United States Department of Agriculture
Northern Forests Climate Hub

Look to the Land: Carbon Management in Forests and Grasslands

Land Trust Alliance's *Ask an Expert Call*
March 6, 2020

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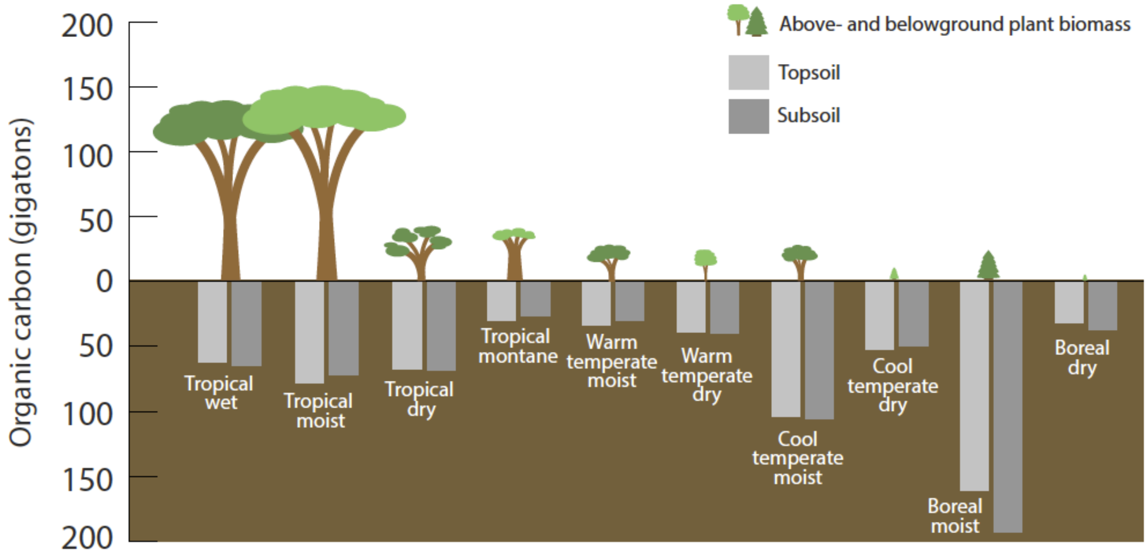
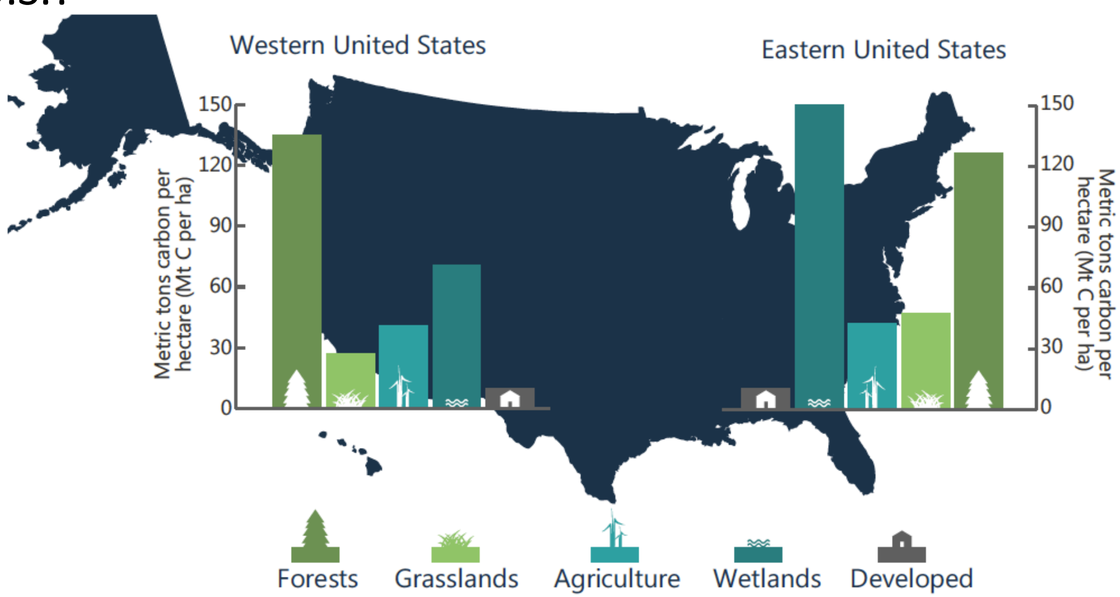
www.niacs.org
www.forestadaptation.org

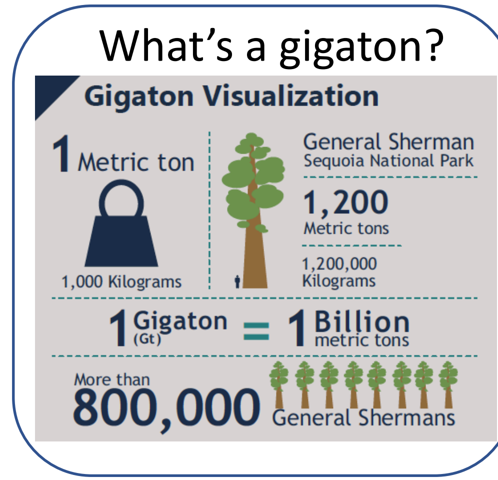
How much carbon is there in different ecosystems or land cover types…

…globally?



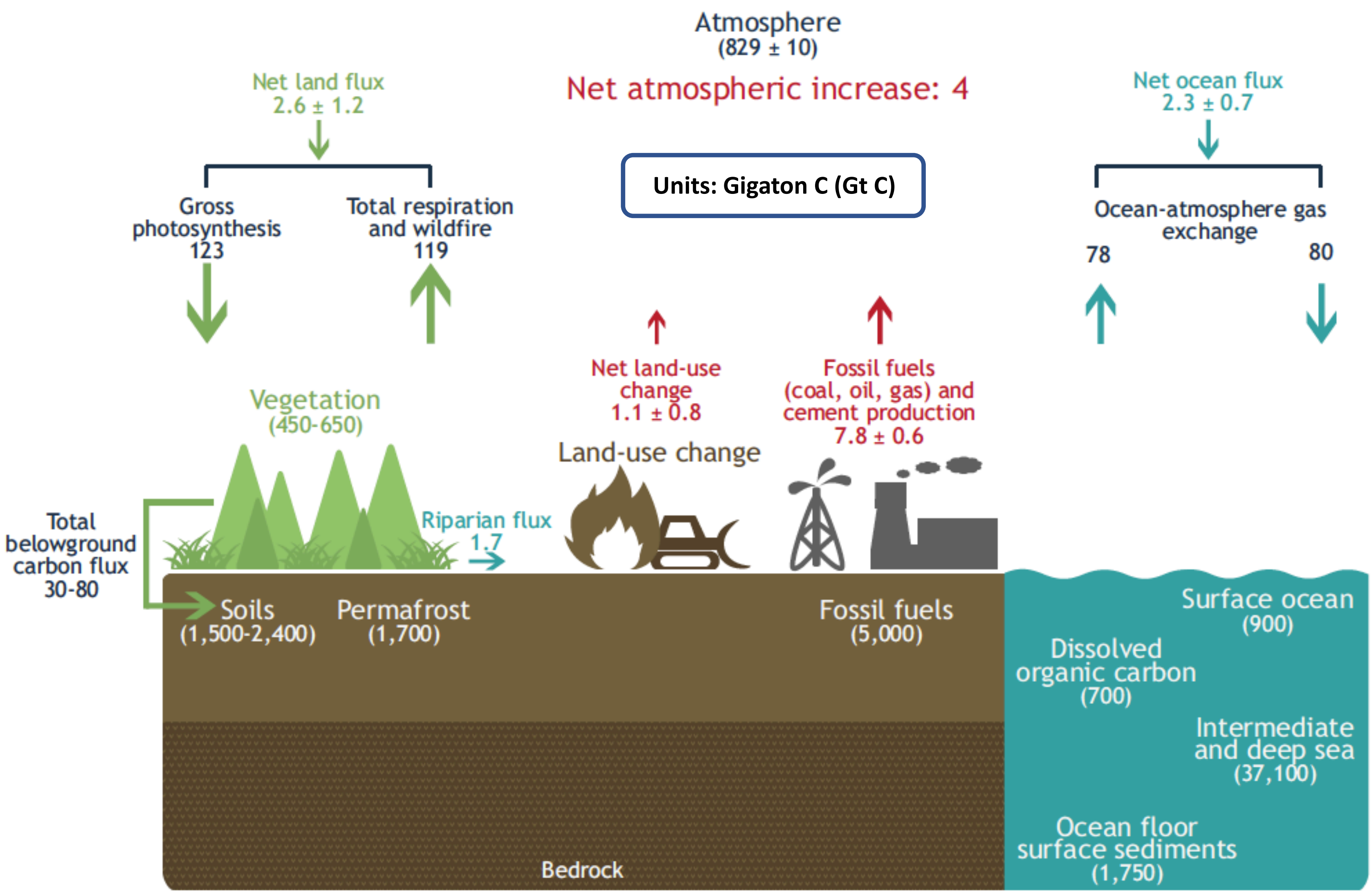
… in the U.S.?





From: Janowiak et al. 2018; www.fs.fed.us/research/publications/gtr/gtr_wo95.pdf

Carbon cycling between ecosystems and the atmosphere is driven many factors. Humans have an important influence on the global carbon cycle, particularly due to carbon release from land use change and burning fossil fuels.

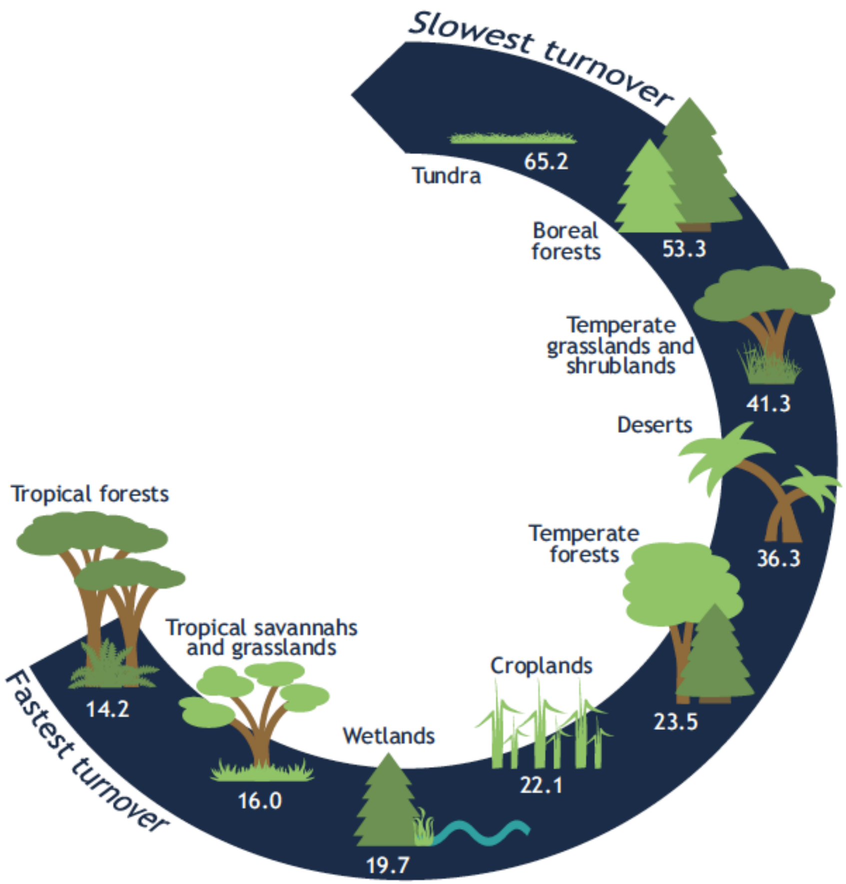


From: Janowiak et al. 2018; www.fs.fed.us/research/publications/gtr/gtr_wo95.pdf

Not all carbon is created equal!

- Ecosystems differ in carbon residence times (e.g. turnover rates).
- Within a single ecosystem, different carbon pools cycle at different rates.

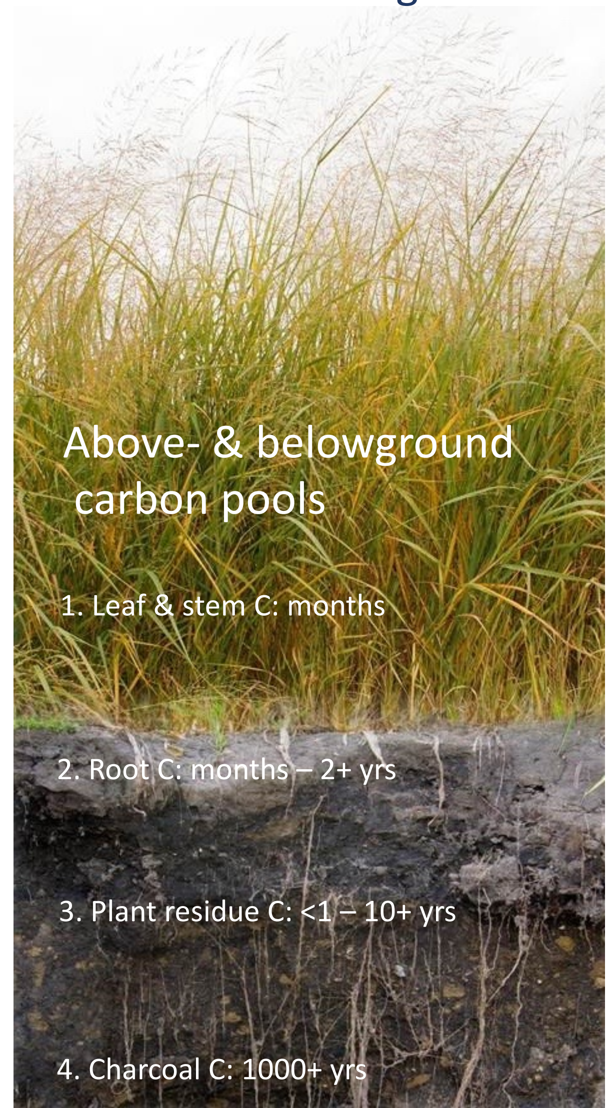
Total carbon turnover in different ecosystems



Average terrestrial ecosystem turnover times of carbon (shown in years)

From: Janowiak et al. 2018

Carbon turnover in grasslands



Is carbon **storage** the same as carbon **sequestration**? No, they are different!

The terms *storage* and *sequestration* are often used interchangeably; however,

EACH ONE HAS A SPECIFIC MEANING AND REACHES ITS MAXIMUM LEVEL AT DIFFERENT TIMES DURING FOREST DEVELOPMENT.

Nevertheless, both are necessary for reducing the effects of climate change.

CARBON STORAGE:

The amount of carbon that is retained in a carbon pool within the forest.

Storage levels increase with forest age and typically peak in the northeastern United States when forests are old (>200 years old).

CARBON SEQUESTRATION:

The process of removing carbon from the atmosphere for use in photosynthesis, resulting in the maintenance and growth of plants and trees.

The rate (or amount and speed) at which a forest sequesters carbon changes over time. In the northeastern United States, carbon sequestration typically peaks when forests are young to intermediate in age (around 30–70 years old), but they continue to sequester carbon through their entire life span.

From: Catanzaro & D'Amato, 2019, *Forest Carbon: An Essential Natural Solution for Climate Change.* UMass-Amherst

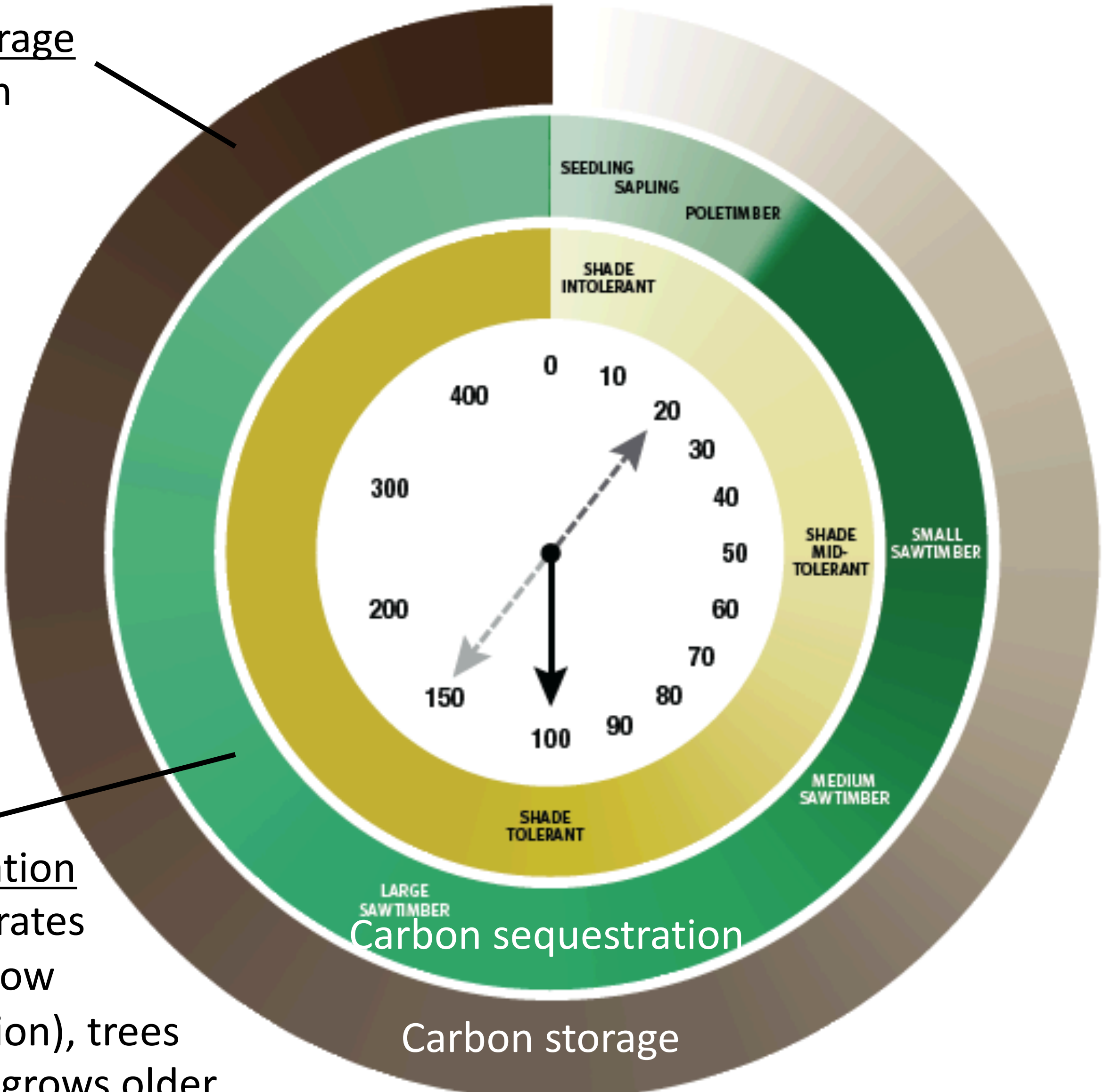
FOREST SUCCESSION & DEVELOPMENT CLOCK

Old Forests are good at carbon storage

Darker brown means higher carbon stocks in:

- Live and standing dead trees
- Course woody debris

As forests change as they age, so do the types of benefits they provide. Not just for wildlife habitat, but also carbon!



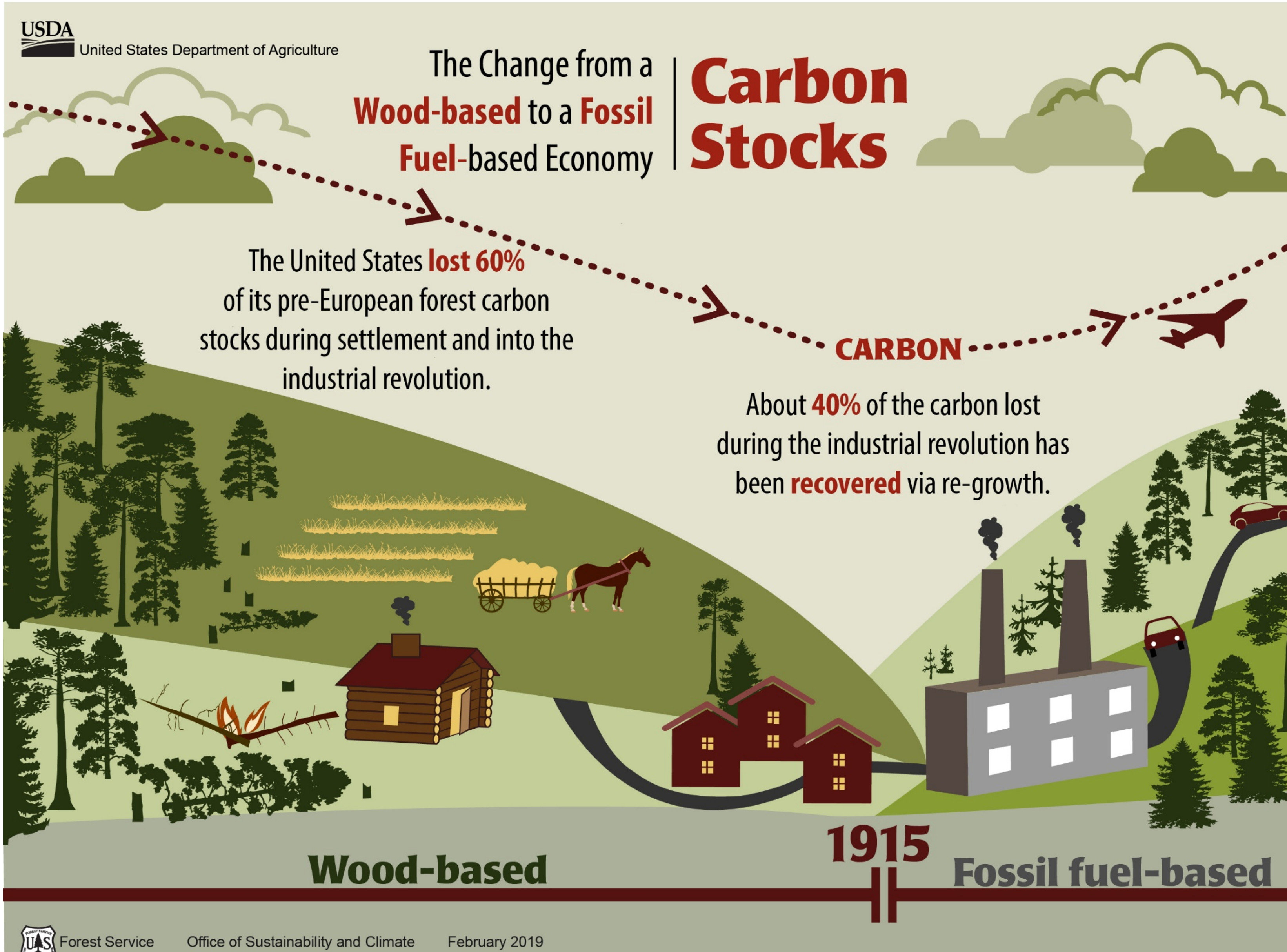
Young forests are good at sequestration

Darker green means higher growth rates

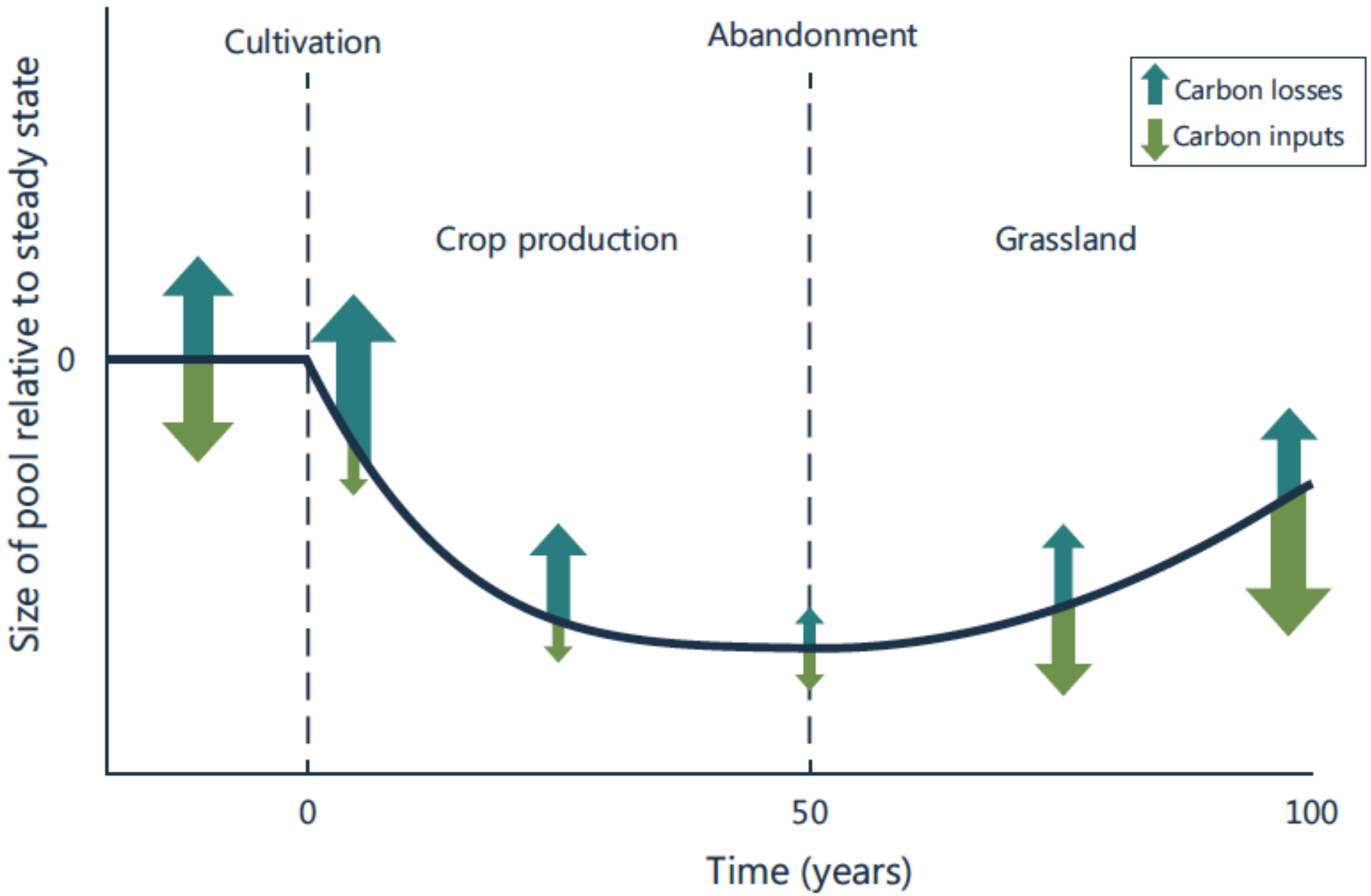
- Initial stages (<20 yr) growth is slow
- After canopy closes (stem exclusion), trees grow quickly, but slows as forest grows older

From: Catanzaro & D'Amato, 2019, *Forest Carbon: An Essential Natural Solution for Climate Change.* UMass-Amherst

The strong forest carbon sink in the U.S. is driven by forest recovery from historic forest clearing



Thinking about carbon in soils: Land use changes result in long-term changes in soil carbon when losses and inputs are not in balance.

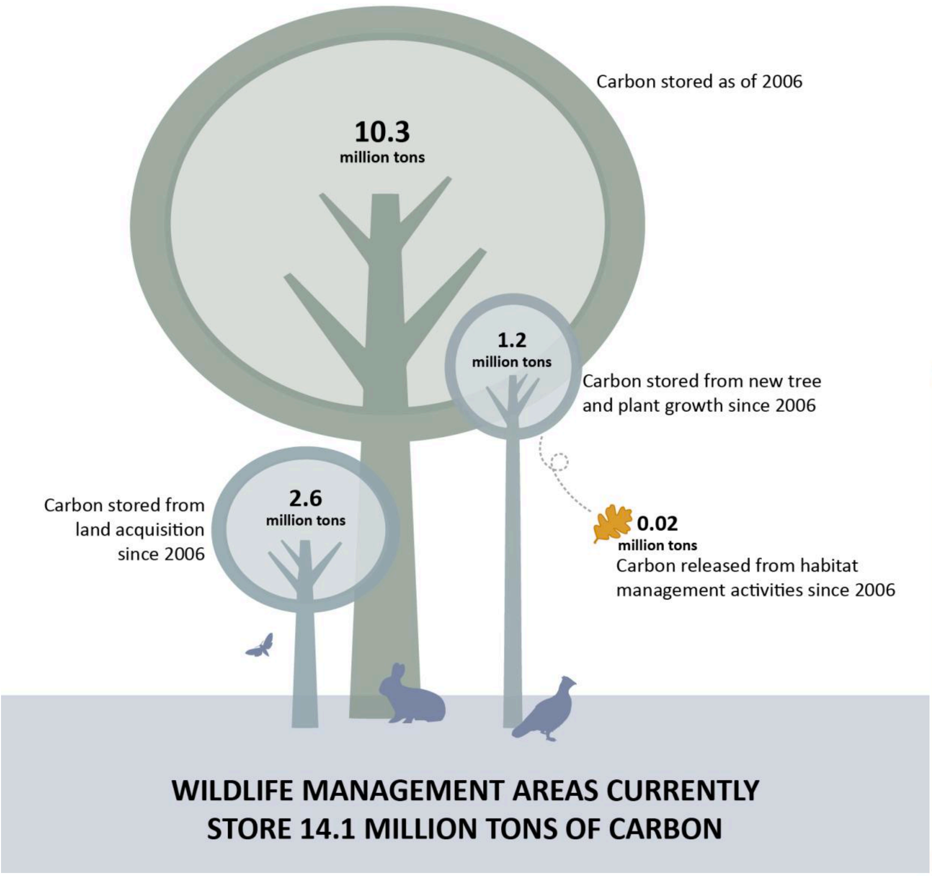


From: Janowiak et al. 2018; www.fs.fed.us/research/publications/gtr/gtr_wo95.pdf

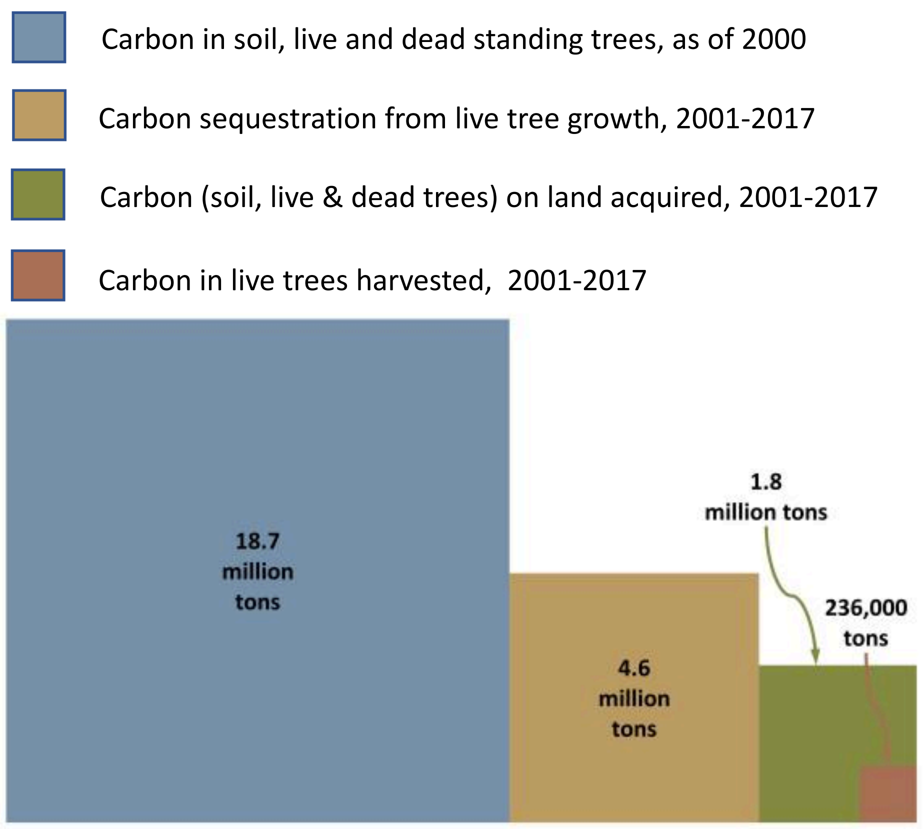
Putting forest carbon pools and fluxes into perspective, a few examples:

Carbon budgets for Commonwealth of Massachusetts owned properties show harvest losses are small in comparison to carbon gains from land acquisition and tree growth

MassWildlife Management Areas



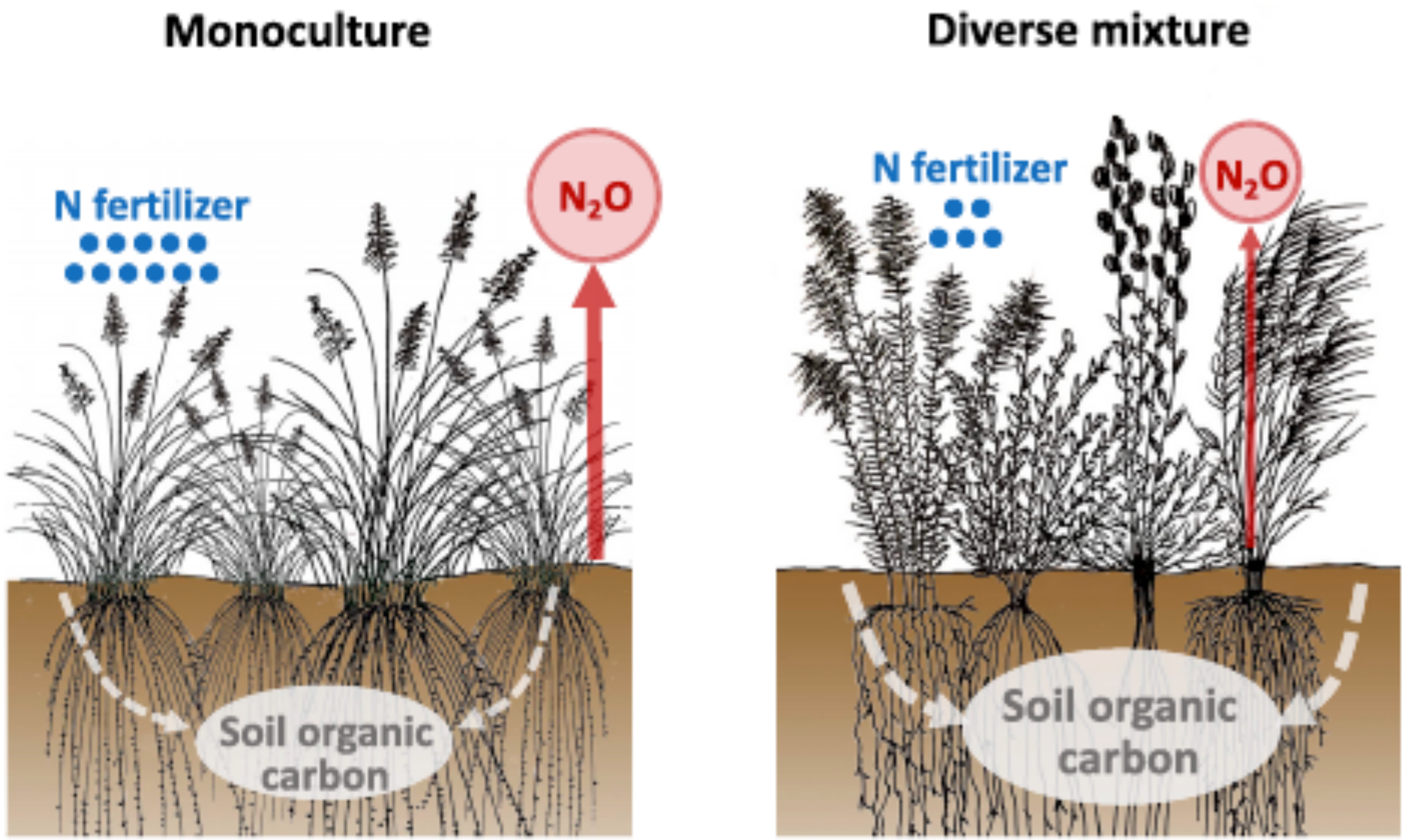
Dept. of Conservation and Recreation State Forest lands



www.mass.gov/service-details/carbon-storage-on-masswildlife-lands

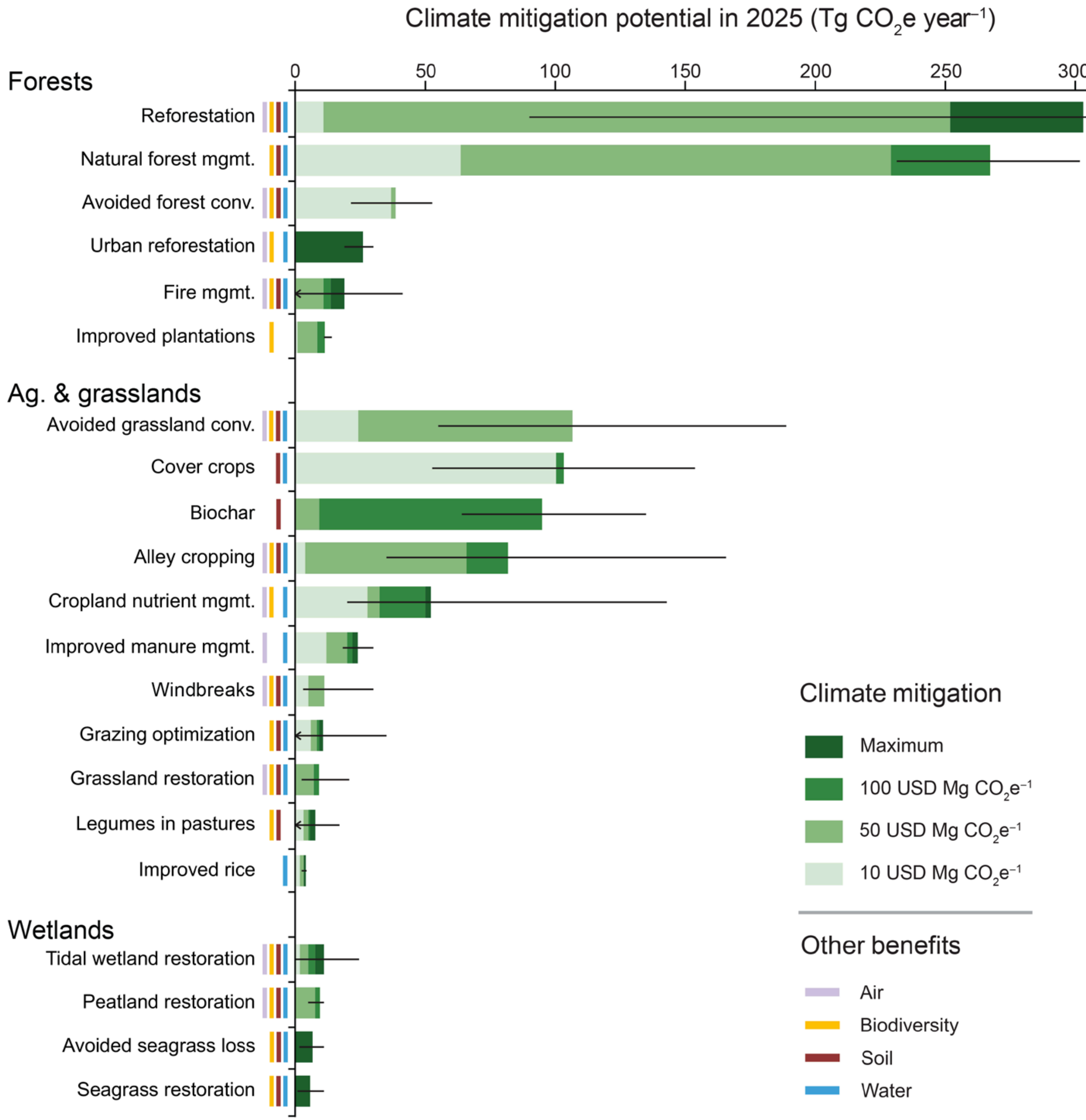
www.mass.gov/info-details/managing-our-forests-for-carbon-benefits#active-management-and-carbon-storage-

Plant diversity in grasslands can impact both carbon sequestration rates (plant productivity) and carbon storage (soil organic carbon stocks)



From: Yang et al. 2019, Climate Benefits of Increasing Plant Diversity in Perennial Bioenergy Crops, doi.org/10.1016/j.oneear.2019.11.011

Natural Climate Solutions



Fargione et al., Sci. Adv. 2018; 4 : eaat1869

What forest management practices can build forest carbon?

Practitioner's Menu of Strategies and Approaches for Forest Carbon Management

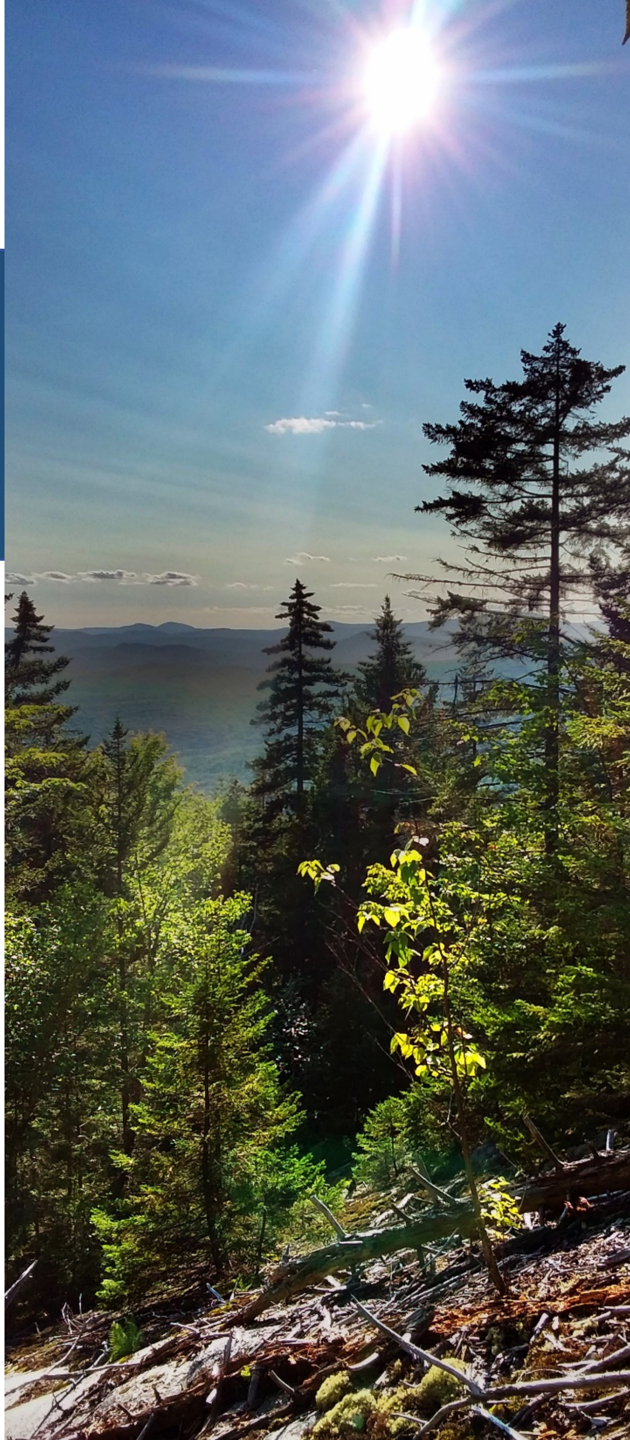
NIACS
Northern Institute of Applied Climate Science

AMERICAN FORESTS
- SINCE 1875 -

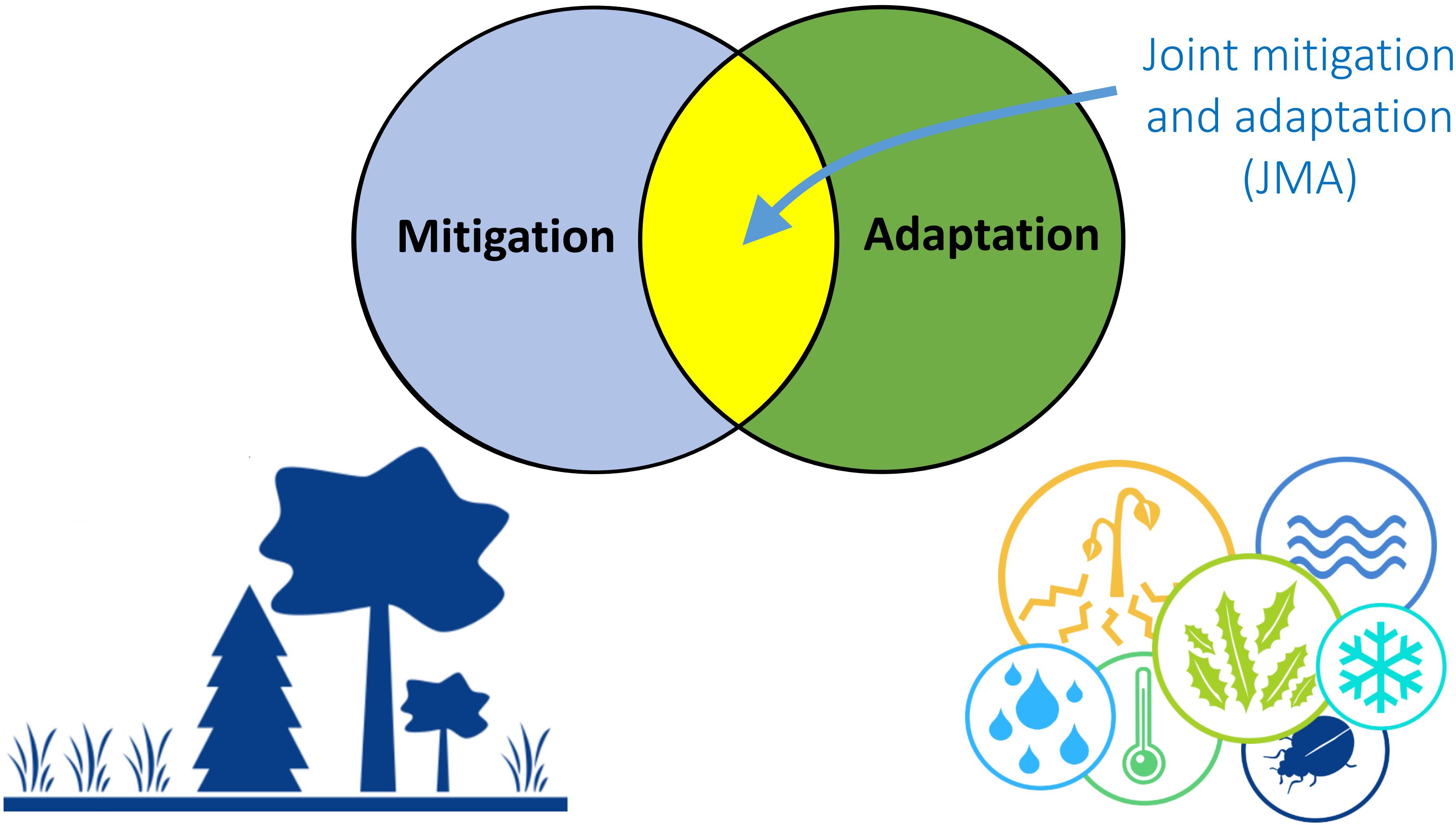
www.forestadaptation.org/carbon

Journal of FORESTRY

Forest management for carbon sequestration and climate adaptation. *Journal of Forestry.*
doi: 10.1093/jofore/fvz062



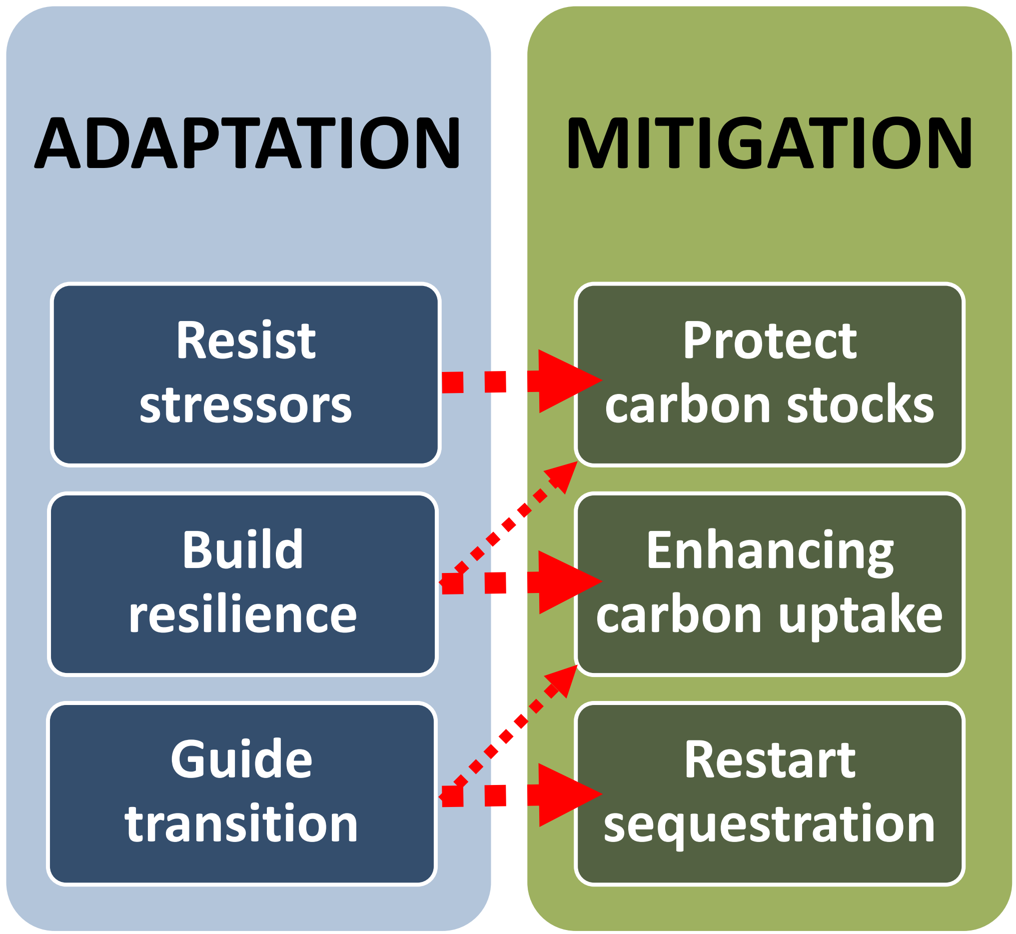
The *Forest Carbon Management Menu* helps managers integrate climate mitigation & climate adaptation together to build **resilient carbon sequestration and storage** in forest ecosystems



Practitioner's Menu of Strategies and Approaches for Forest Carbon Management

Forest Carbon Menu

1. Maintain forest extent
2. Sustain ecological function
3. Reduce carbon losses
4. Enhance forest recovery
5. Prioritize critical locations
6. Enhance carbon stocks
7. Enhance sequestration



Management influences on carbon: Beyond the ecosystem level, humans can influence carbon cycling through management actions that store carbon in wood products or substitute for fossil fuel use (energy and materials).