RESOURCES *for the* FUTURE

HEALTHY ENVIRONMENT.
THRIVING ECONOMY.

The Policy Context for Bioenergy

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Yale Forest Forum

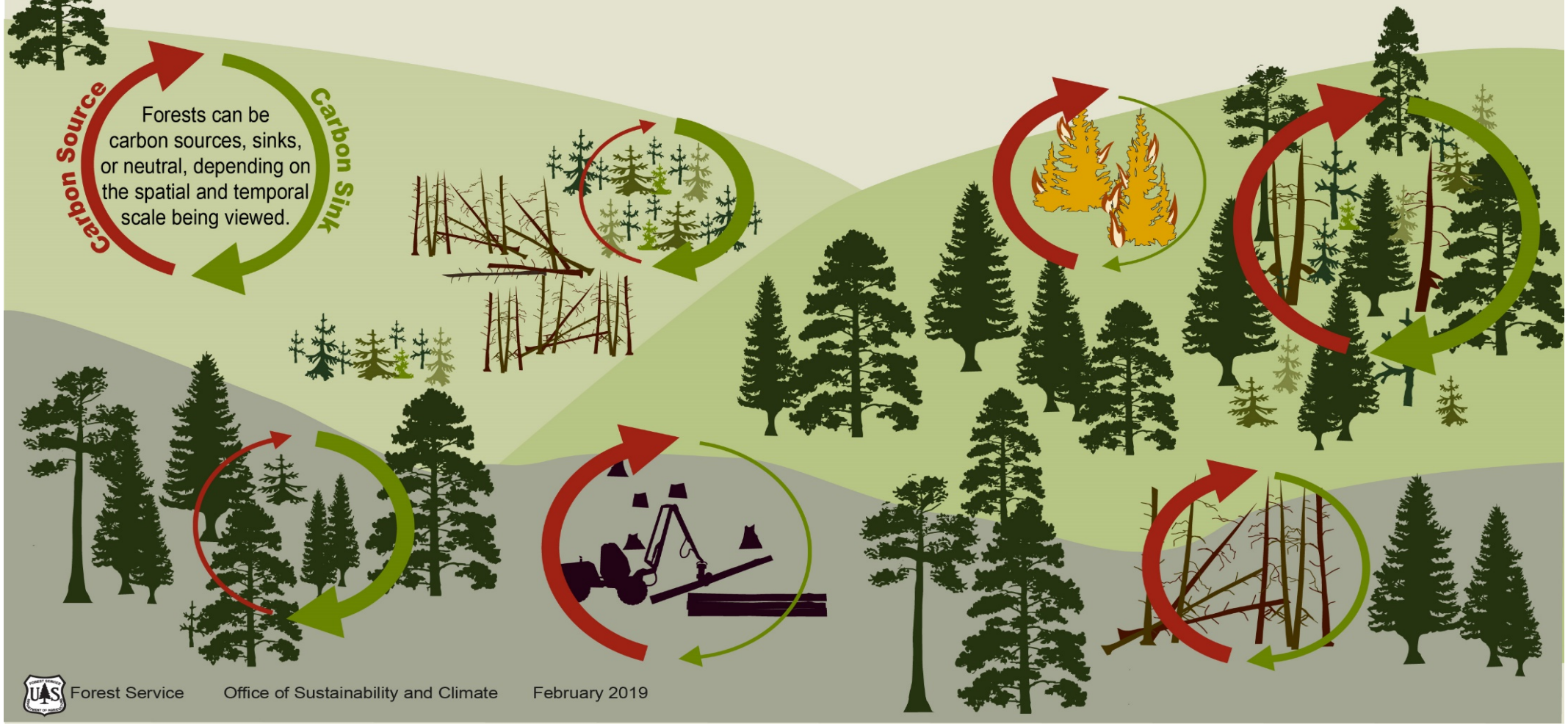
April 19, 2022

USDA United States Department of Agriculture

A Spatial and Temporal View

Carbon in Time & 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.

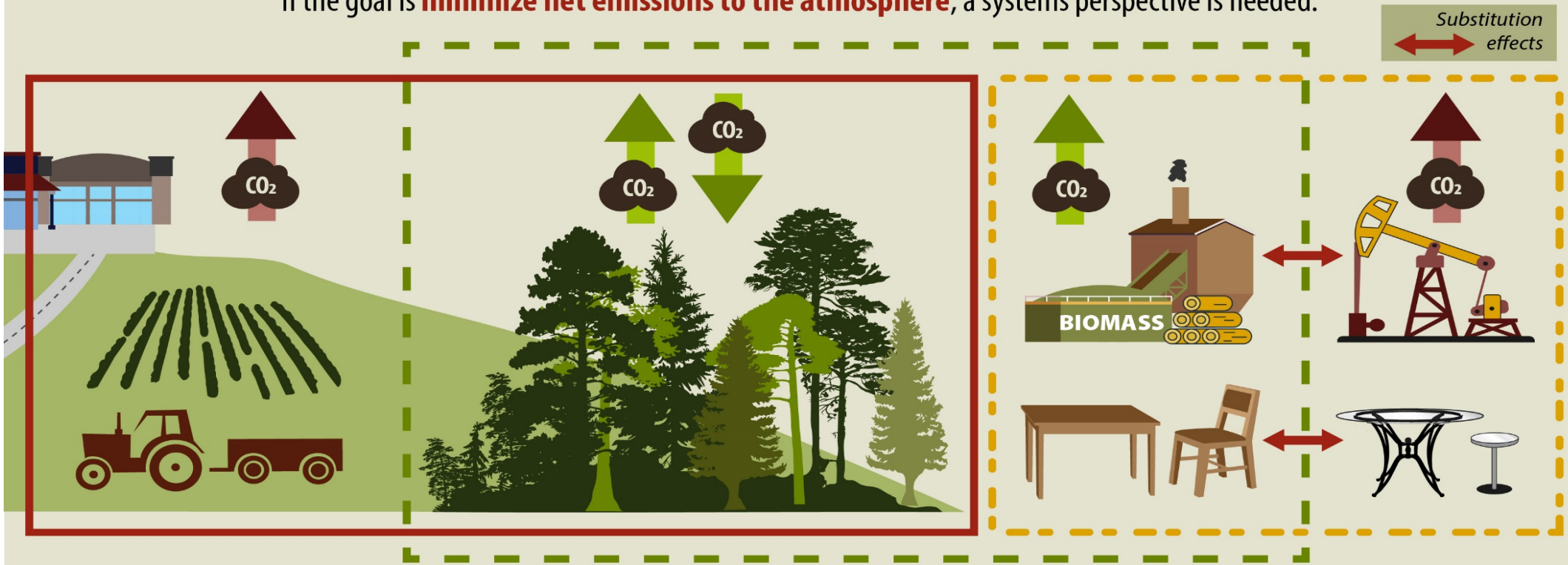


Forest Service Office of Sustainability and Climate February 2019

USDA United States Department of Agriculture

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

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



Land Use Sector
Consider loss or gain of forested land.

Forest Sector
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Consider the use and fate of wood once it leaves the forest, such as biomass for energy and storage in wood products.

Substitution Effects
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Forest Service Office of Sustainability and Climate June 2020

Adapted from IPCC 2007, AR4 WGIII, Forestry

The Policy Context

- S.3600 – **Department of Energy Science for the Future Act - To provide guidance for and investment in the R&D activities of the DOE Office of Science….establishes up to 6 bioenergy research centers
    - *+ 5 other bills building out DOE's capacity around renewables and BECCS – RD&A*
- S. 2836 – **America's Revegetation and Carbon Sequestration Act –** To improve revegetation and carbon sequestration in the U.S…..directs DOE and USDA to measure and monitor the amount and average lifespan of carbon stored in wood biomass energy feedstocks and building materials
- H.R. 2639 – **Trillion Trees Act –** To establish forest conservation practices through management, reforestation, and utilization which lead to the sequestration of greenhouse gases…includes Trible and Alaska native biomass demonstration projects
- S. 4603 - **Forest Health and Biomass Energy Act of 2020 -** To promote the use of forest restoration residue harvested on National Forest System land for renewable energy, and for other purposes – includes direction to do an assessment of biomass capacity, develop a metric system to track harvested biomass, and assistance to producers to harvest, transport and use

USDA Farm Bill Energy Title programs - 2018

- There are 12 distinct programs that include promoting biobased products, manufacturing assistance, rural energy efficiency, and biodiesel education.
- Most relevant to forest bioenergy:
  - Biomass Crop Assistance Program (BCAP) – financial assistance to landowners of NIPF land to establish, produce and deliver feedstock
  - Rural Energy for America Program (REAP) – provides grants for energy audits and renewable energy development assistance
  - Biomass Research and Development (BR&D)
  - Community Wood Energy and Wood Innovation Program – matching grants for building an innovative wood product facility

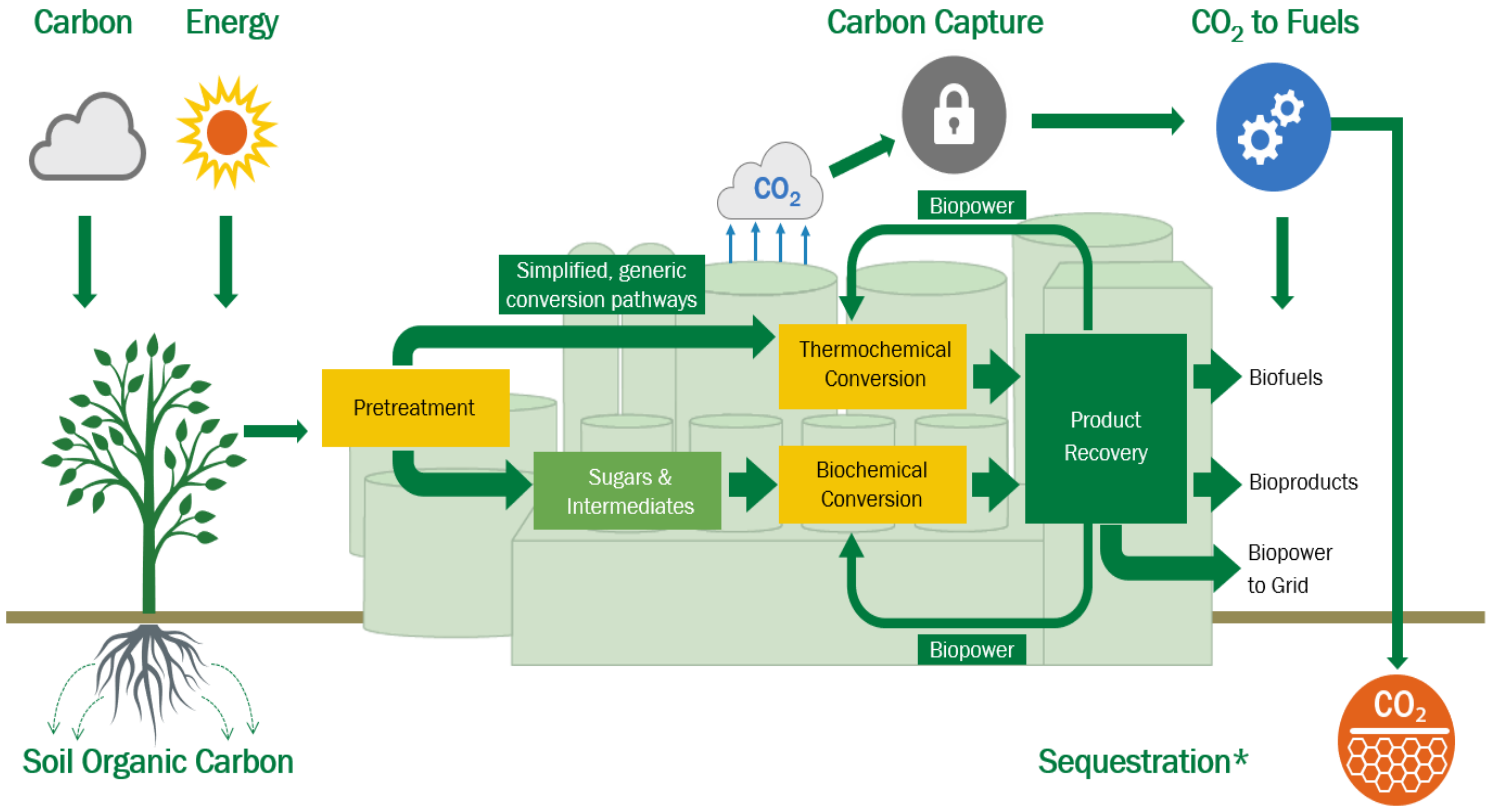
USDA Forest Service

Renewable Wood Energy program

- Expanding renewable energy by promoting the use of ‘wood waste’ or ‘wood residues’ across residential, commercial, and industrial sectors.
- Considers economic development along each stage of the supply chain
- Recognizes and supports sustainable forest management – *wildfire, I&D, invasive species*

DOE: A commitment to sustainable bioenergy

- **Biomass** includes food waste, municipal solid waste, agricultural and forest wastes, animal wastes, and energy crops.
- **Bioenergy** is the conversion of biomass to energy that can replace fossil fuels.



** Office of Fossil Energy R&D on technologies of relevance to bioenergy industry.*

Bioeconomy: An economy based on products, services, and processes derived from biological resources (e.g., plants and microorganisms) and encompassing multiple sectors.

Bioenergy is a key component of the U.S. bioeconomy and contributor to ***decarbonizing transportation, industry, and agriculture***.

Sustainable Aviation Fuel – What and Why

- **SAF is a 'drop-in,' low-carbon substitute for conventional jet fuel**
  - Compatible with current airline infrastructure and planes
  - Generated from biological and waste materials
- **The aviation sector will rely on liquid fuels for the foreseeable future**
  - Electrification remains decades away for flights causing 80% of airline emissions
- **SAF can reduce CO_2 emissions by 55% or more compared to conventional fossil fuels**

December 2021, First commercial, passenger flight using 100% non-petroleum-based SAF.

Major US airlines are competing to make SAF offtake agreements with producers

Feedstock supply will come from regions across the United States

Inter-Mountain West

Upper Midwest

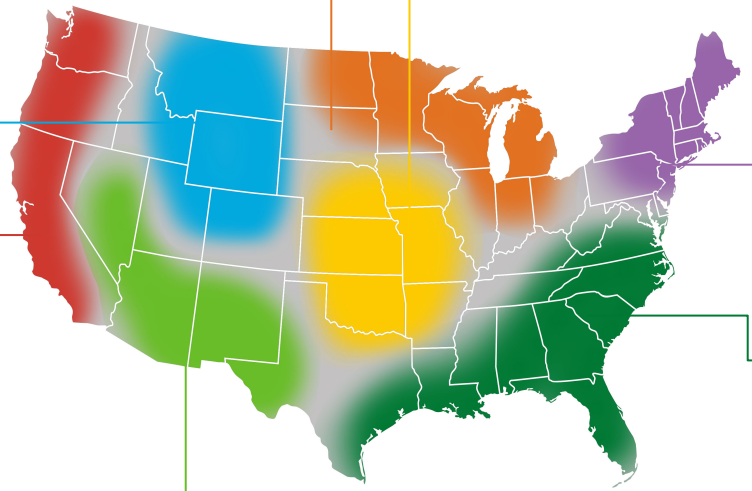
Great Plains

Northeast

Pacific West

Southeast

Southwest



$60/ton, product density > 50 tons/square mile

*Saline, current productivities, minimally lined saline ponds, co-location with CO_2 from coal, natural gas, and ethanol plants at prices from $755-$2,889 per dry ton ($2014)
**Energy crops derived from 2040 dataset, all other biomass from 2017 dataset

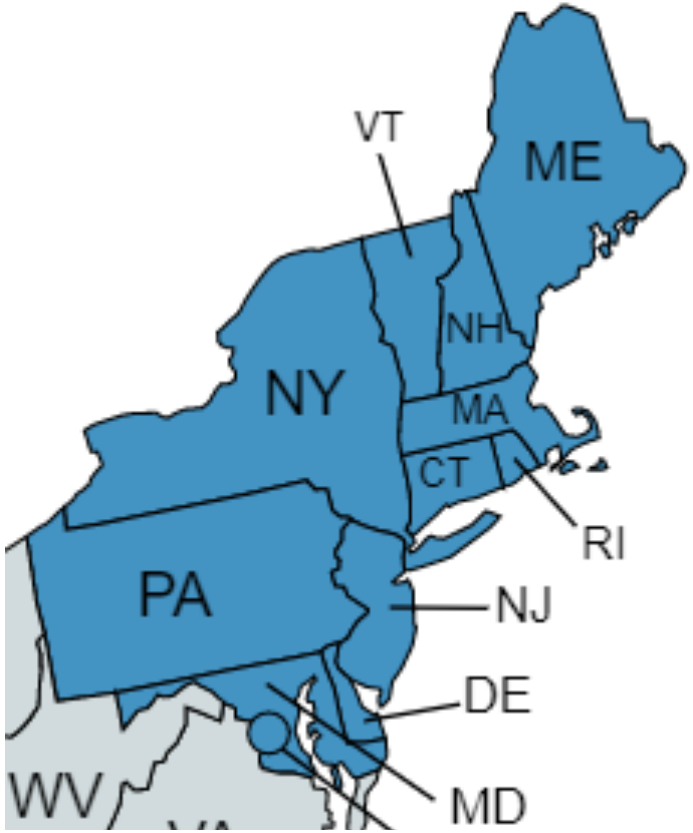
KEY

- Agricultural Waste
- CAFO Manure
- Municipal Solid Waste
- Timberland
- Algae*
- Energy Crops**

Northeast

Primary Feedstocks

- **Agricultural Waste:** Dairy manures
- **Algae:** Macroalgae
- **Dedicated Energy Crops:** Willow
- **Forest Product Waste:** Tree bark, sawdust and shavings, wood chips, and tall oils
- **Forest Residues:** Forest slash
- **Urban Waste**: Contaminated paper, C&D wood, food waste



Urban or forestry-based feedstocks are currently available.
Future potential in woody energy crops and algae.

EPA and Biomass Energy

- Triggered by the Renewable Fuels Standard which explicitly recognizes renewable biomass as a category
  - Requires an analysis of the GHG reductions throughout the life cycle including both direct and indirect (i.e. land use change)
- Since 2011, EPA has sought to determine a scientifically process for biogenic carbon assessment – *Science Advisory Board reviews in 2011, 2014 and 2019*
  - What is the appropriate time scale?
  - What is the relevant spatial scale for assessment – stand? Landscape? Management unit?
  - What is the baseline?
- The one consensus across assessments is that you can not assume carbon neutrality *a priori*

European Forest Strategy- The Way Forward (2020)

- Substitution of fossil-based raw materials and energy, the continuing work of promoting the most efficient use of wood following the ‘cascading principle’;
- Implementation of sustainability criteria for biomass under the recast of the Renewable Energy Directive, and to make optimum use of the substitution effect by substituting CO2-intensive fossil-based materials and energy;
- Emphasizes the criticality of ***sustainable forest management*** as demands for wood and biomass increase
- Residuals at the end of the wood value chain can be favorably used as biomass in order to substitute fossil-based heat
- CAUTIONS: Bioenergy subsidies lead to worsening of the ratio of wood use between material and energy use, and at the same time to an artificial increase in the supply of biomass, thus lowering the capacity of forests to sequester carbon

Some closing thoughts

- Forest bioenergy will continue to be considered a renewable fuel and a substitute for fossil fuels….*pellets, residuals, BECCS*
- As a feedstock, can reduce waste (i.e., residuals from wood products) and be a use for low value wood removed as part of active forest management
- The heterogeneity of forests contributes to the uncertainty in calculating carbon through the life cycle….*can't assume carbon neutrality*
- To reduce the controversy, the accounting needs to be standardized at the appropriate temporal and spatial scale
- Incorporate carbon accounting into 3rd party certification systems (e.g. SFI) and BMP's as a measure of sustainability

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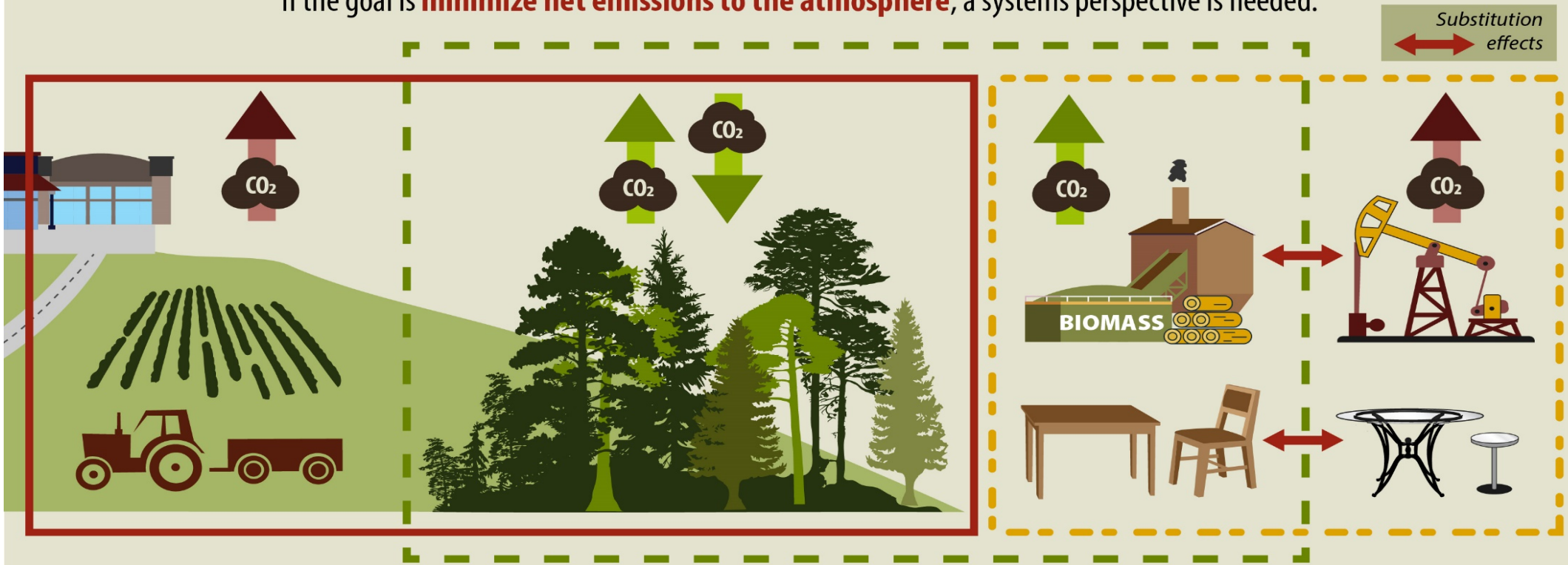

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