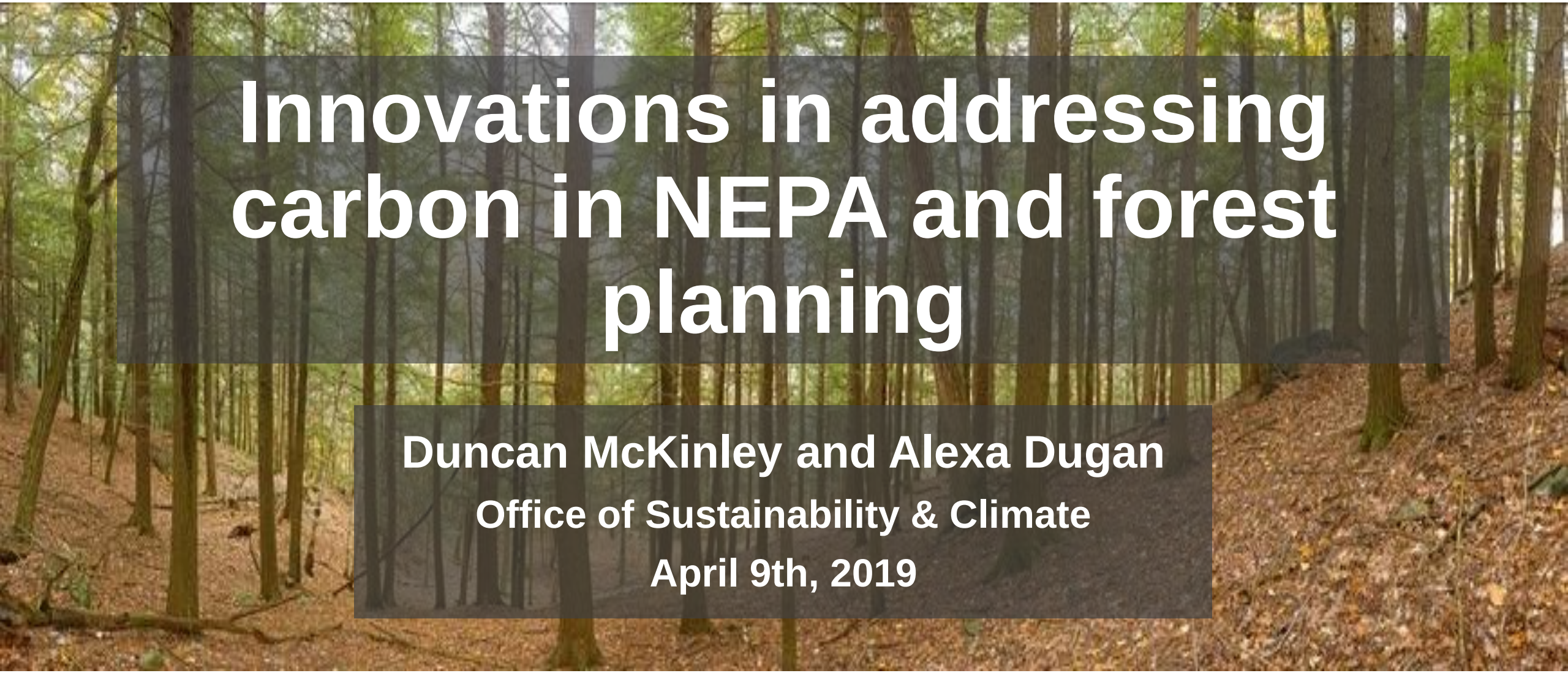
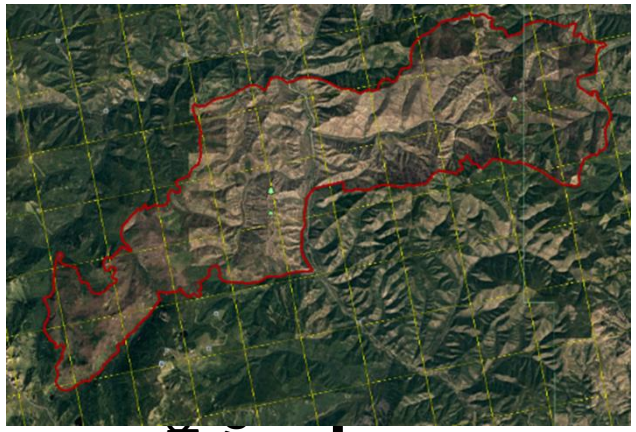


Innovations in addressing carbon in NEPA and forest planning

Duncan McKinley and Alexa Dugan
Office of Sustainability & Climate
April 9th, 2019

Diminishing Returns – Carbon Analysis



EADM?

Imagine if?

You can provide high-quality and legally defensible information and decision documents…

1. **Project-level NEPA; from days to weeks: now < hours**
2. **Forest carbon assessment/white paper; 4-6 weeks: now 2-days**
3. **Plan-level NEPA; 4-6 weeks: now 2-4 days**
4. **Broader-scale monitoring report: 4-6 weeks; now 2-3 days**

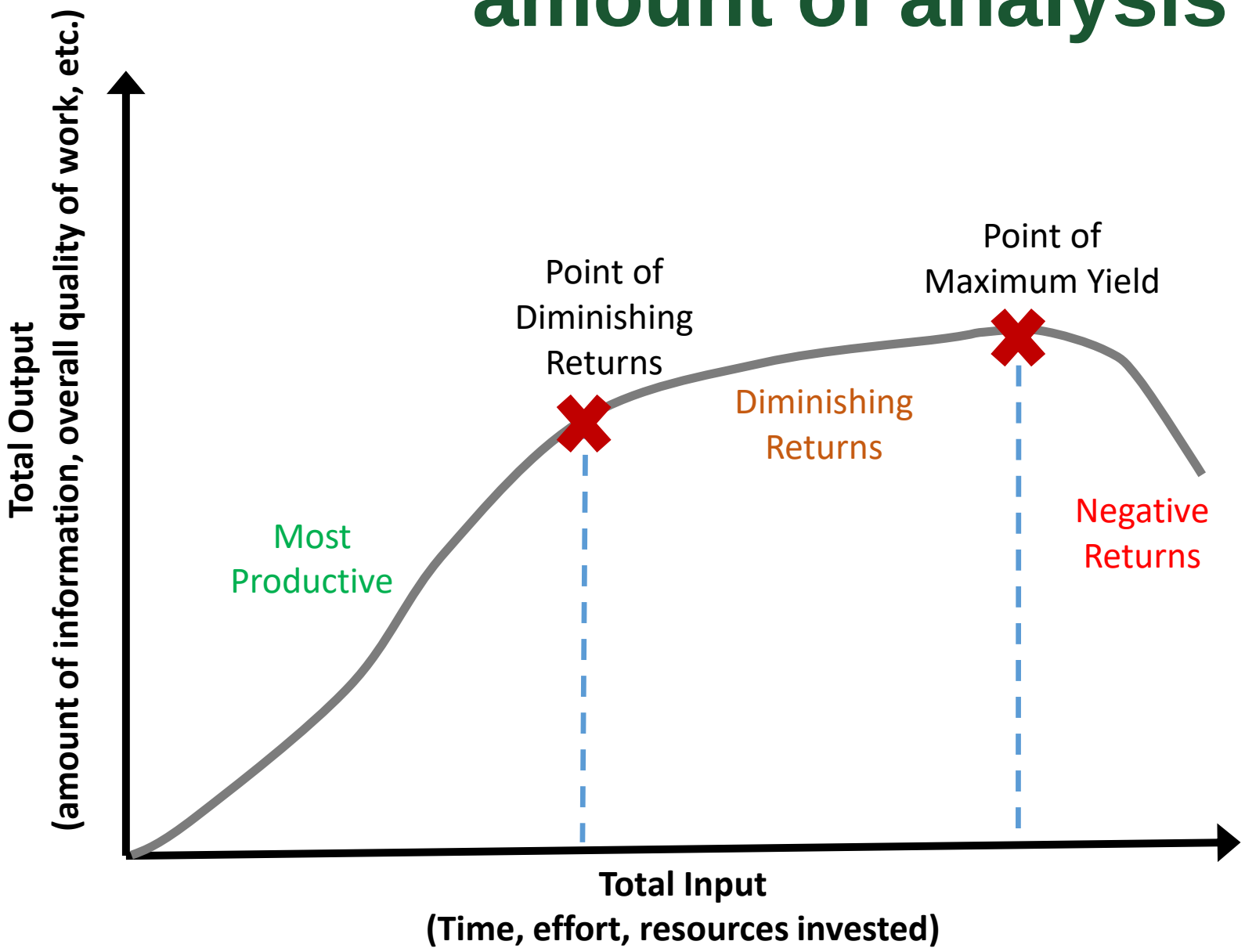
Outline

1. **How innovation is possible**
   - **Consistent conceptualization of the forest carbon system**
   - **Availability of nationally consistent set of carbon information**
     - *Baseline report*
     - *Disturbance report*
2. **Conceptual framing of forest carbon – the foundation for the approach**
3. **Why templates and how they work**
   - **Goals**
   - **Key innovations**
   - **How to use**
4. **What the Office Sustainability and Climate is working on to better serve you**

Key innovations that make this level of efficiency possible…

- Adoption of holistic view of the forest system that is fully supported by policy and the best available science
- Availability of nationally consistent data sets for each national forest/administrative unit
- Templates that are clear, concise, and emphasizes the most important issues
- Staffing model – OSC is a bridge between R&D and NFS

Diminishing Returns – Finding the right amount of analysis



The ***sweet spot*** depends on:

- **Policy**: what's driving our need to know?
- **Biology**: What makes sense to measure?
  - Context
  - Ability to measure carbon with accuracy and precision.

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

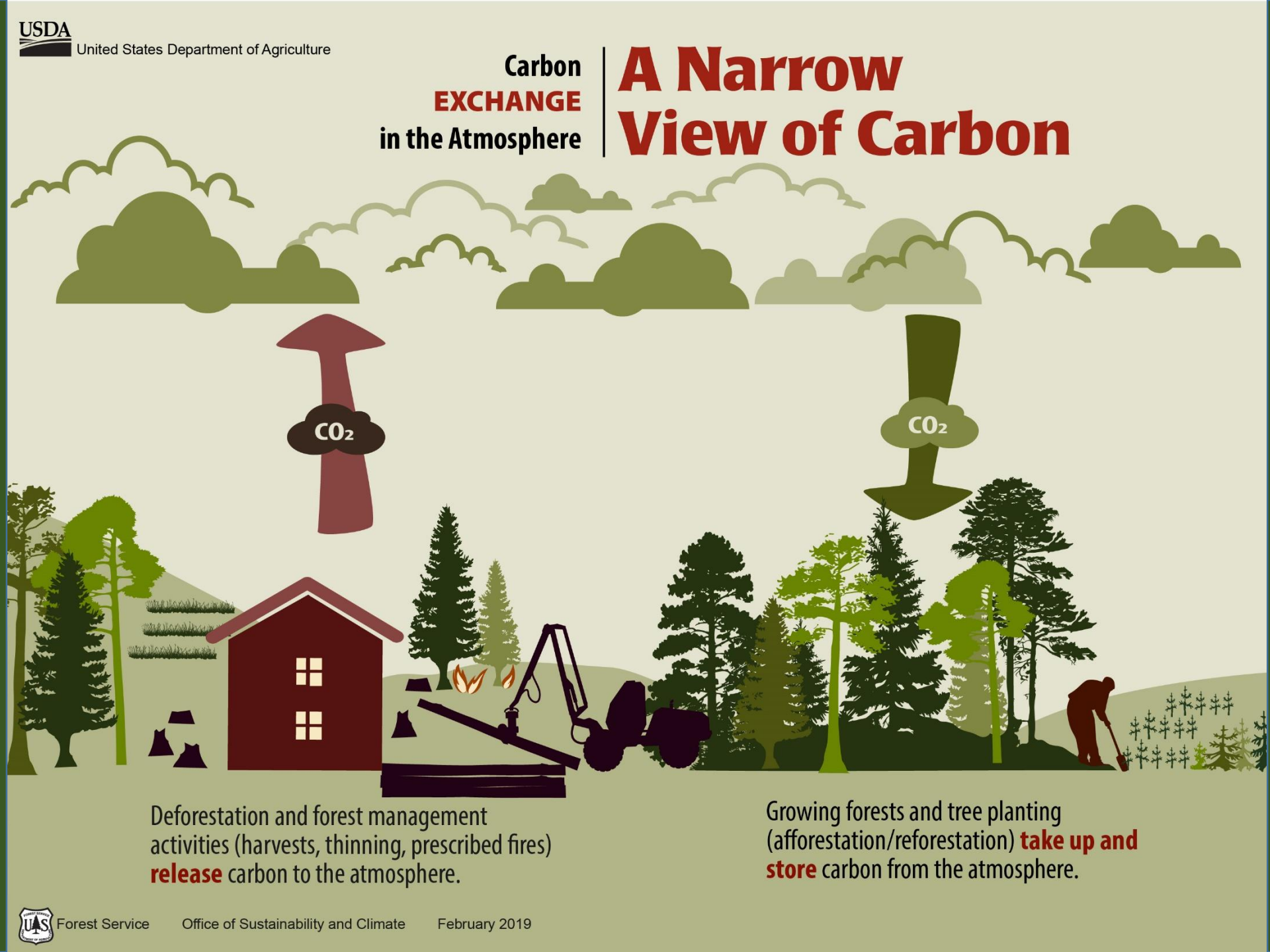
Why a shared view of the system is helpful

- Can develop a common approach (e.g., template, framework, generic language, etc.) for reporting.
- Focus on what's really meaningful and deemphasizing what's not, to increase efficiency and reduce vulnerabilities to litigation
- Reduce inconsistencies
- Provide agreement on what activities will have a desirable or undesirable effect on carbon
- Produce clear and concise documents or responses

Some big questions that we struggle with that's related to how we view the forest system…

- How to reconcile the scale of decision making (i.e. project or forest level) with best **spatial scale** to evaluate patterns and trends in carbon dynamics?
- How to reconcile the **temporal scale** of decision making with the long-term dynamics of carbon?
- How much detail on carbon is necessary to fully inform decision making?

How most people view the forest system…



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

Key concepts that lay the foundation for our approach

- Conceptualizing the forest system – where to draw forest boundaries
- Influence of past legacies on current trends
- Identifying high-impact influences – e.g., land-use/land-cover change
- Forest management on carbon – magnitude of emissions in context

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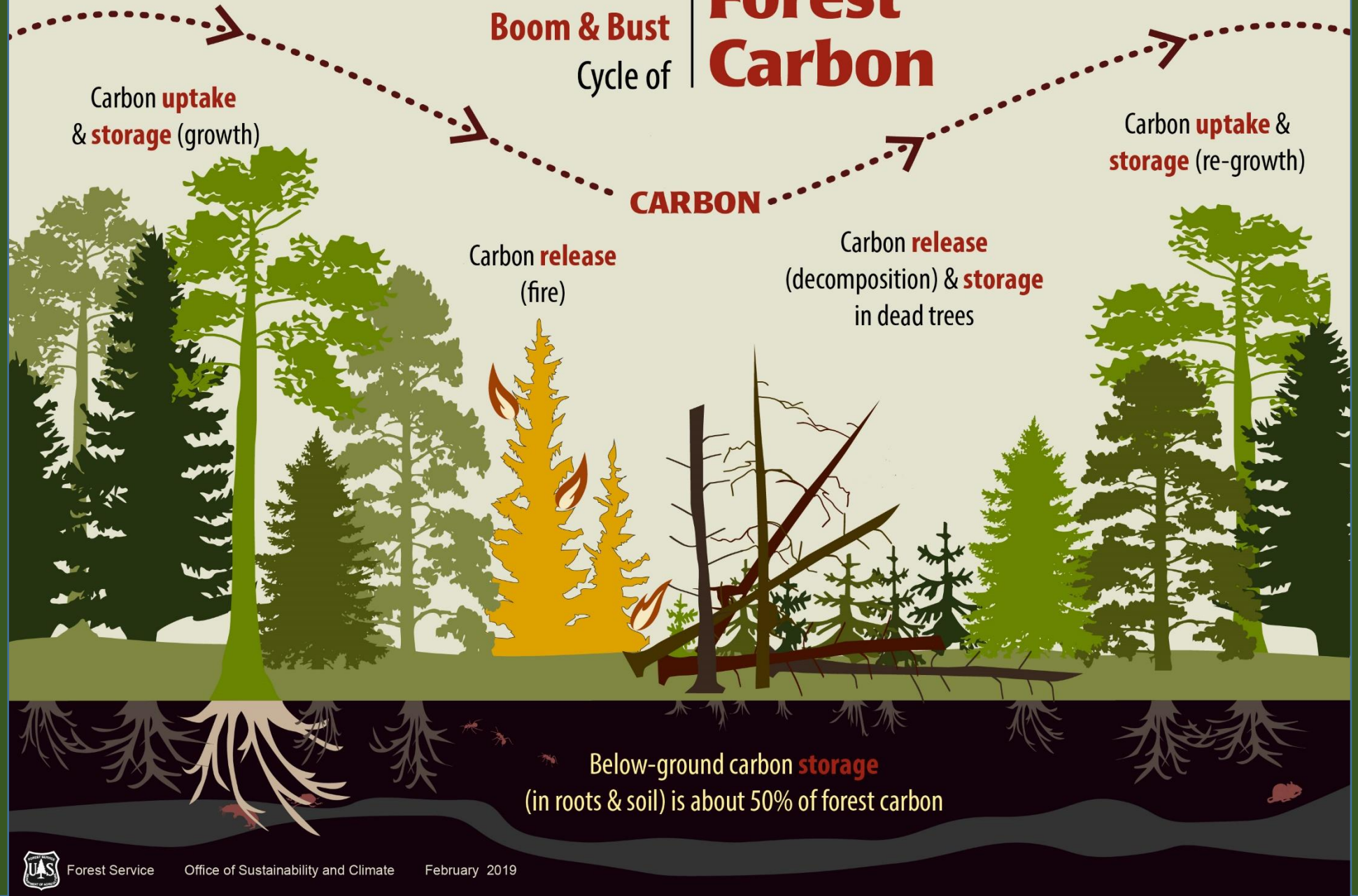
The Natural Boom & Bust Cycle of Forest Carbon



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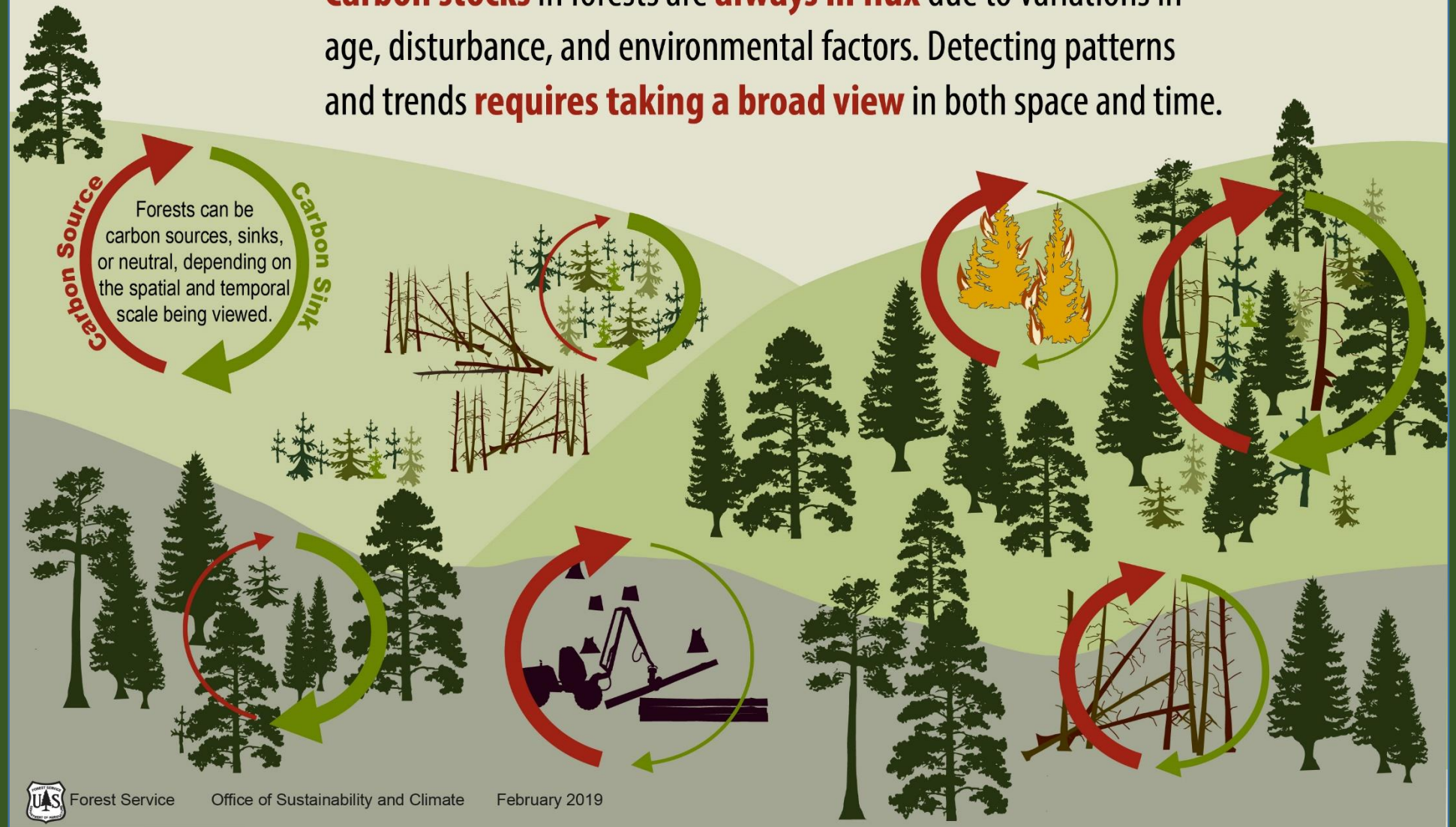
A spatial and temporal view

Carbon in Time and Space

Carbon stocks in forests are **always in flux** due to variations in age, disturbance, and environmental factors. Detecting patterns and trends **requires taking a broad view** in both space and time.



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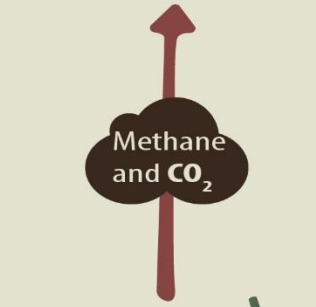
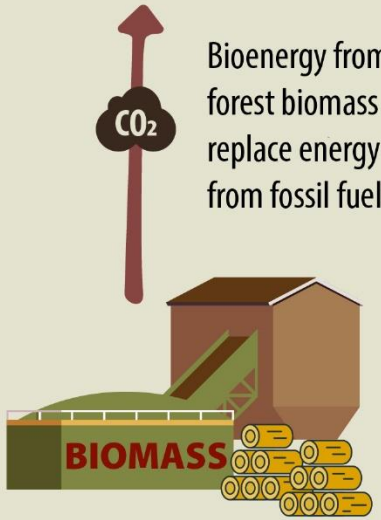
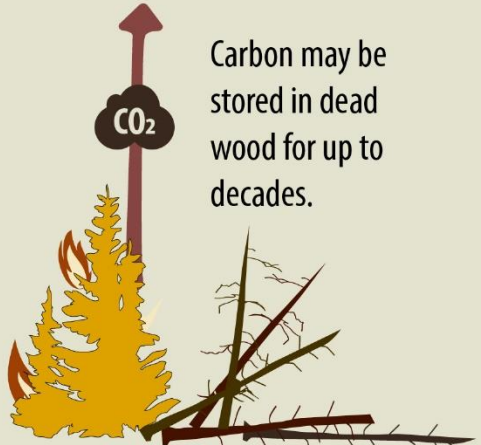
Various pathways of FOREST CARBON into the ATMOSPHERE | Carbon Flux



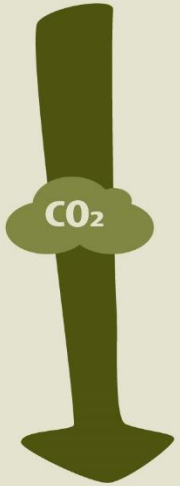
LANDFILL



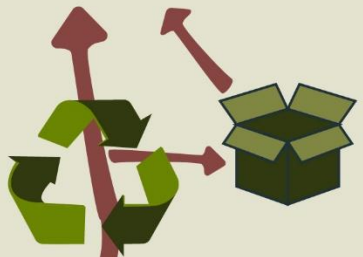
Bioenergy from forest biomass can replace energy from fossil fuels.



Carbon may be stored in dead wood for up to decades.



FIRE & DECOMPOSITION



Forest carbon is released to the atmosphere through **DIRECT** and **INDIRECT** routes.

Forest carbon can take longer to reach the atmosphere if it is recycled or stored in long-lived wood products.

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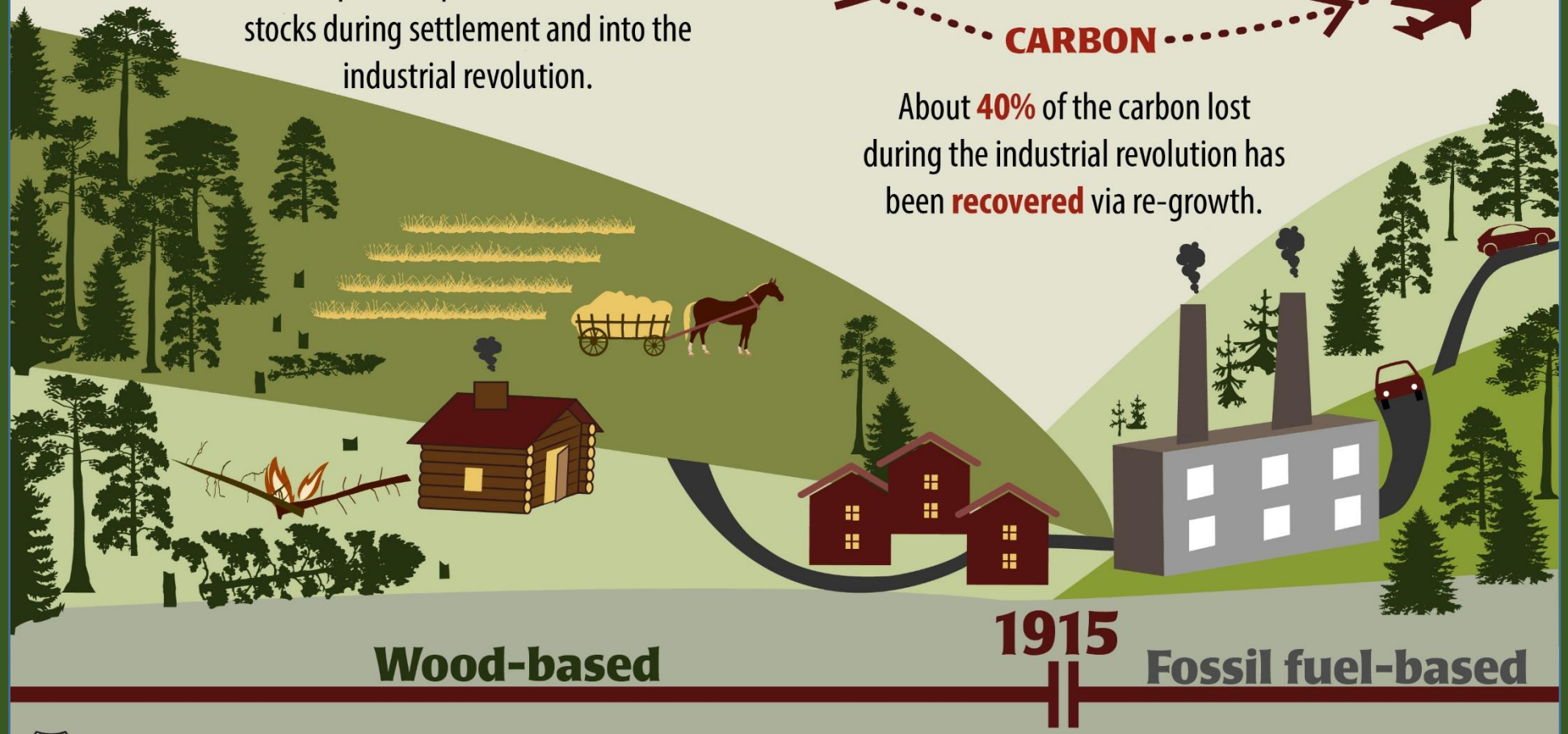
Carbon Stocks

The Change from a Wood-based to a Fossil Fuel-based Economy

The United States **lost 60%** of its pre-European forest carbon stocks during settlement and into the industrial revolution.

CARBON

About **40%** of the carbon lost during the industrial revolution has been **recovered** via re-growth.



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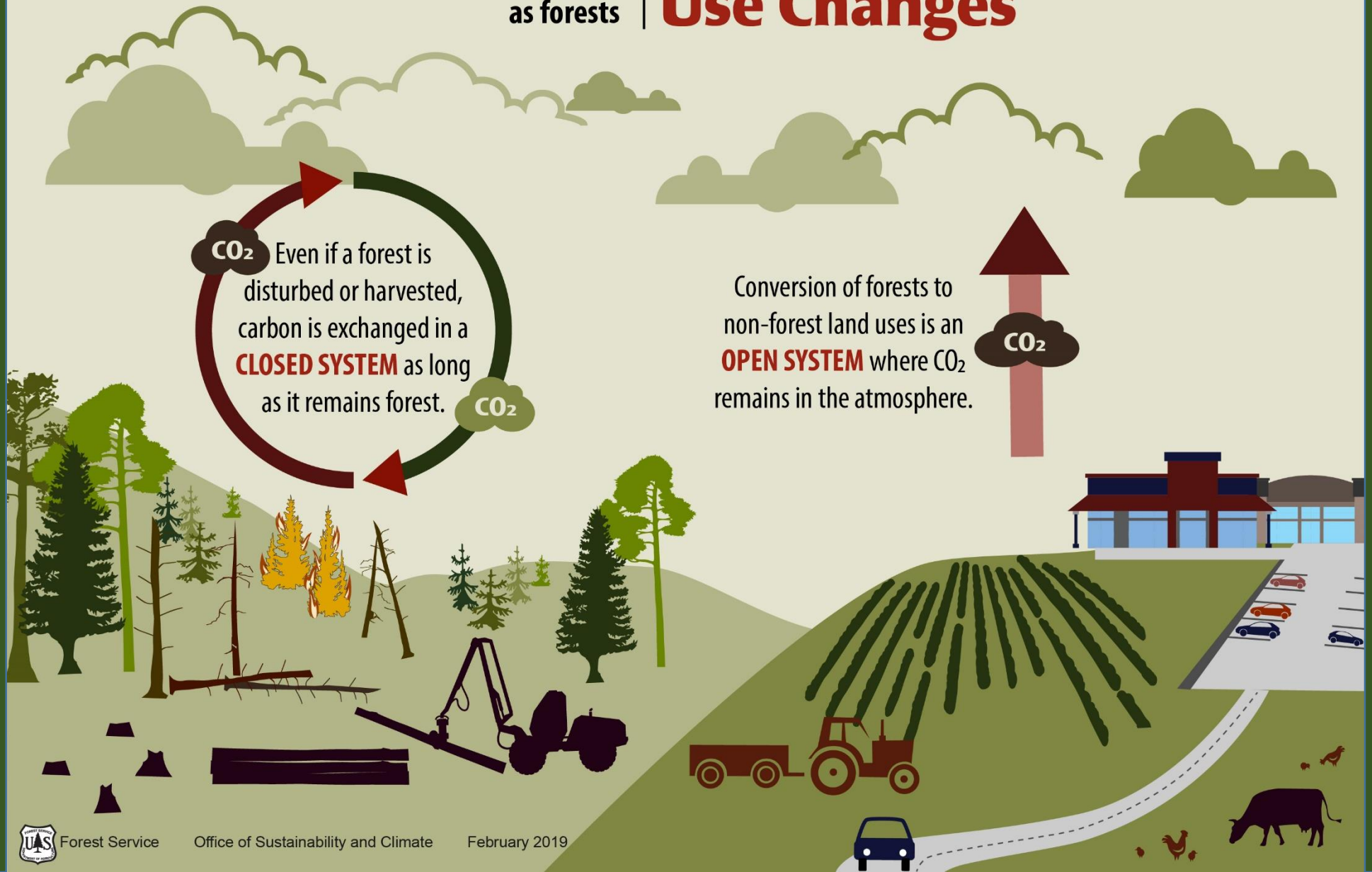
The importance of **KEEPING FORESTS** as forests

Carbon & Land Use Changes



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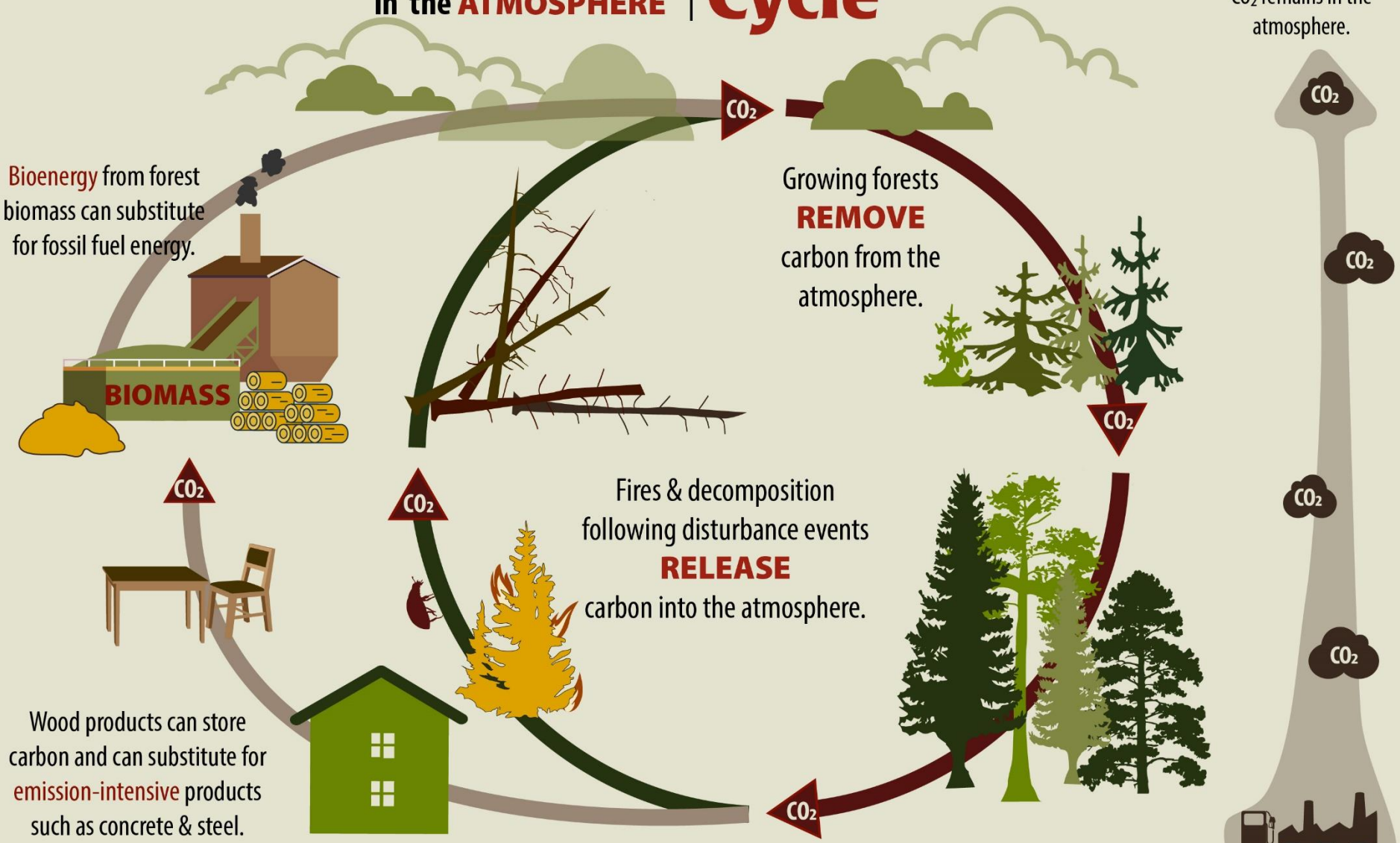
Carbon Cycle

The closed loop of FOREST CARBON in the ATMOSPHERE



Fossil fuel use is an **OPEN SYSTEM** where CO_2 remains in the atmosphere.

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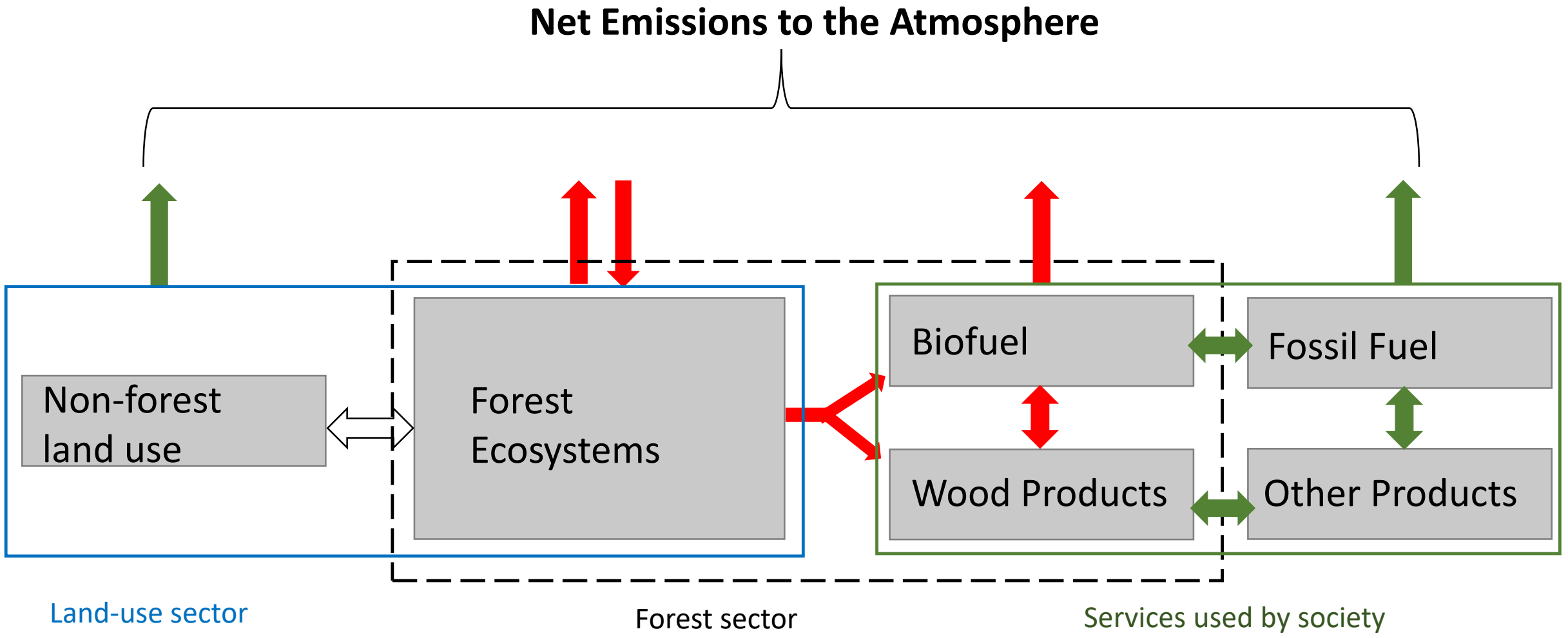
IPCC recommends a Broad View



Adapted from IPCC 2007, AR4 WG III, Forestry

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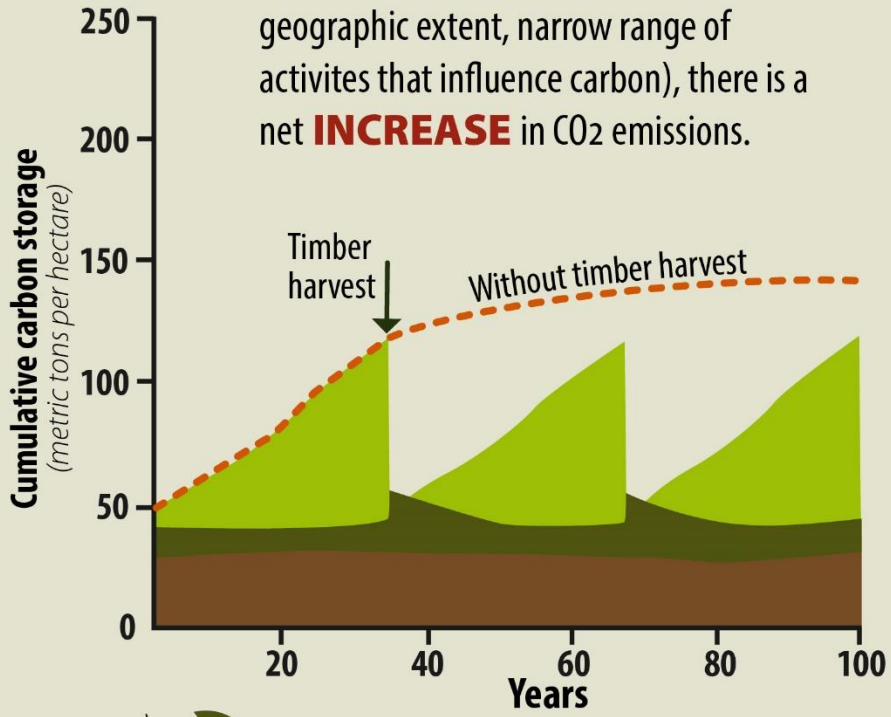
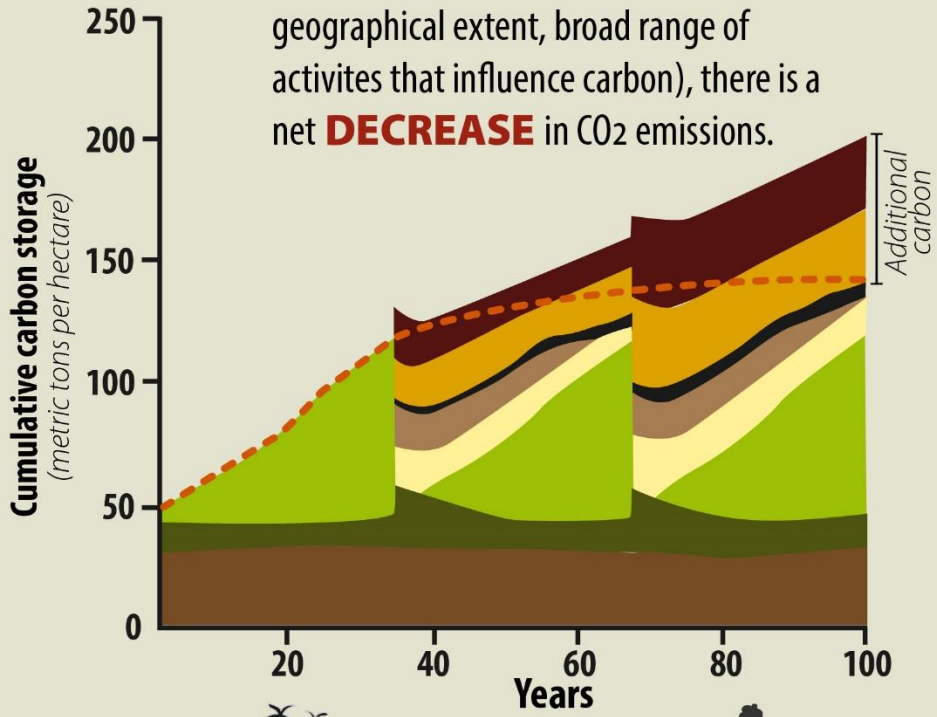
Carbon **BENEFITS** in the Broad View

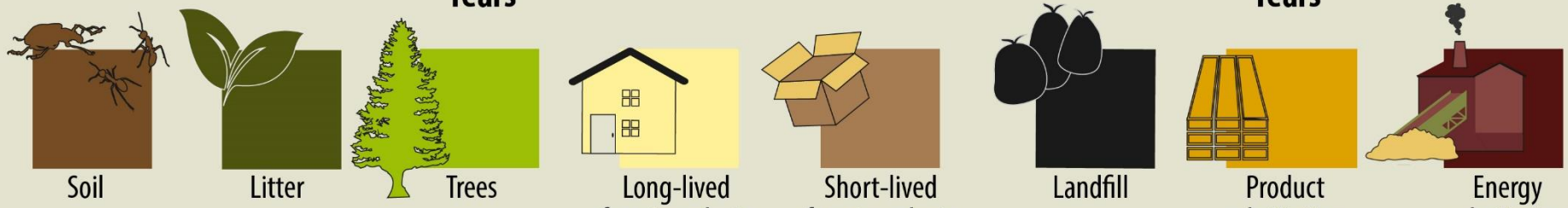
How Carbon Stacks Up

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 CO_2 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 CO_2 emissions.





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Concepts that apply to forests apply to grasslands and rangelands

90-95% of the carbon is belowground in soils and roots/rhizomes – very stable

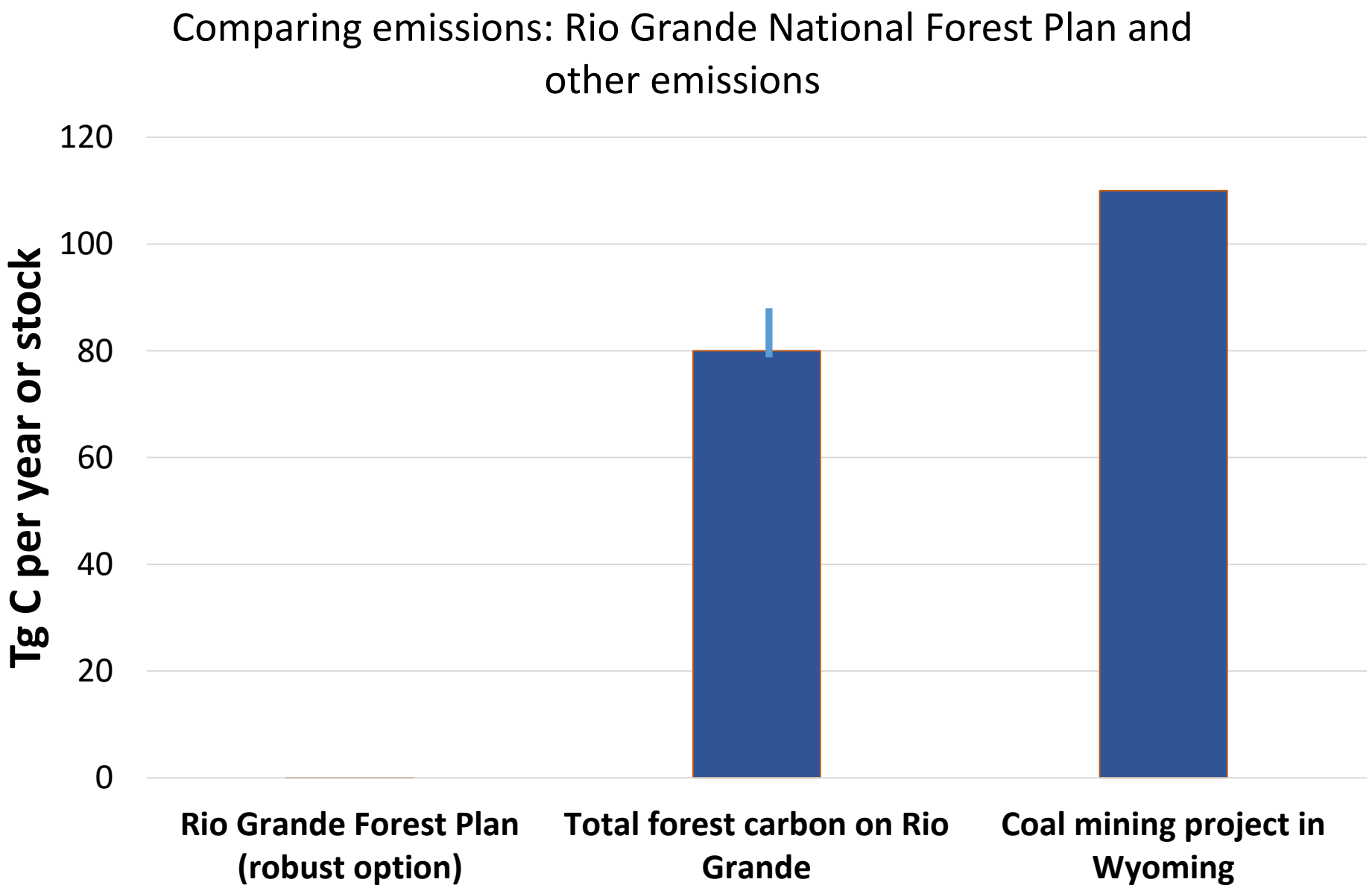
Carbon loss from very stable pools -soils

Native grasslands are in steady state – no changes in carbon is the most desirable condition in most situations

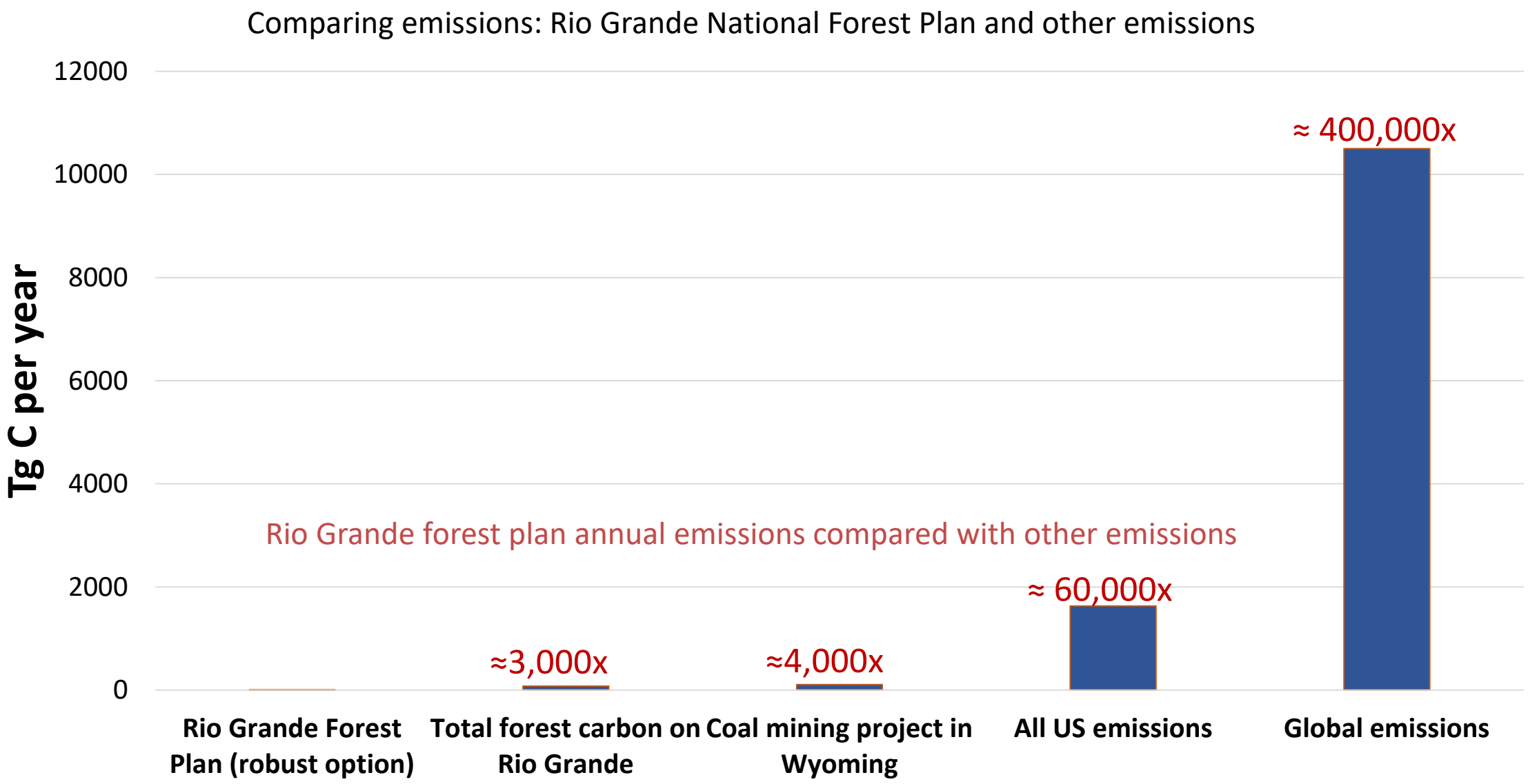
Carbon gain leads to loss of grasslands – conversion to shrub system

Carbon in perspective

Impact of vegetation management in context

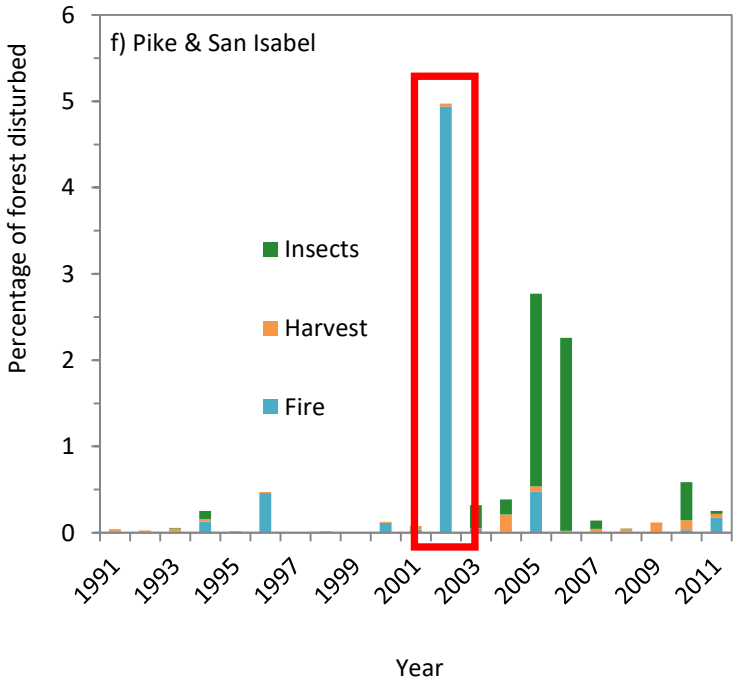


Impact of vegetation management in context

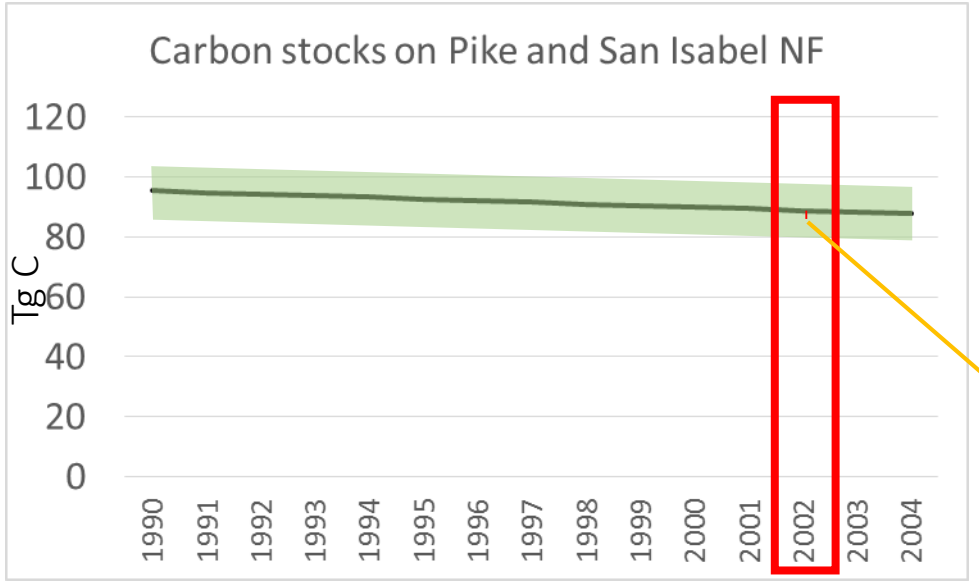


Detecting changes in carbon stocks after large disturbances: “Hayman fire”

- 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

Carbon trends on a regional scale: forest carbon stocks are increasing…

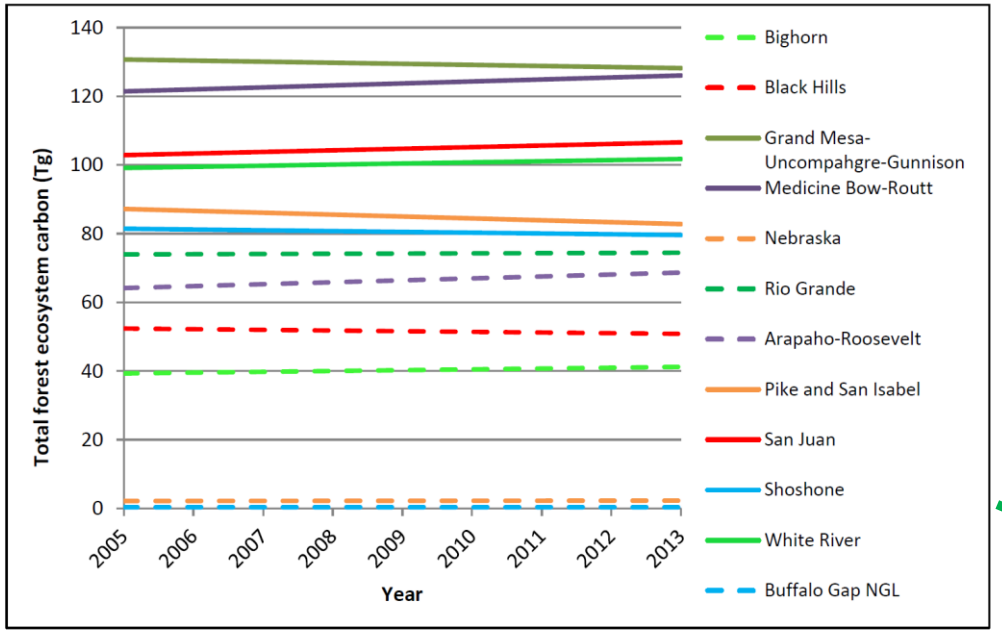
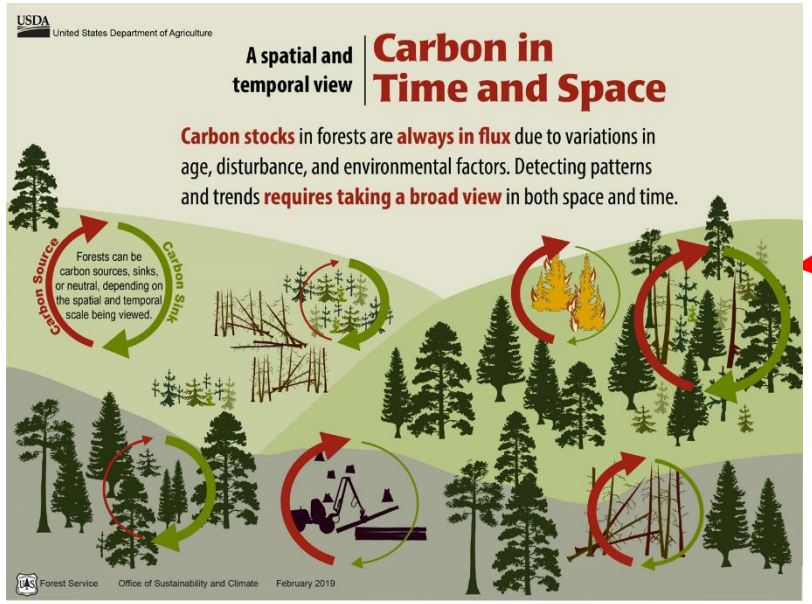


Figure 4. Total forest ecosystem carbon (Tg) for the national forests and grassland in the Rocky Mountain Region from 2005 to 2013.

- Pike & San Isabel and Grande Mesa-Uncompahgre-Gunnision trending downward
- All other forests and region trending upwards



Best scale to identify trends related to environmental change and land-use

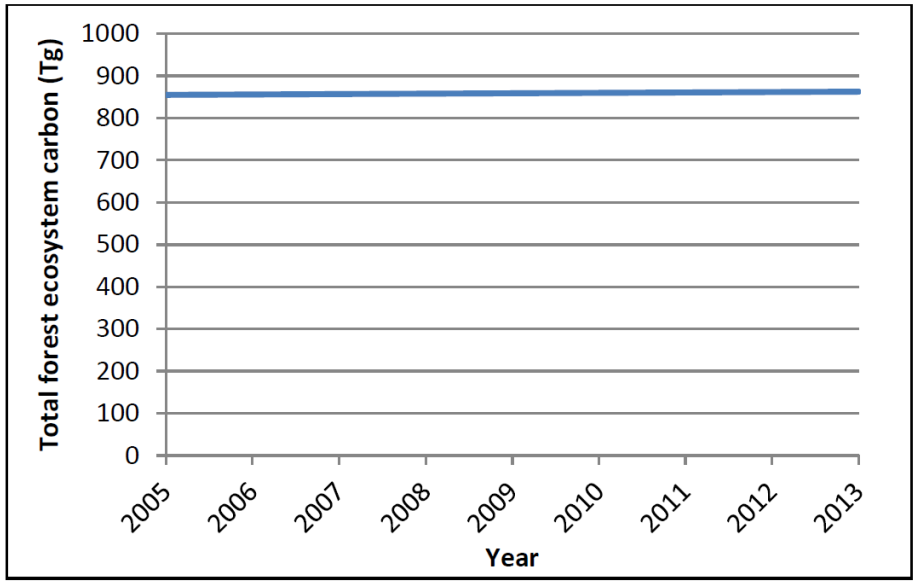


Figure 3. Total forest ecosystem carbon (Tg) for the Rocky Mountain Region from 2005 to 2013.

USDA
United States Department of Agriculture

The Carbon Bathtub of National Forests | Carbon Dynamics

Numbers are for national forests only.

Carbon entering the tub through tree growth **= 42 ounces.**

Carbon leaving the tub from harvesting **= 3 ounces,** equivalent to what a washcloth can absorb.

Carbon leaving the tub through natural disturbances = 8 ounces.

Nationally consistent information to inform carbon trends and patterns on the National Forest System

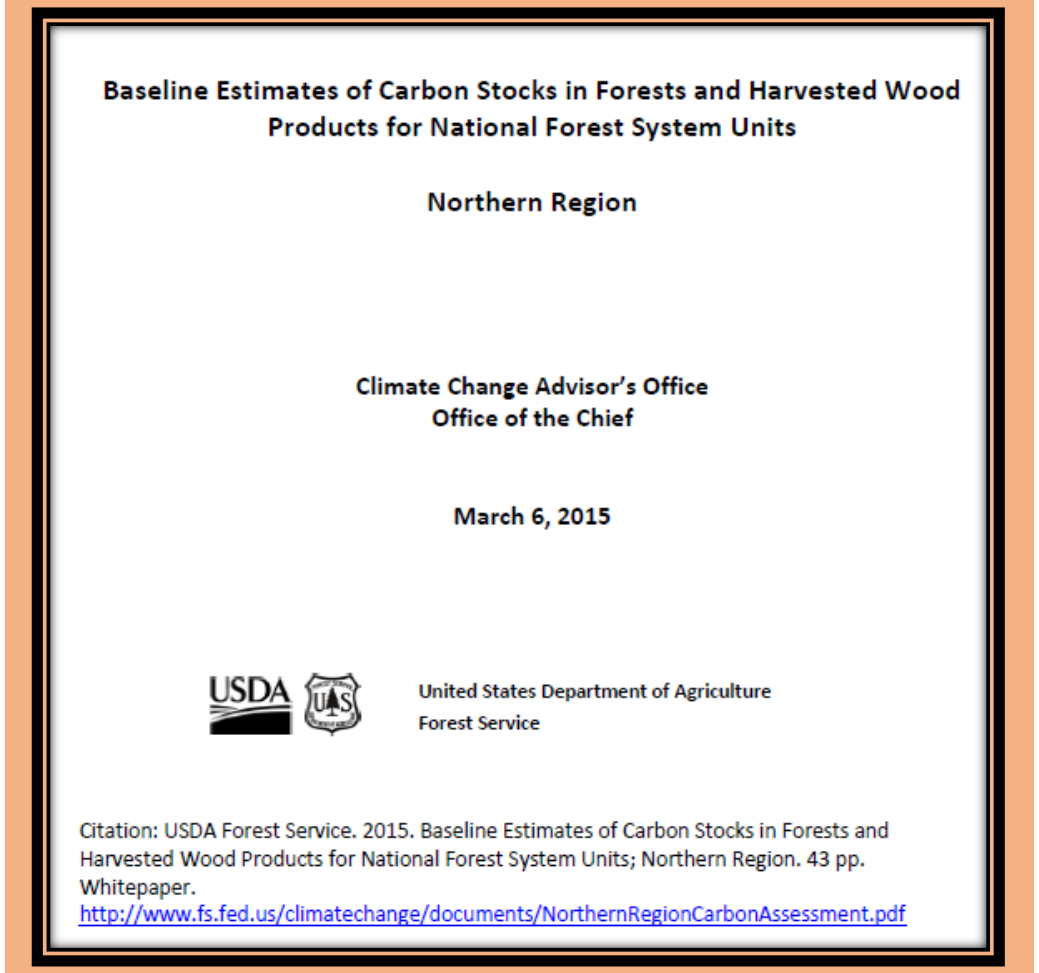
Direction tells us what to look at…

2012 Planning Rule (FSH 1909.12.4)

- **Assessment of carbon stocks to understand how:**
  - The plan area plays a role in sequestering and storing carbon
  - Disturbances, projects, and activities influenced carbon stocks in the past and may affect them in the future
  - Where carbon is stored, how the storage is changing, and how storage might be influenced by management
- **Responsible official may consider:**
  - Whether existing conditions and trends of vegetation (aboveground carbon pool) indicate that the plan area is a carbon sink or carbon source; and
  - The future trend of the plan area in sequestering and storing carbon under existing plan guidance

Two standardized reports for each NFS region intended to provide carbon information for 2012 Planning Rule

Stocks/Stock Change



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

Northern Region

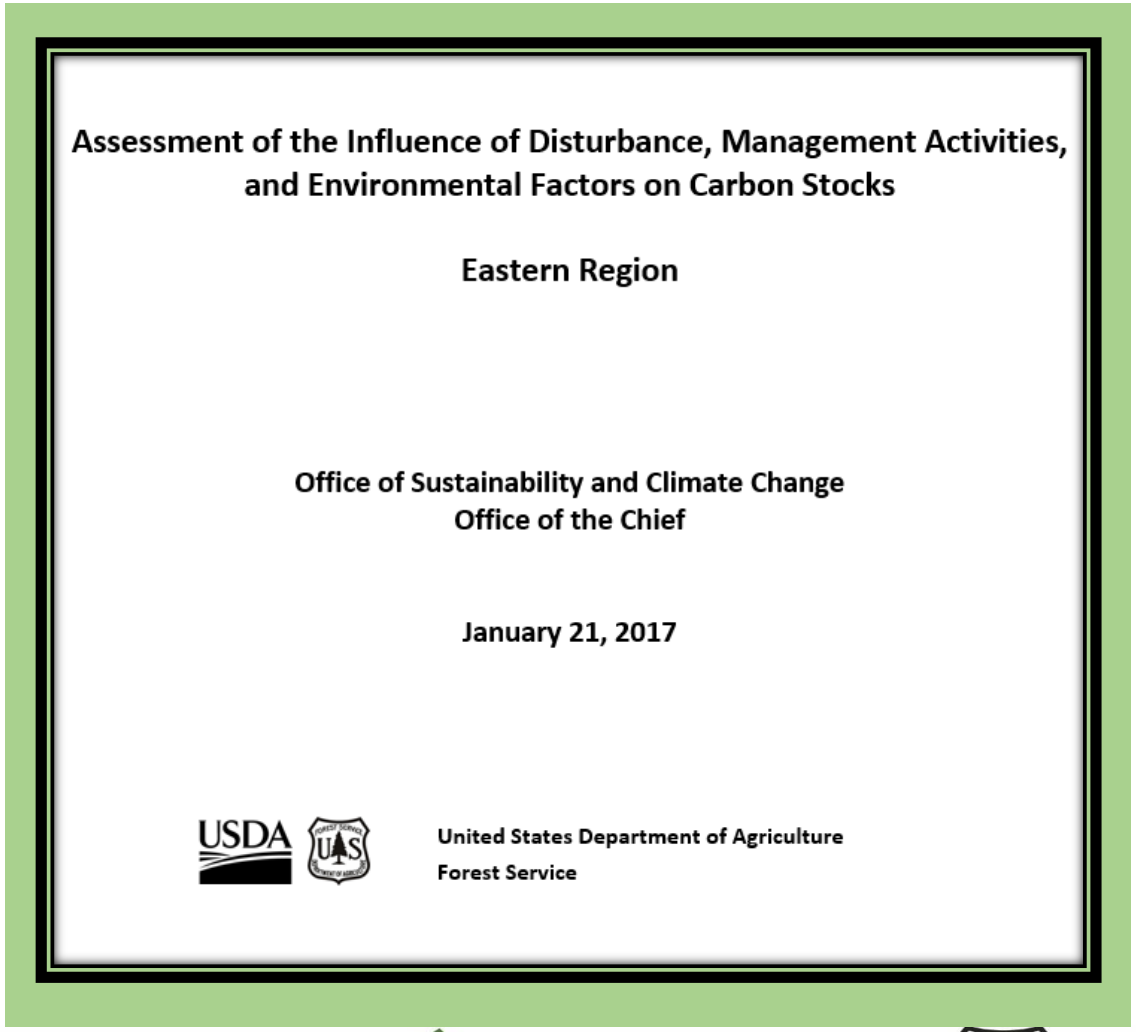
Climate Change Advisor's Office
Office of the Chief

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



Assessment of the Influence of Disturbance, Management Activities, and Environmental Factors on Carbon Stocks

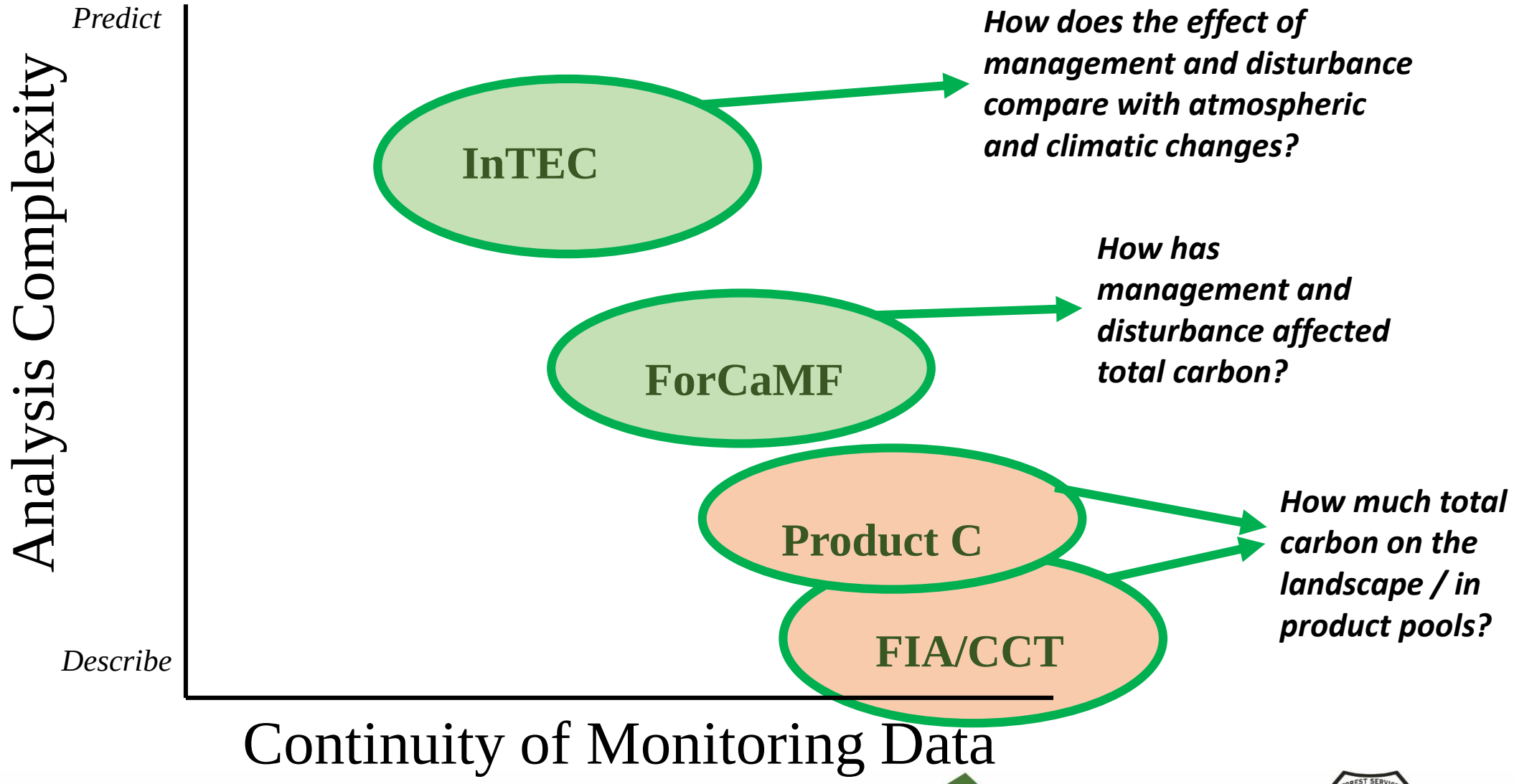
Eastern Region

Office of Sustainability and Climate Change
Office of the Chief

January 21, 2017

USDA United States Department of Agriculture
Forest Service

Tools in the reports can be used to answer relevant questions



Carbon Templates

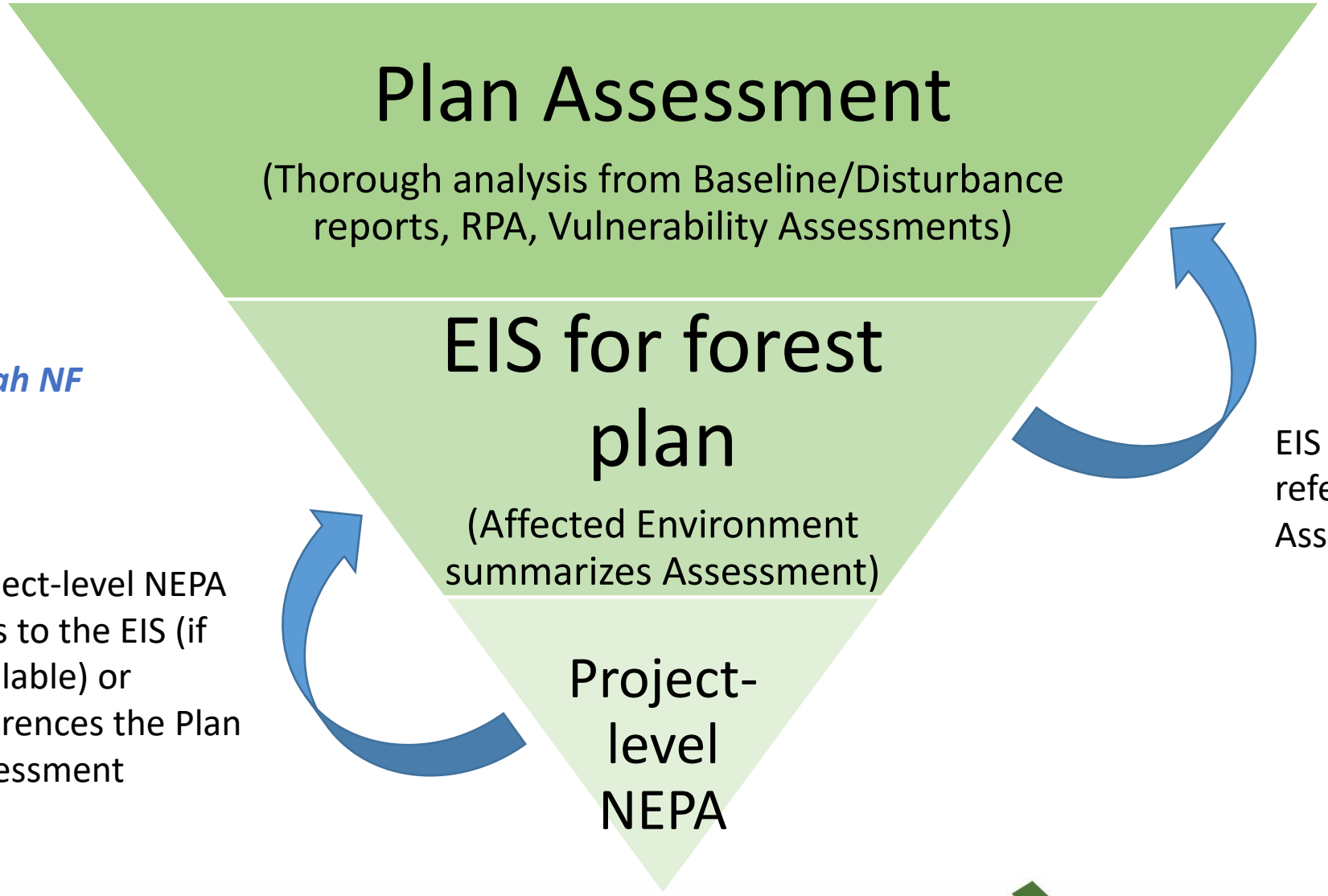
Why carbon templates?

- Increase efficiency (Aligned with EADM goals)
  - Identify the most relevant information & sources to include
  - Canned language based on best available science
  - Uses *tiering* and *incorporation by reference* to reduce redundancies and produce more concise documents
- Provide framing of the “broad view” that disarms many of the arguments made from the narrow view perspective
- Provide scientifically sound interpretation
- Ensure consistency and transferability among forests
- Reduce legal vulnerabilities
- Produce clear, concise, and focused documents

Where carbon templates have been piloted

1. **Plan-level (aka forest level) Carbon Assessment (*forests in revision*) or White Paper (*forests not in revision*)**
   - Green Mountain NF
   - Wayne NF
   - Nantahala-Pisgah NF
   - Francis Marion NF
   - White Mountain NF
2. **Plan-level NEPA (Carbon Chapter in Forest Plan EIS)**
   - Nantahala-Pisgah NF
3. **Project-level NEPA (EA, EIS, response to comments)**
   - Green Mountain NF (2 projects)
   - White Mountain
   - Francis Marion NF
4. **Broad-scale Monitoring (Modified version of plan-level assessment)**
   - Sumter NF
   - Uwharrie & Croatan NFs

Forest in Revision

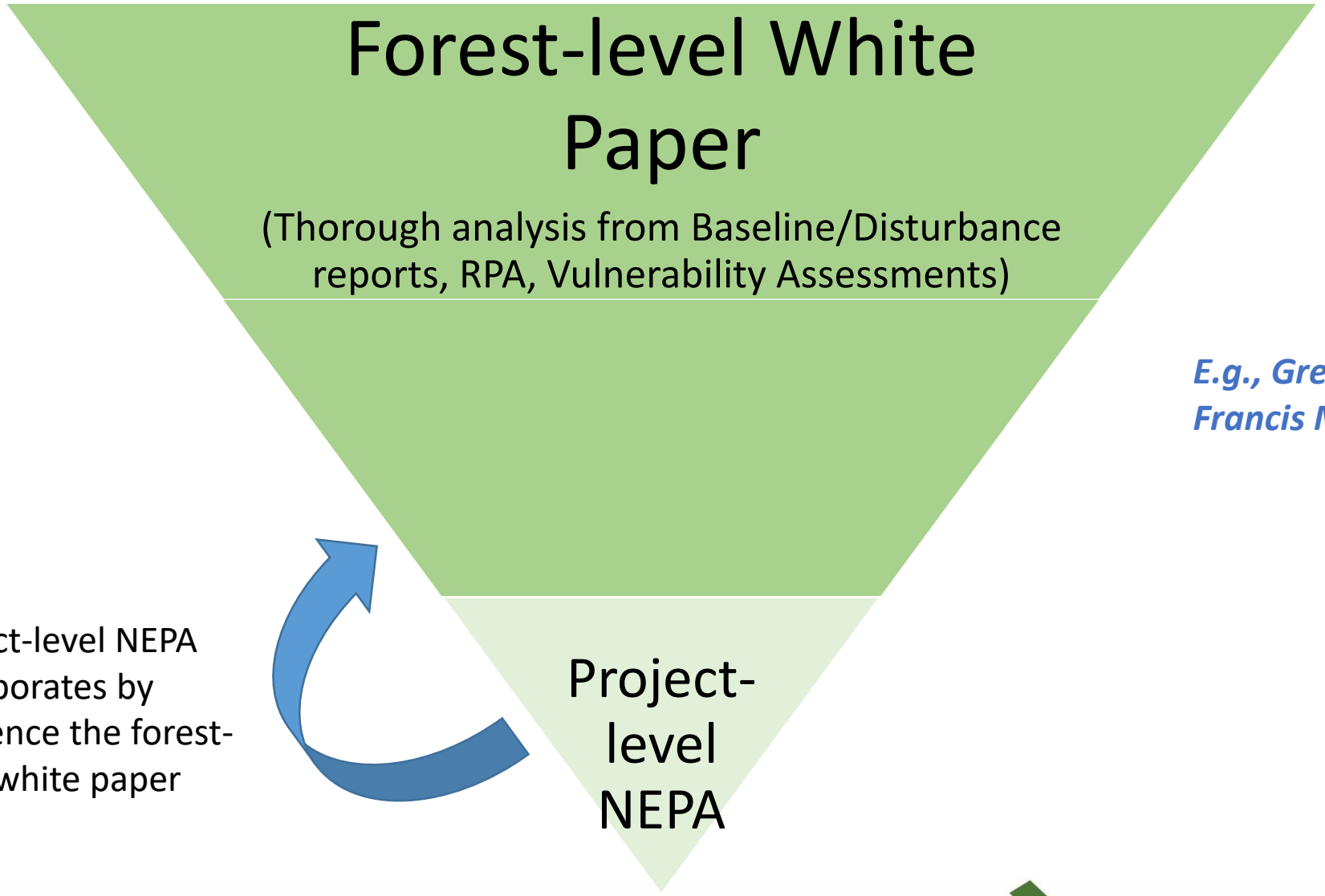


E.g., Wayne NF
Nantahala Pisgah NF

EIS incorporates by reference the Plan Assessment

Project-level NEPA tiers to the EIS (if available) or references the Plan Assessment

Forest NOT in Revision



Project-level NEPA incorporates by reference the forest-level white paper

E.g., Green Mountain NF
Francis Marion NF

How to use the templates - Summary

1) Follow guidebook (*coming soon*)

- Templates highlighted with comments/instructions
- All the necessary conceptual background and context

2) Replace all figures with appropriate figures for your forest from the reports

- Some additional figures may be made (instructions provided)

3) Replace all values with those for your forest from the reports

- E.g. forested area, carbon stocks, stock change, disturbance effects

4) You can copy all un-highlighted text verbatim (and please do!)

- Introduction, discussion of uncertainty
- There are some spaces where specialist may opt to add some local detail or nuance, if desired and necessary

5) Update references

- E.g. Baseline/Disturbance Reports for your Region, any added references

How to use the templates (Project-level)

- **Replace highlighted text**

1.1.1 Affected Environment

The carbon legacy of the [*National Forest*] is tied to the history of Euro-American settlement, land management, and disturbances. [*Insert short background/history of the forest from assessment… e.g., "As the first region to be widely settled in the United States, eastern forests have had a long history of intensive harvesting and conversion of forests to agriculture. Historical disturbance dynamics, forest regrowth and recovery, and forest aging have been most responsible in driving carbon accumulation trends since 1950.*] Forests in the [*National Forest*], are maintaining a carbon [*sink/source and/or relatively stable (best to evaluate over a period of years, such as 1990-2013 or 2005-2013, from the baseline assessments)*]. Forest carbon stocks have [*increased/decreased*] by about [*--percent (calculate percent change in carbon stocks from 1990 to 2013 from the baseline assessments)*] between 1990 and 2013 (USDA Forest Service, 2015), and negative effects on carbon stocks caused by disturbances and environmental conditions have been modest and exceeded by forest growth [*modify if carbon stocks have decreased. Note: values reported here are from the Baseline Report, and Assessment/White Paper.*].

[**Option A** - ***If project is thinning or harvest provide some context of harvesting on the forest***]
According to satellite imagery, timber harvestings has been [*a/the*] dominant disturbance type on the [*National Forest*] from 1990 to 2011, although harvesting has typically affected less than [*--percent*] of the forested area annually (USDA Forest Service, in review). During this period, about [*-- percent*] of the

How to use the templates (Project-level)

- Choose your adventure
- Add additional rationale if necessary

[Option A - *If project is thinning or harvest*] In the absence of [*commercial thinning/harvesting*], the forest where this proposed action would take place will thin naturally from mortality-inducing natural disturbances and other processes resulting in dead trees that will decay over time, emitting carbon to the atmosphere. Conversely, the wood and fiber removed from the forest in this proposed action will be transferred to the wood products sector for a variety of uses, each of which has different effects on carbon (Skog et al. 2014). Carbon can be stored in wood products for a variable length of time, depending on the commodity produced. It can also be burned to produce heat or electrical energy, or converted to liquid transportation fuels and chemicals that would otherwise come from fossil fuels. In addition, a substitution effect occurs when wood products are used in place of other products that emit more GHGs in manufacturing, such as concrete and steel (Gustavasson et al. 2006, Lippke et al. 2011, McKinley et al. 2011). In fact, removing carbon from forests for human use can result in a lower net contribution of GHGs to the atmosphere than if the forest were not managed (McKinley et al. 2011, Bergman et al. 2014, Skog et al. 2014). The IPCC recognizes wood and fiber as a renewable resource that can provide lasting climate-related mitigation benefits that can increase over time with active management (IPCC 2000). Furthermore, by reducing stand density, the proposed action may also reduce the risk of more severe disturbances, such as insect and disease outbreak and severe wildfires, which may result in lower forest carbon stocks and greater GHG emissions. [*Optionally, add any rationale from the prescription that supports how you are improving specific tree species composition that may be more resistant to insect attack or fire, or may maintain or increase biomass production over the long term. Take care to add only a few concise sentences and to limit additional information.*]

How to use the templates (Project-level)

- Choose your adventure
- Add additional rationale if necessary

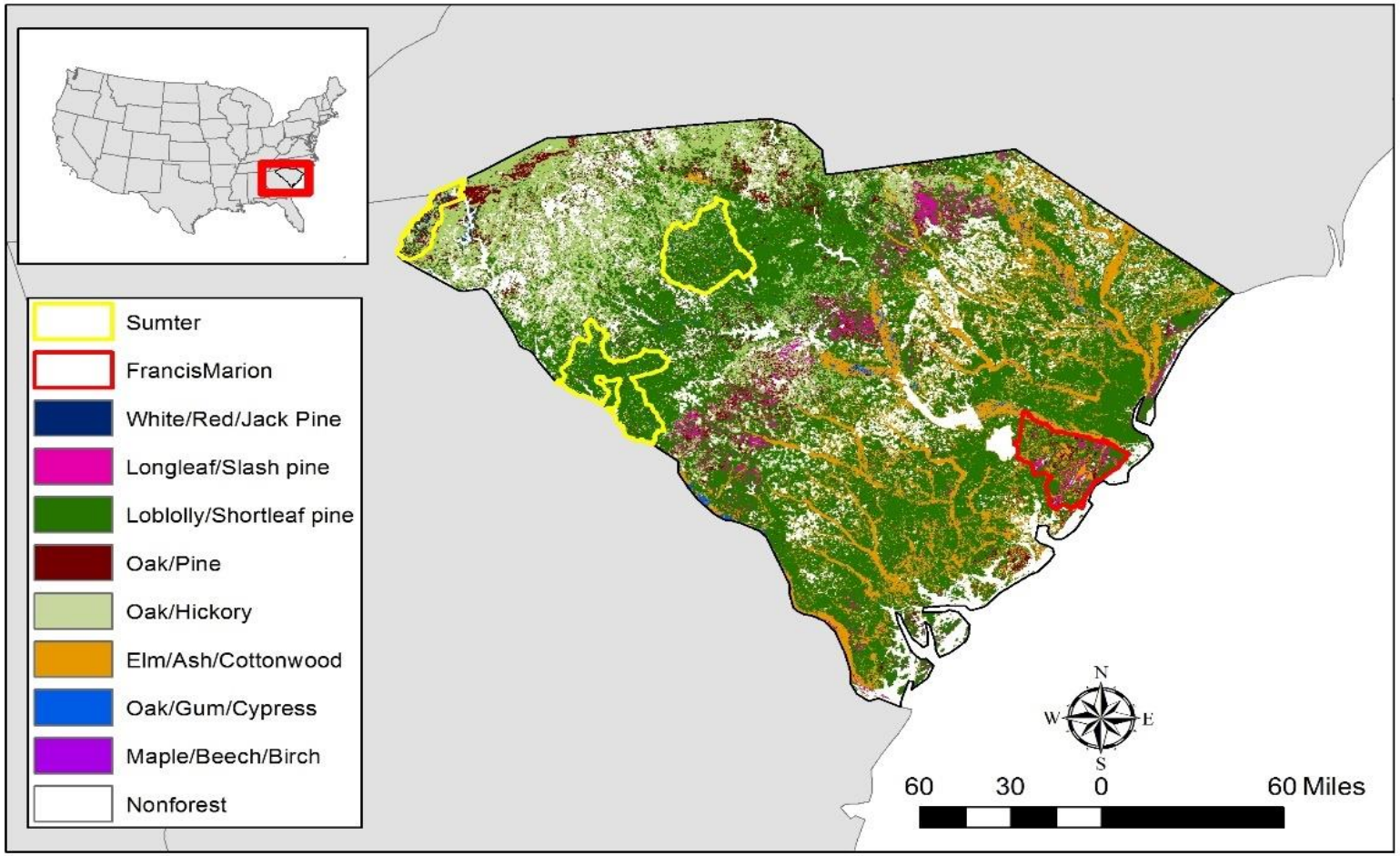
[Option B - *If project is prescribed burn*] Many forest species of the [*region*] are well adapted to fire and in some cases may depend on it for survival and regeneration. Historical fire suppression has allowed some fire-dependent forests to become unnaturally dense and surface fuels to build up in some areas of the [*region*] [*if eastern forests:* *(e.g., Fowler and Konopik 2007, Waldrop and Goodrick 2012)]* *[if western forests:* *(e.g., Agee 1998, Agee and Skinner 2005)*]. *[if western forests:* Furthermore, warming and drying conditions associated with climate change are projected to continue to enhance wildfire potential particularly in western U.S. forests (Abatzoghlou and Williams 2016)]. In the absence of prescribed fire to reduce stand density and fuel loads, the fire-adapted forest where the proposed treatments would take place may be more at risk to a high-severity wildfire, resulting in decreased ecosystem services and potentially increased carbon emissions. Prescribed fires generally target surface and ladder fuels and are typically less severe than wildfires (Agee and Skinner 2005), because they are conducted only when weather conditions are optimal and fuel moisture is high enough to keep combustion and spread within predetermined limits. Thus, prescribed fires result in minimal overstory tree mortality and typically combust less than 50 percent of the available fuel (Carter and Foster 2004, Hurteau and North 2009, Waldrop and Goodrick 2012), producing lower GHG emissions than might be emitted if the same area were to burn in a high-severity wildfire (Wiedinmyer and Hurteau 2010). Also, a large portion of the emissions associated with prescribed fires is from duff, litter, and dead wood which comprise carbon pools that would otherwise decay quickly over time, releasing carbon to the atmosphere. Hazardous fuels reduction and restoration treatments can help reduce the incidence, severity, and areal extent of wildfires in forests where fire exclusion has resulted in high fuel loadings and tree densities (Agee and Skinner 2005, Stephens et al. 2013, Addington et al. 2015). High-severity fires, especially when they occur repeatedly, can affect human health and safety, infrastructure, and ecosystem services, and can cause delayed regeneration or even a transition of forests to non-forest ecosystems in some areas (Roccaforte et al. 2012, Haffey et al. 2018). By reducing the threat of wildfire, the proposed action would create conditions more advantageous for supporting forest health in a changing climate and reducing GHG emissions over the long term. [*Optionally, add any additional rationale from the prescription that*

Summary of innovations within the templates

- Developed in the “broad view,” i.e. holistic perspective
- Extensive tiering/referencing – reducing page length of project and plan-level NEPA
- Based on nationally consistent data sets – easily transferable and comparable
- Addresses NEPA alternatives qualitatively – leverages existing information making additional analyses unnecessary

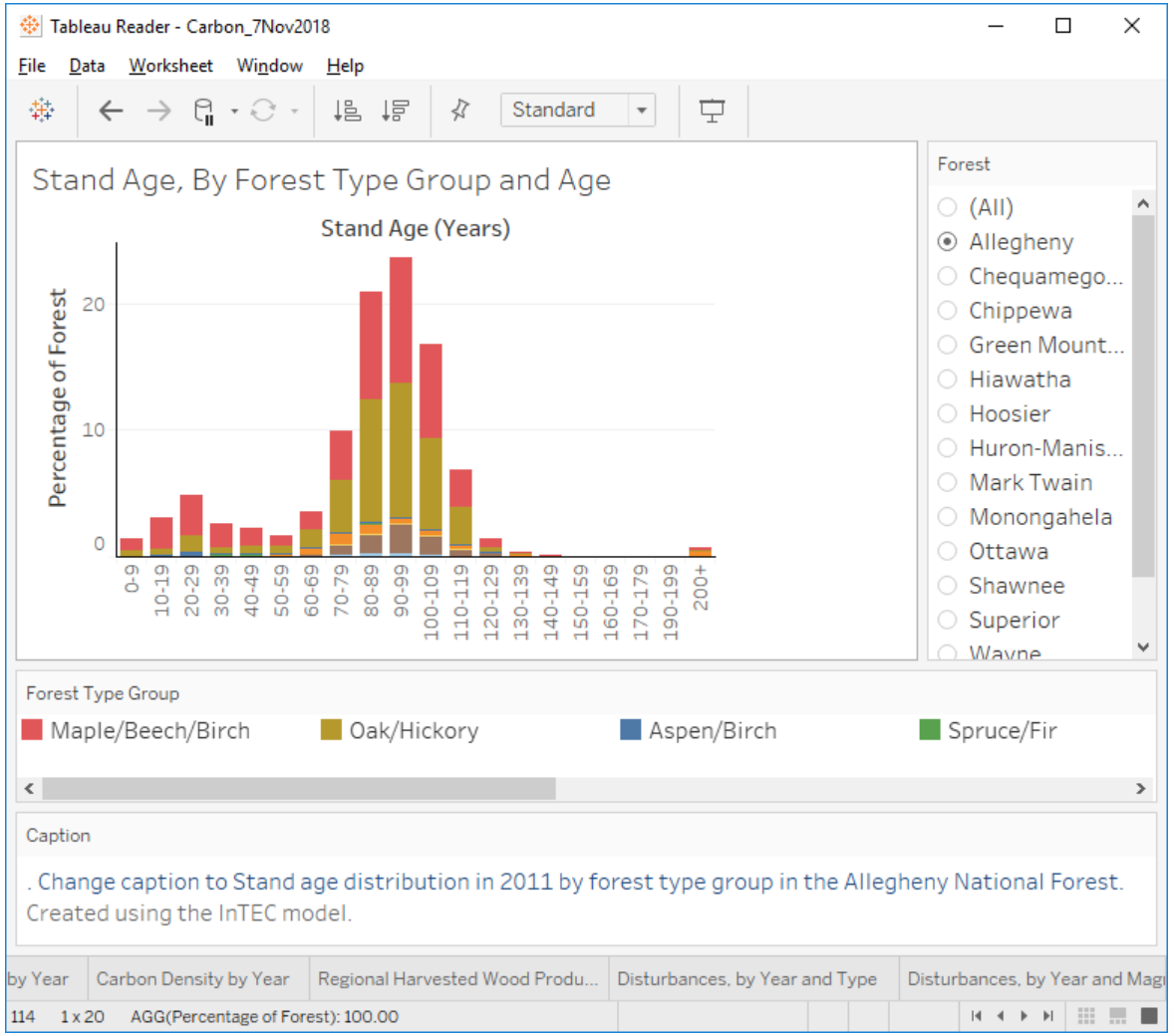
Some challenges, but not too difficult to deal with

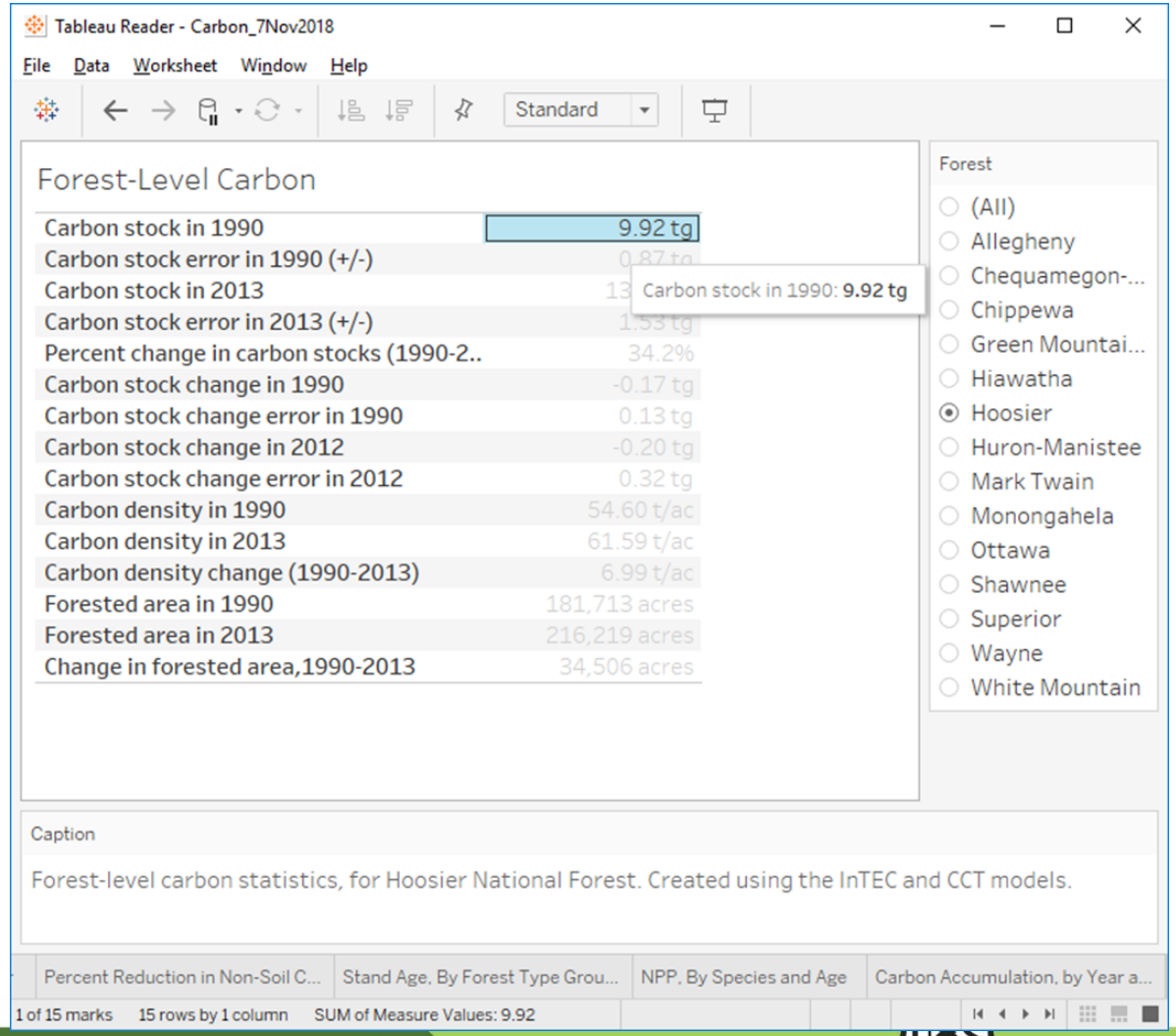
Sometimes reports use administrative rather than forest boundary



- Reports generated for Administrative Units
  - Francis Marion & Sumter admin unit:
    - Francis Marion NF
    - Sumter NF
  - Planning decisions & monitoring conducted at forest-level

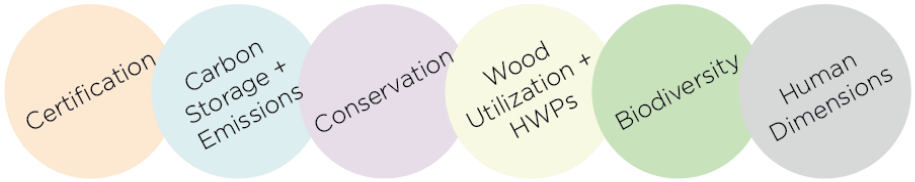
New way to access and visualize information from the reports…



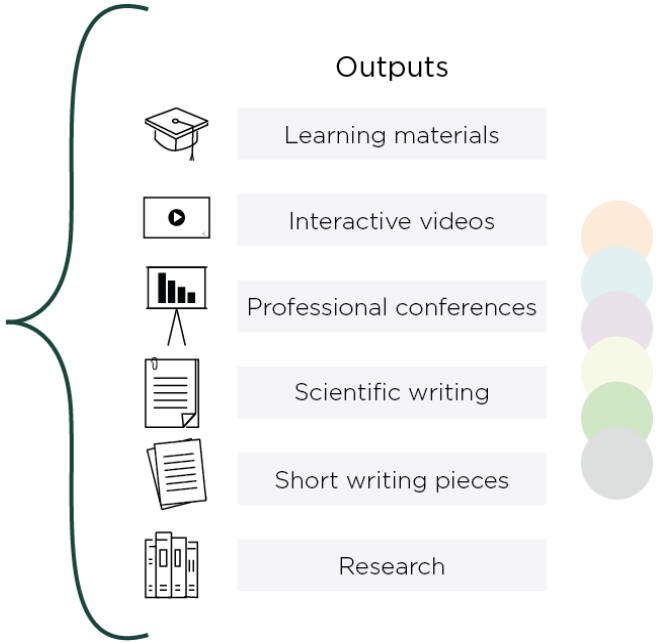


Coming!
Carbon communication and educational products

Forest Carbon and Climate Program



Interdisciplinary Interpretation, Analysis, and Content



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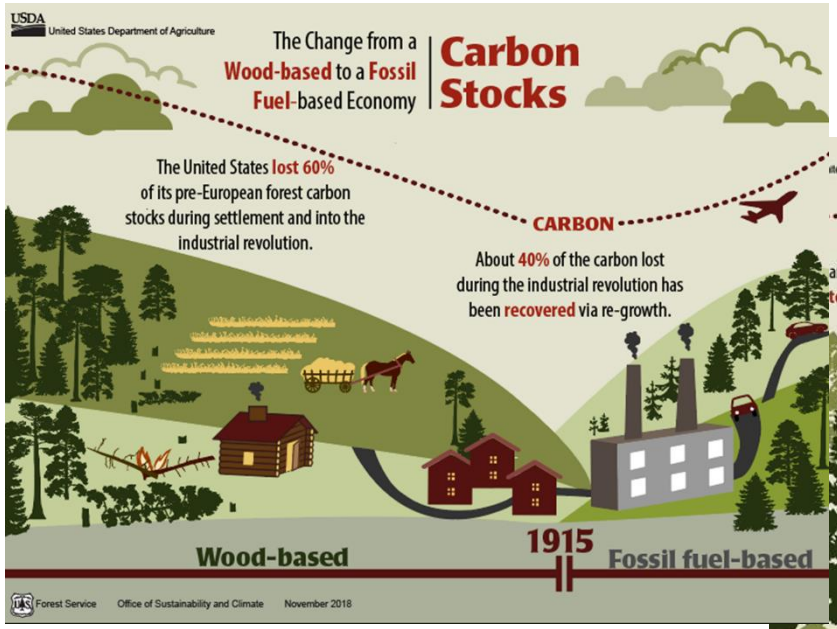
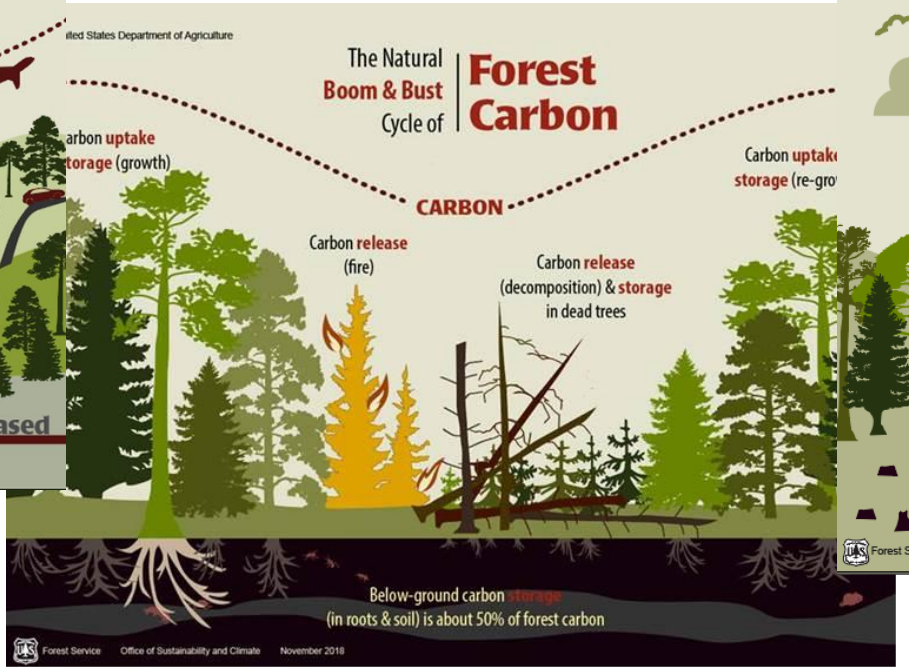
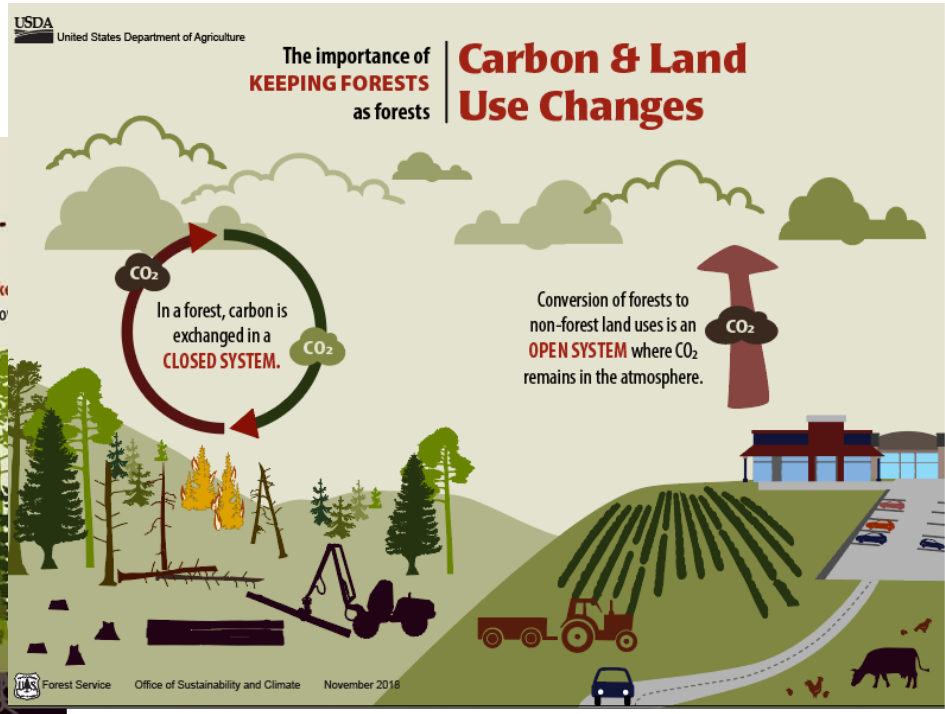
We'll reach out for your input

Carbon Communication Tools for internal and external audiences

- Developing content that can be used in presentations, planning documents, pamphlets, etc.





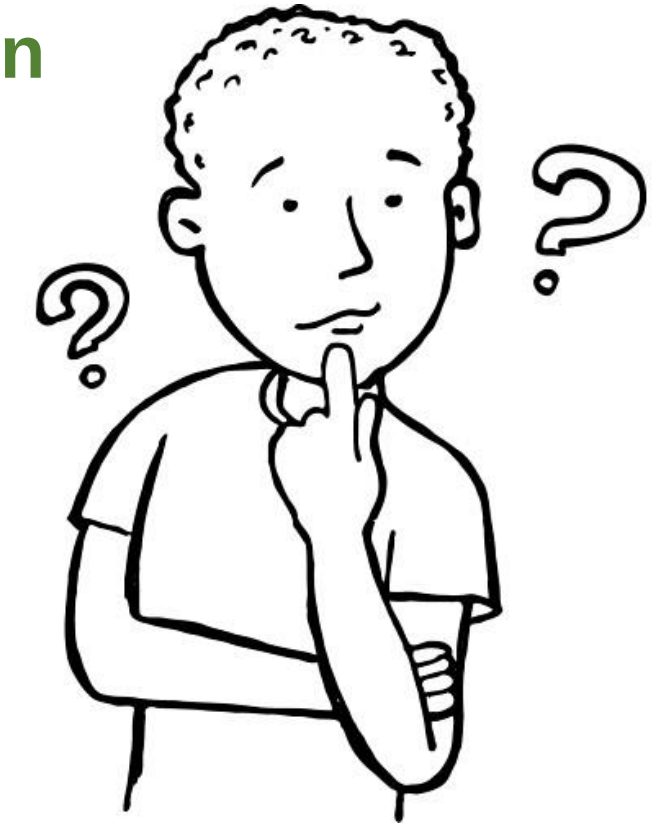


Maintaining and improving carbon information in the future – "next generation carbon assessments"…

What questions do you need answered now or in the future that the next assessment should address?

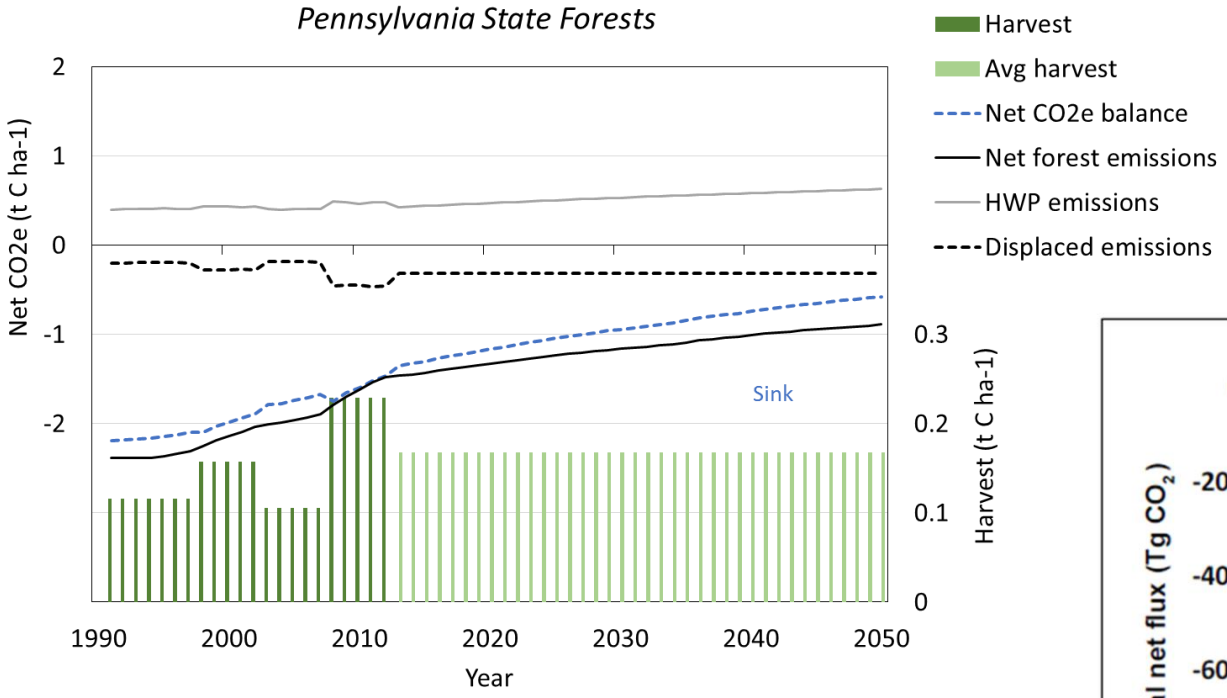
What is missing from current tools? Are there gaps in these reports?

What would you like to see from these carbon tools?

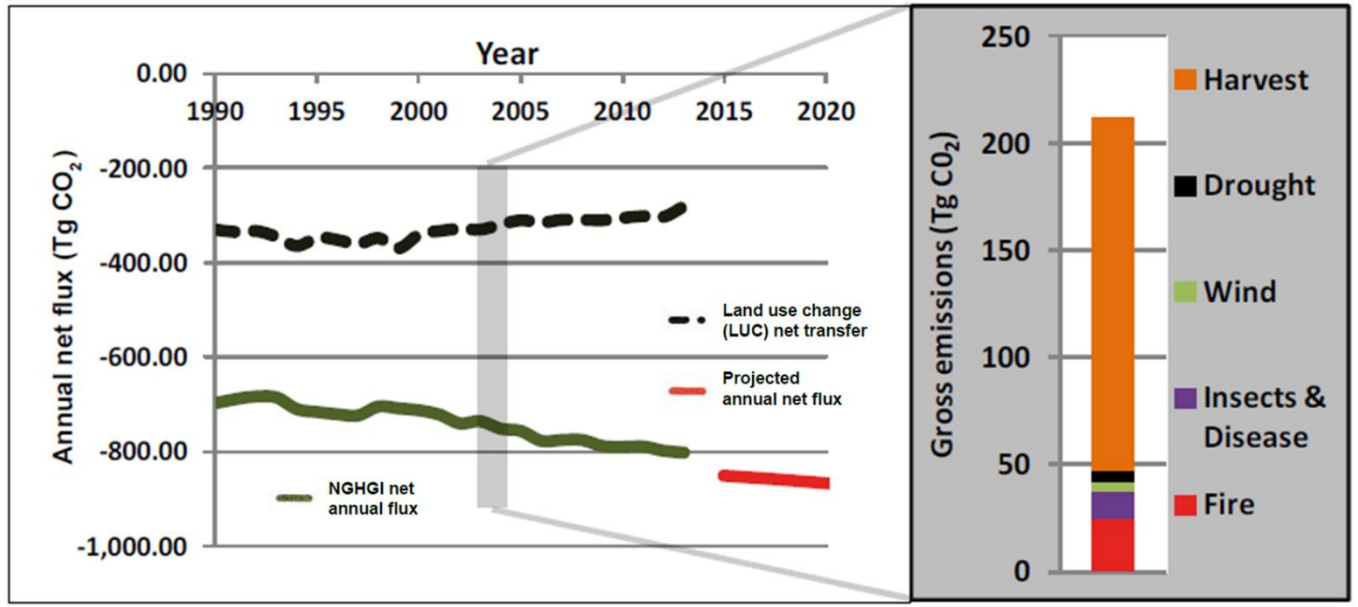


Some options we are exploring…

Carbon Budget Model



FIA's Vision

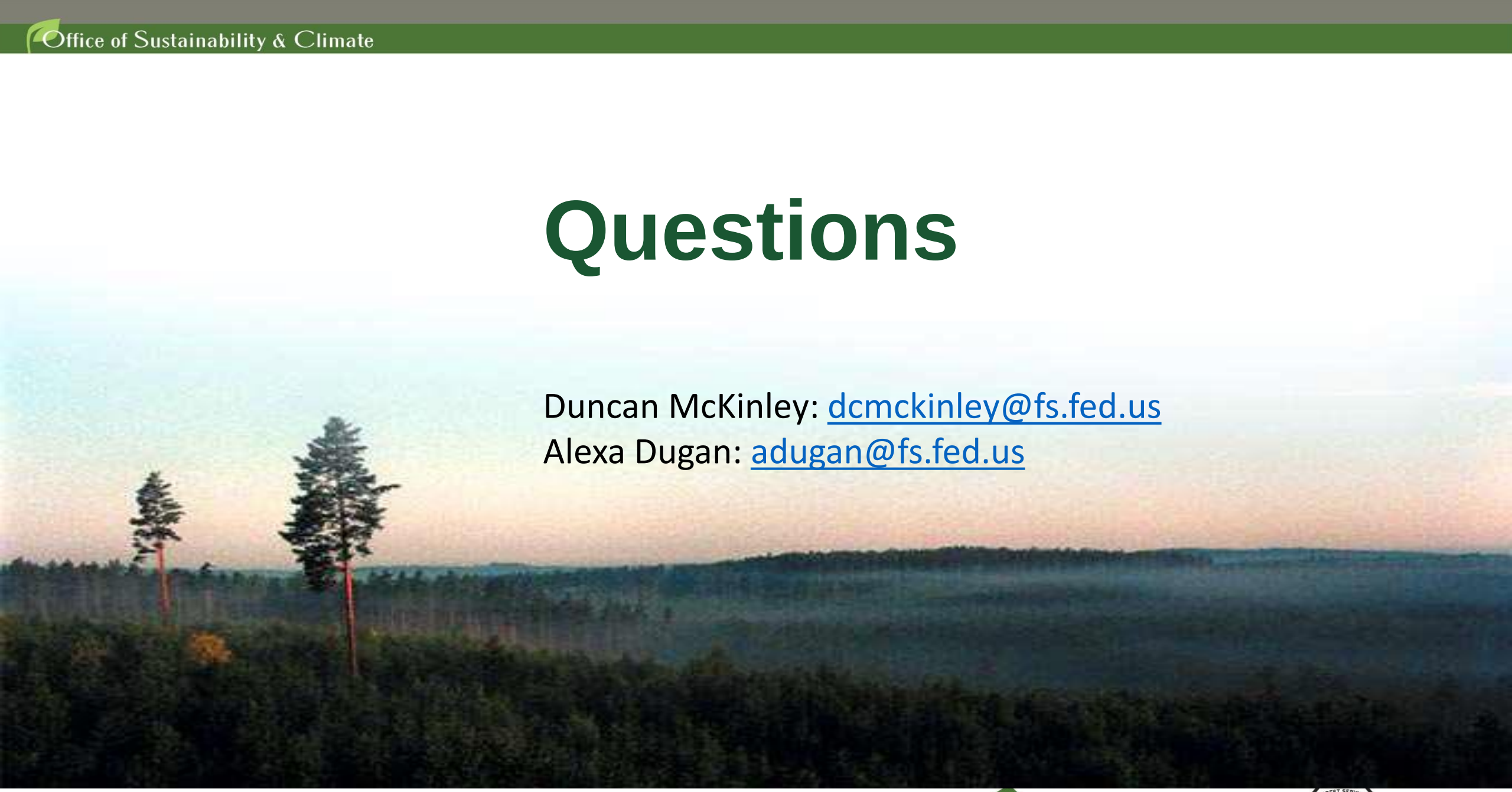


Models:
CBM-CFS3
CBM-FHWP
Published Displacement factors

Final Thoughts

- The goal is to make it easier for specialists and others to effectively address carbon
- We're here to provide assistance!
- Future…
  - Communication and educational tools
  - Helping to facilitate the update of the Baseline and Disturbance "next generation" reports
  - Incorporating advancements in tools, best available science, and changes in policy

Questions



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