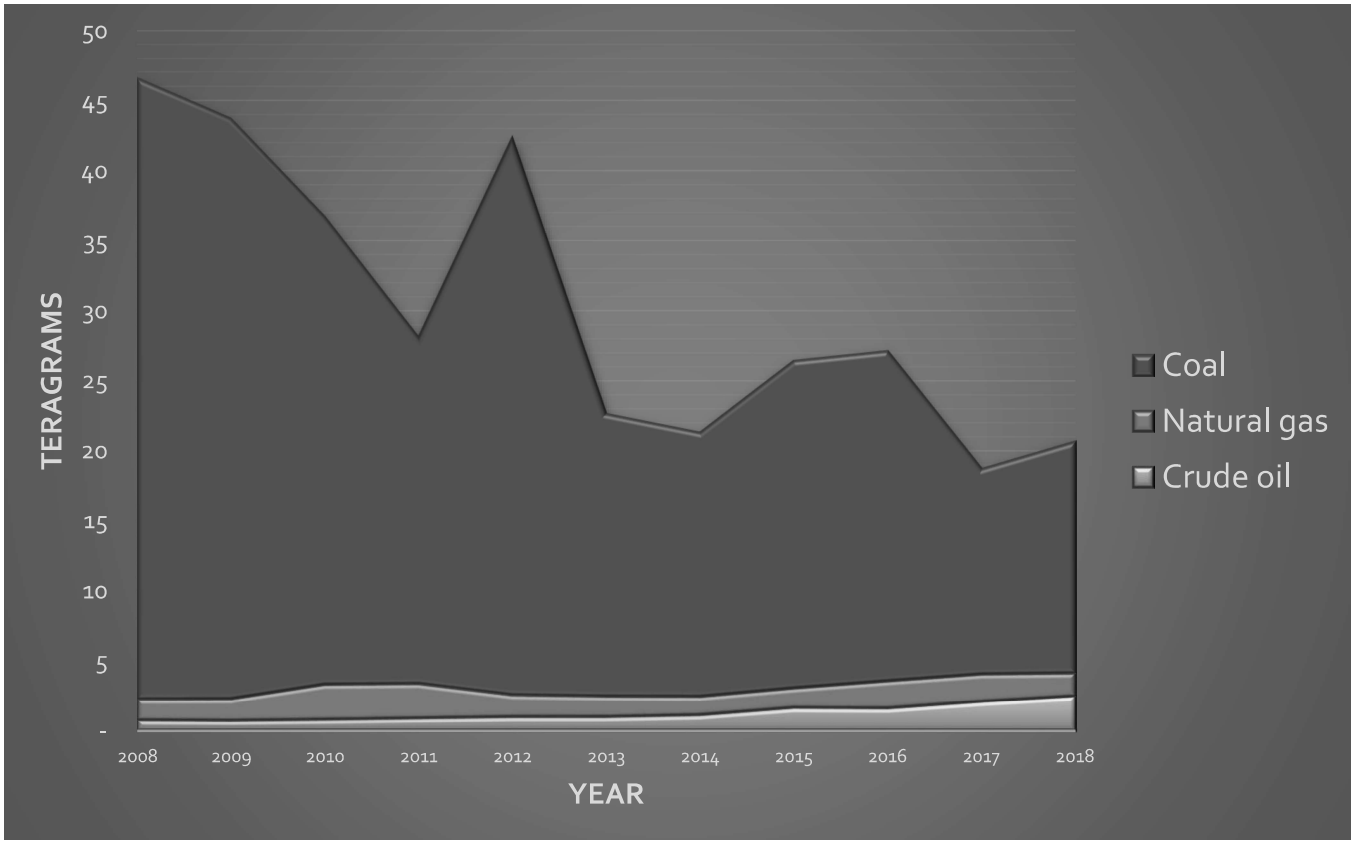


GLOBAL STOCKS AND FLOWS OF CARBON

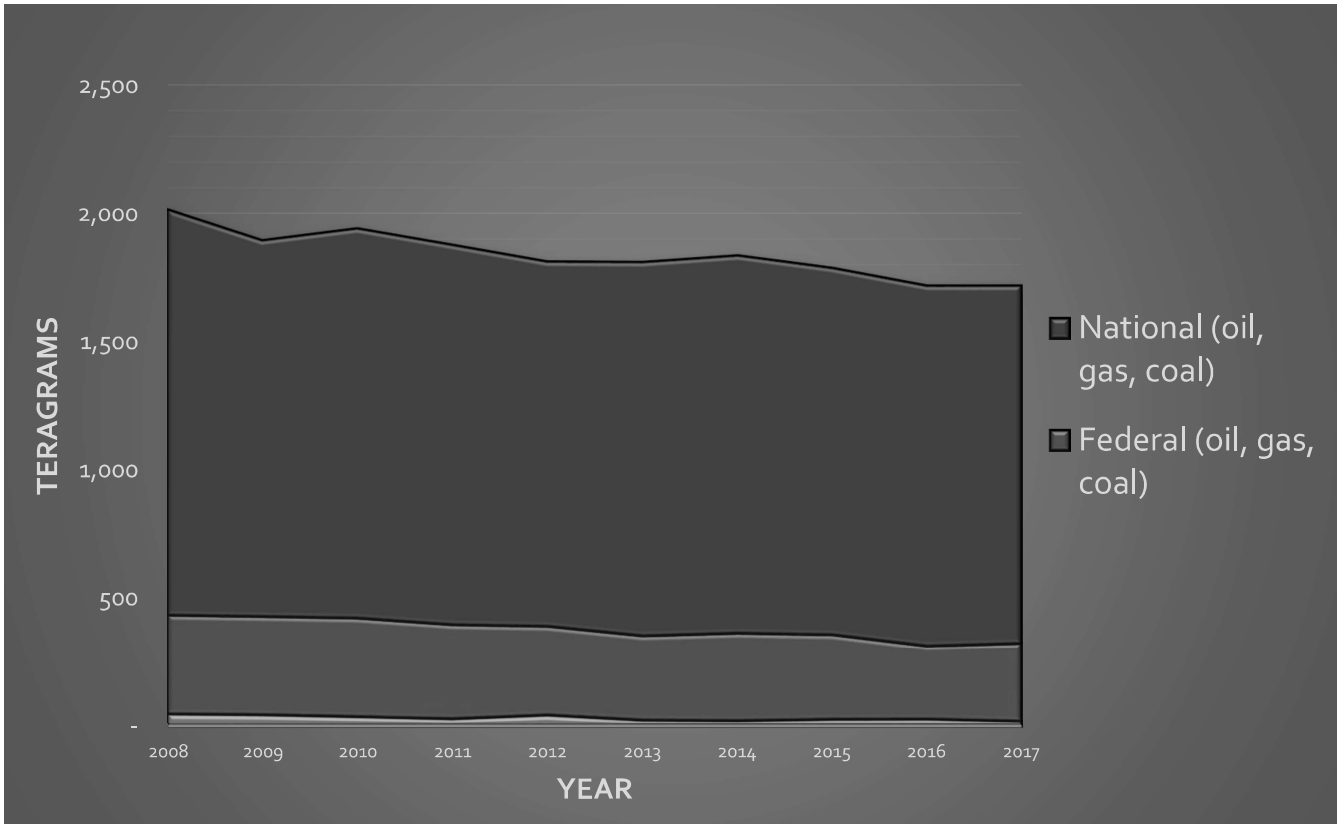


McKinley et al. 2011

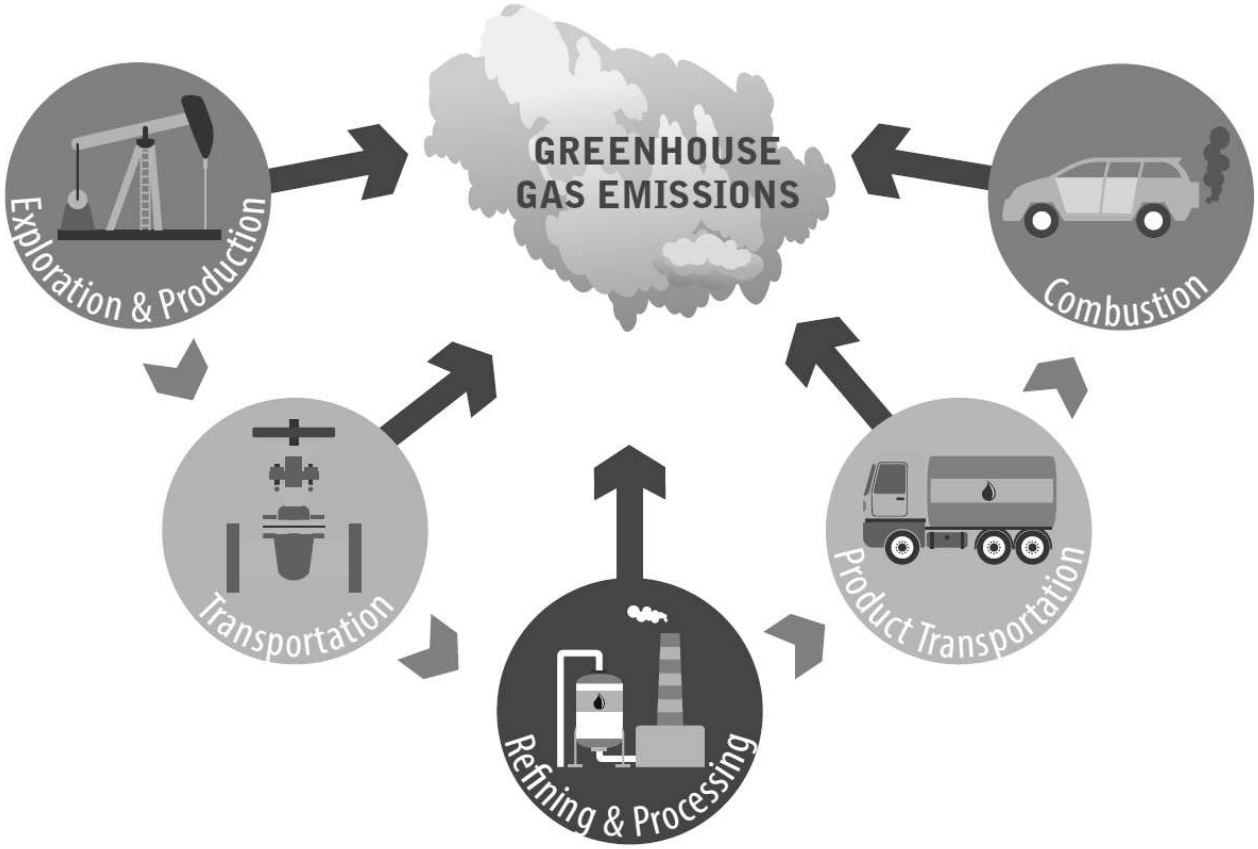
GHG EMISSIONS FROM FOREST SERVICE LEASES



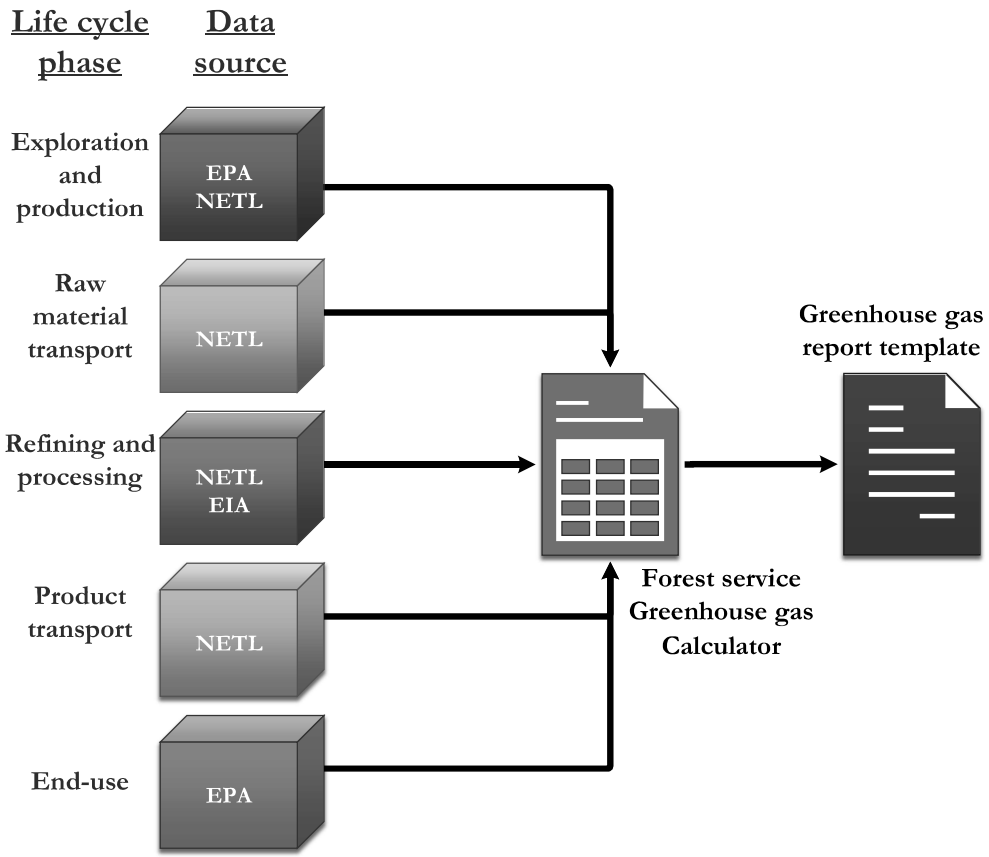
BUT HOW DO OUR LEASE EMISSIONS COMPARE?



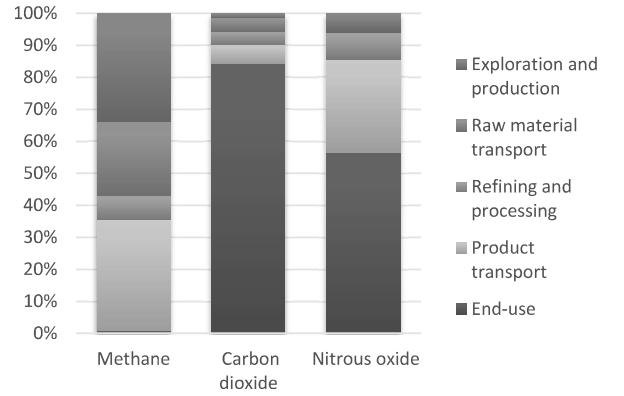
A HOLISTIC APPROACH

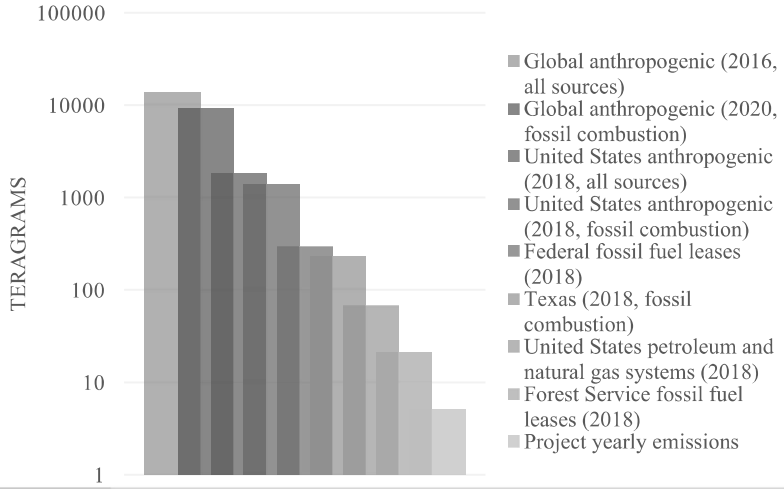


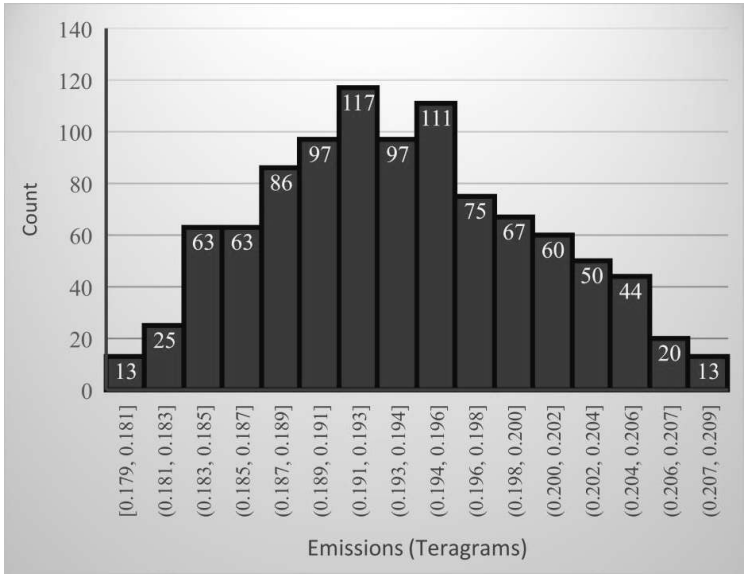
DATA TO TEMPLATE



Example of analysis in template



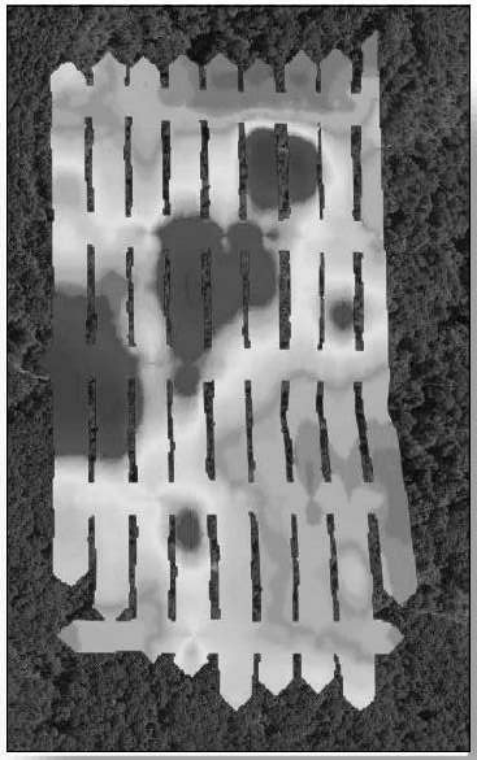




EXPAND OUR ANALYSIS BOUNDARY?

ABANDONED INFRASTRUCTURE ON THE DANIEL BOONE NF

- Wells, pump jacks, tanks full of bottom sludge, powerlines with cables strewn across the forest floor, silt ponds, buildings and miles of pipeline
- Utilized drone technology and various sensors
- Prioritize areas for mitigation
- Work is relevant to recent "Climate Crisis" EO



Raw magnetometer data. Red (warmer) colors indicate wells and other metal hits. Credit: Shiloh Benton, Daniel Boone NF


What can I personally do to decrease my footprint?

SPEAKER

Aurora Cutler

Information and Education Specialist

Office of Sustainability and Climate

OUTLINE

- What's the interest in forest carbon?
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SUSTAINABILITY IS AT THE HEART OF THE FOREST SERVICE MISSION.

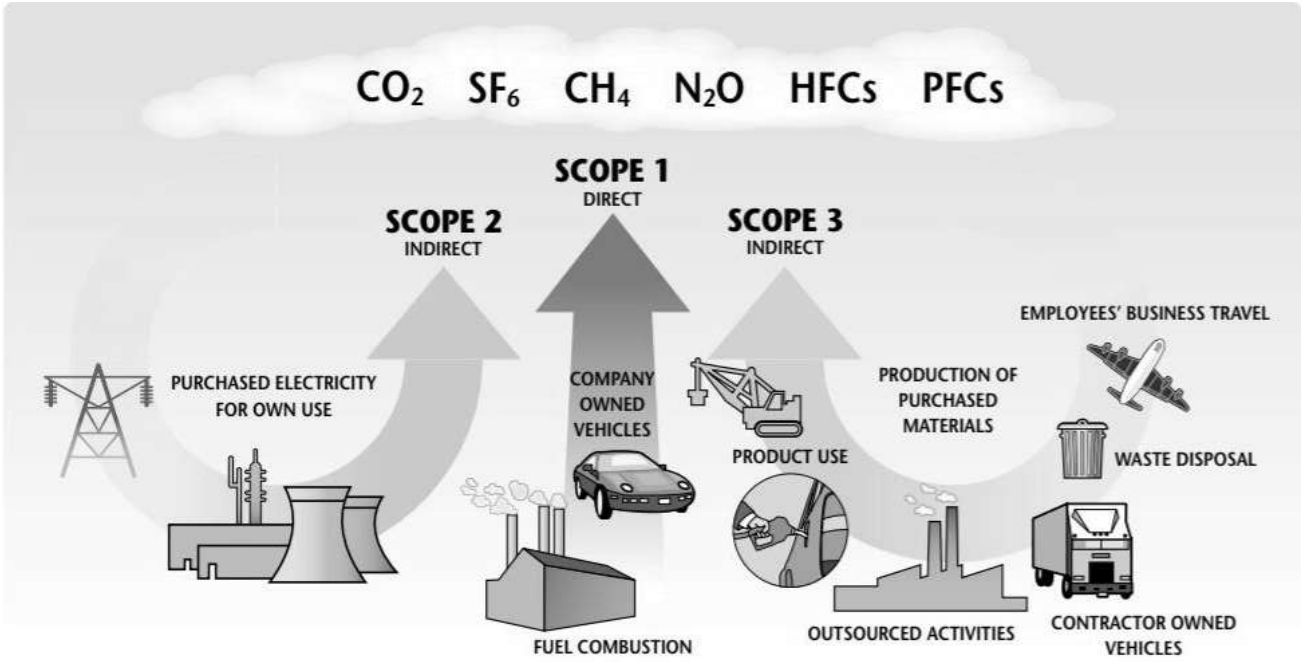
"...TO SUSTAIN THE HEALTH, DIVERSITY, AND PRODUCTIVITY OF THE NATION'S FORESTS AND GRASSLANDS TO MEET THE NEEDS OF PRESENT AND FUTURE GENERATIONS."

SUSTAINABLE OPERATIONS IN THE FOREST SERVICE

- Sustainable Operations reduces the impact of operations on our ecological footprint
- The agency's goal is to integrate sustainability into our operations, to reduce impacts in:
  - Energy and Water Consumption
  - Fleet & Transportation
  - Acquisition
  - Waste Prevention & Recycling
- Results:
  - Saves money, time, and resources
  - Results are tracked by USDA and Office of Management and Budget
  - Part of the individual Performance Plan of every supervisor in FS

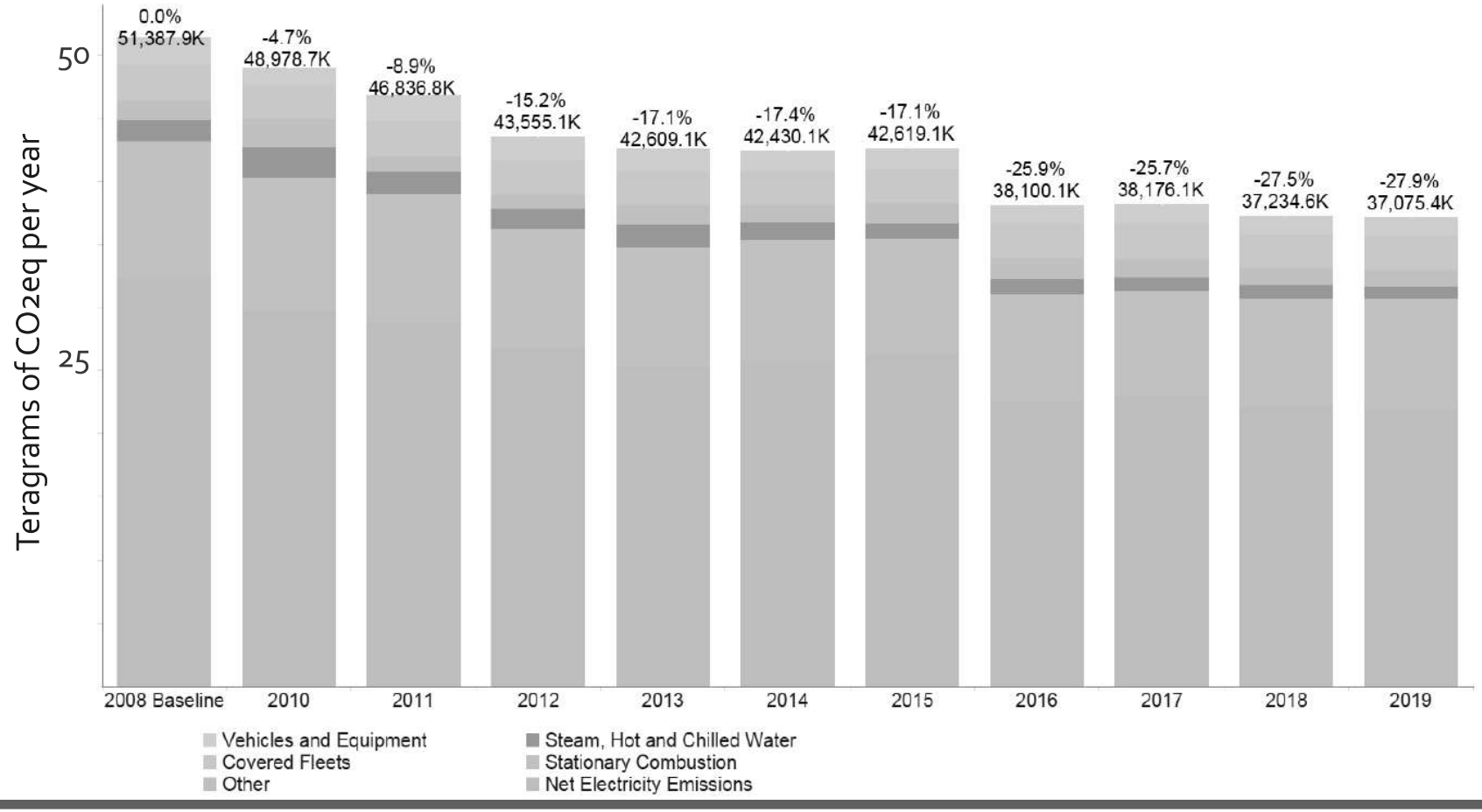
HOW WE MEASURE OUR EMISSIONS

- **Scope 1 – All Direct Emissions** from the activities of the Agency or under their control. Includes fuel combustion on site such as gas boilers and fleet vehicles.
- **Scope 2 – Indirect Emissions** from electricity purchased and used by the Agency. Emissions are created during the production of the energy and eventually used by the Agency.
- **Scope 3 – All Other Indirect Emissions** from activities of the Agency, occurring from sources that they do not own or control. Includes employee commuting and business travel.

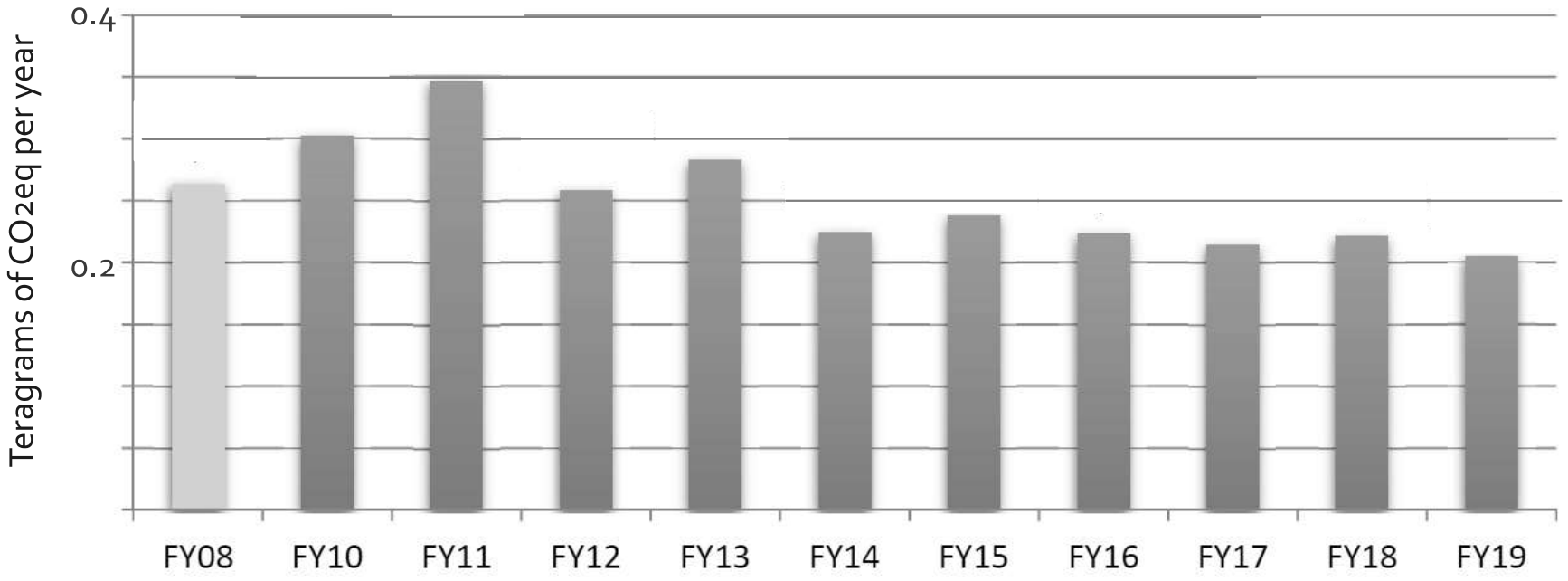


Source: Bhatia and Ranganathan, 2004

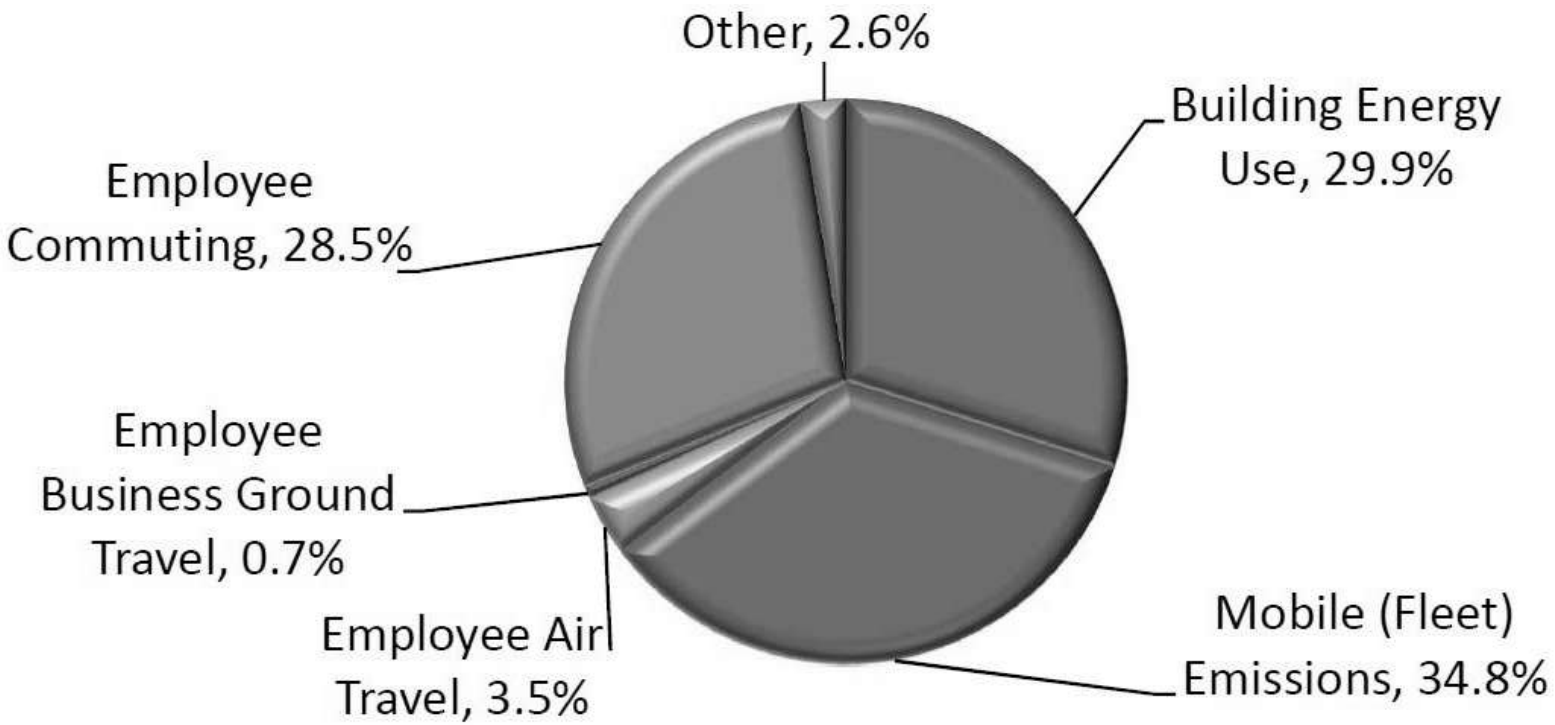
SCOPES 1 & 2 GHG EMISSIONS (FEDERAL GOVERNMENT)



SCOPES 1 & 2 GHG EMISSIONS (FOREST SERVICE)



FY19 GHG EMISSIONS CATEGORIES (FOREST SERVICE)



REDUCING OUR CARBON FOOTPRINT

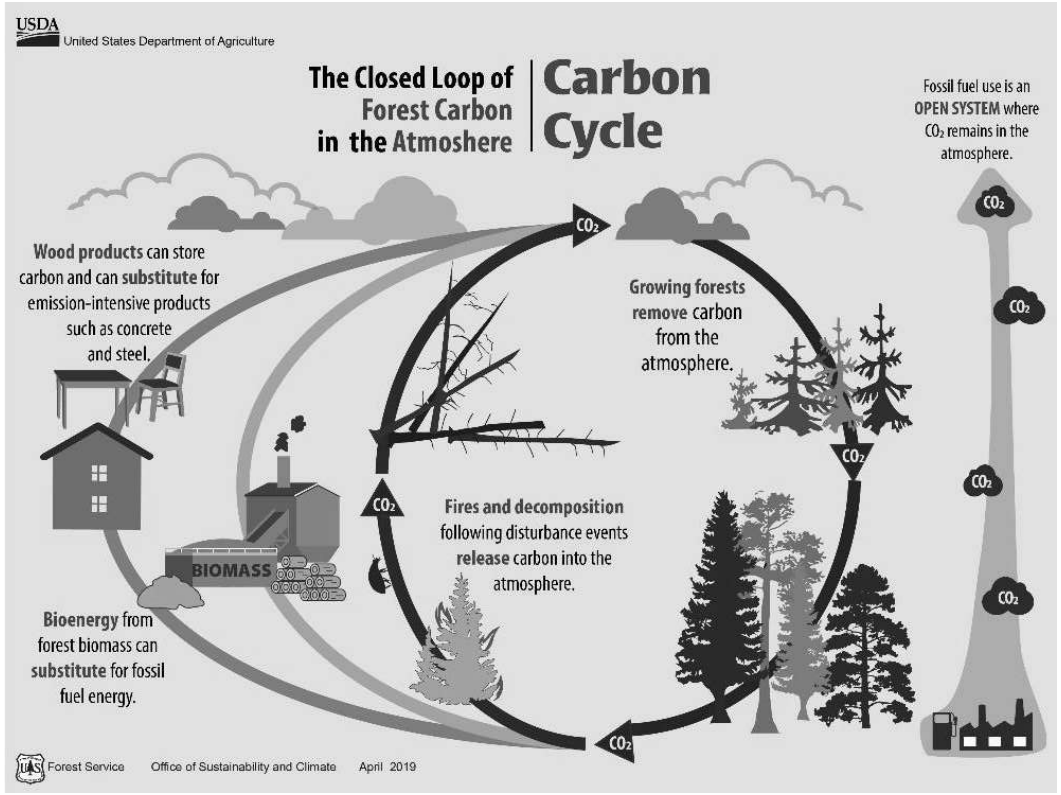
It's all about our dedicated employees

Forest Service savings from the Leadership in Sustainable Operations (LISO) Database (FY16-Current)

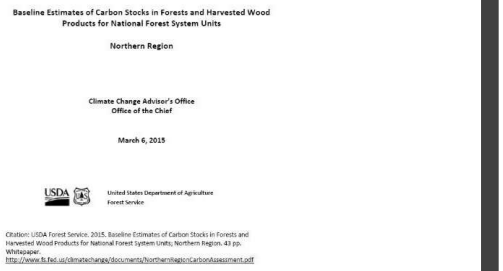
- **Estimated Savings Reported since 2016**
  - Electricity: 796,128 kWh
  - Water: 3,439,887 gallons
  - Fuel: 139,637 gallons
  - **Money: $750,540!!**

UNDERSTANDING THE SUBSTITUTION EFFECT

One woman's quest to understand her emissions in heating her Colorado home. Wood or propane?



CARBON INFORMATION AND TOOLS & RESOURCES



Baseline Estimates of Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units

Northern Region

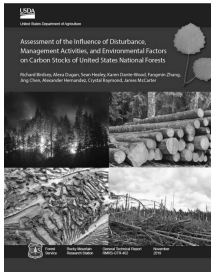
Climate Change Advisor's Office
Office of the Chief

March 6, 2015

USDA United States Department of Agriculture
Forest Service

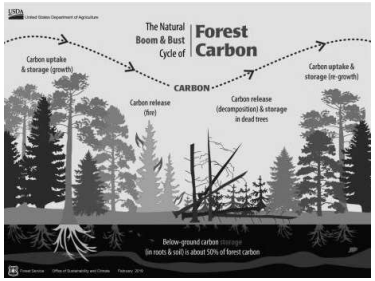
Citation: USDA Forest Service. 2015. Baseline Estimates of Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units, Northern Region. 43 pp.
Whitepaper:
http://www.fs.fed.us/climatechange/documents/NorthernRegionCarbonAssessment.pdf

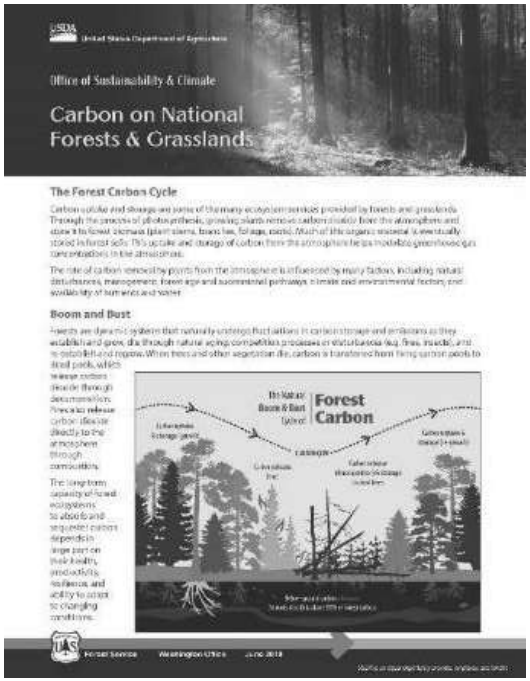
Forest Carbon FAQs



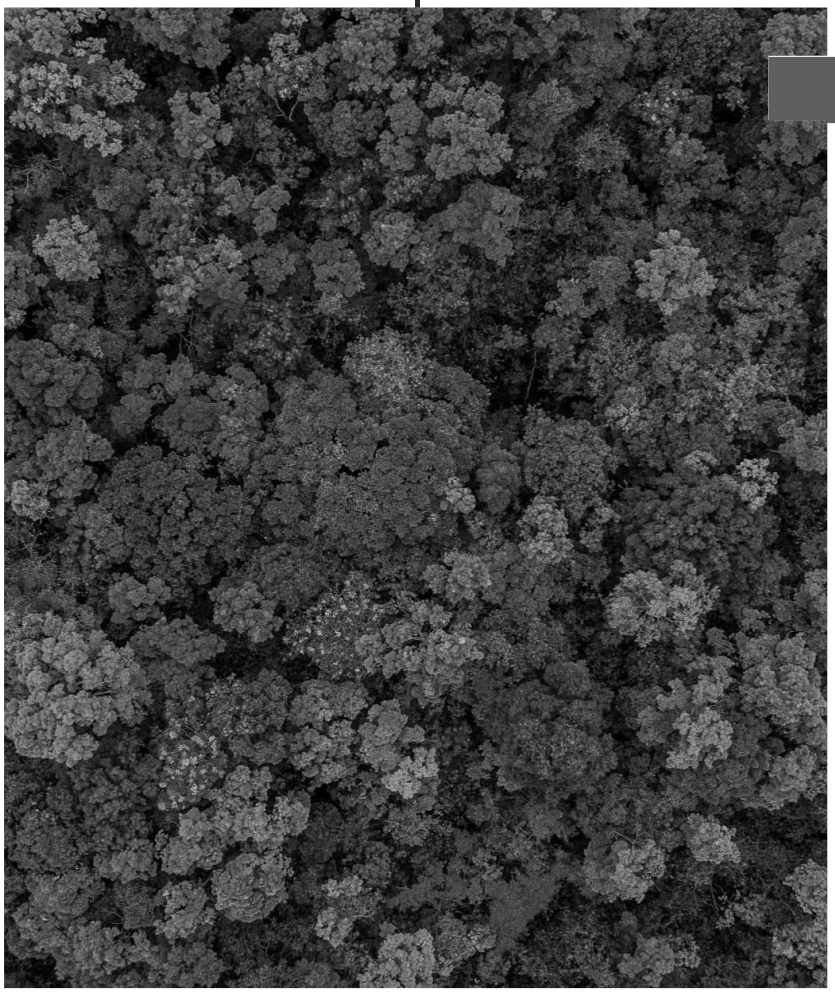
USDA United States Department of Agriculture

Assessment of the Influence of Disturbance, Management Activities, and Environmental Factors on Carbon Stocks of United States National Forests





Resources (one stop shopping)
OSC Carbon Sharepoint:
https://usdagcc.sharepoint.com/sites/fs-nfsosc/Pages/Carbon.aspx
Public facing website:
https://www.fs.fed.us/managing-land/sc/carbon (public)



SUMMARY

- Public interest in carbon is increasing as well as the need for information and capacity to respond effectively.
- The Forest Service does not manage to maximize carbon, but already does a lot of management activities that create carbon benefits.
- The carbon template-based approach for forest carbon and energy development is an effective and efficient means to deliver information to inform decision making.
- Sustainability starts with all of us….
- OSC is developing education and communication products to help build internal capacity and foster constructive public engagement.

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Website,
https://www.fs.usda.gov/managing-land/sc/carbon