

Primer on Forest Carbon

Securing Northeast Forest Carbon Program

Ohio State Extension

November 10, 2022



Charles Levesque, Executive Director
North East *State* Foresters Association
www.northeastforestcarbon.org

Securing Northeast Forest Carbon Program

Goal is for forestry professionals to have the latest info on forest carbon and forest carbon markets to provide to private forest landowners so they can make informed forest carbon decisions about their land – including whether to sell forest carbon:

- 3- year project funded through a grant by the USDA Forest Service to the North East *State* Foresters Association;
- cooperative effort among the State forestry offices in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont;
- Forest carbon website and training for state forestry outreach and education staff and then private forestry professionals & forest landowners;
- Working forestland program.

State leads for



- Connecticut – **Andrea Urbano**, Service Forester, CT Dept. of Energy and Environmental Protection – Andrea.Urbano@ct.gov
- Maine – **Donald Mansius**, Director of Forest Policy and Management Division, Maine Forest Service – Donald.J.Mansius@maine.gov
- Massachusetts – **Christina McKeown**, MA DCR Climate Forester Christina.MCKeown2@mass.gov
- New Hampshire – **Matt Kelley**, Forestry Field Specialist, UNH Cooperative Extension – Matt.Kelly@unh.edu
- New York – **Molly Hassett**, Climate Forestry and Carbon Section Leader, NY DEC, Division of Lands and Forests – molly.hassett@dec.ny.gov
- Rhode Island – **Nancy Stairs**, Cooperative Forestry Program Supervisor, RI Dept of Environmental Management, Div. of Forest Environment – Nancy.Stairs@dem.ri.gov
- Vermont – **Alexandra Kosiba**, Extension Forester, University of Vermont – Alexandra.Kosiba@uvm.edu



[Home](#)

[About Us](#)

[Especially for Forest Landowners](#)

[Science of Forest Carbon](#)

[Forest Carbon Markets](#)

[Forest Carbon Financing Programs and Developers](#)

[Carbon Friendly Forest Management](#)

[Forest Carbon Case Studies](#)

[Additional Resources](#)

[Contact Us](#)

Home

The **Securing Northeast Forest Carbon Program** is a cooperative effort among the State forestry offices in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont to secure as much of the private forest carbon in the northeast region as possible in a 3-year period (2021-2024). The focus is on working forestland carbon. Each State Forester's office has a forest carbon lead staffer and others will be trained as well in how to encourage private forest owners in the region to secure their forest carbon through carbon sales in the voluntary and compliance markets, through special management practices and through use of conservation easements.

Sign up for our enewsletter [HERE](#)

Search ...

Securing Northeast Forest Carbon Program is a project of the North East *State* Foresters Association funded through a grant from the USDA Forest Service



www.northeastforestcarbon.org

In-depth forest carbon webinars available

RECORDINGS AVAILABLE – www.northeastforestcarbon.org

The Science of Forest Carbon

The Science of Forest Carbon Management

Forest Carbon Markets Overview and NRCS Forest Carbon Opportunities

Forest Carbon Project Developers

Presentation outline:

The Science of Forest Carbon

**Quick Overview: Science of Forest Carbon
Management**

Forest Carbon Markets Overview

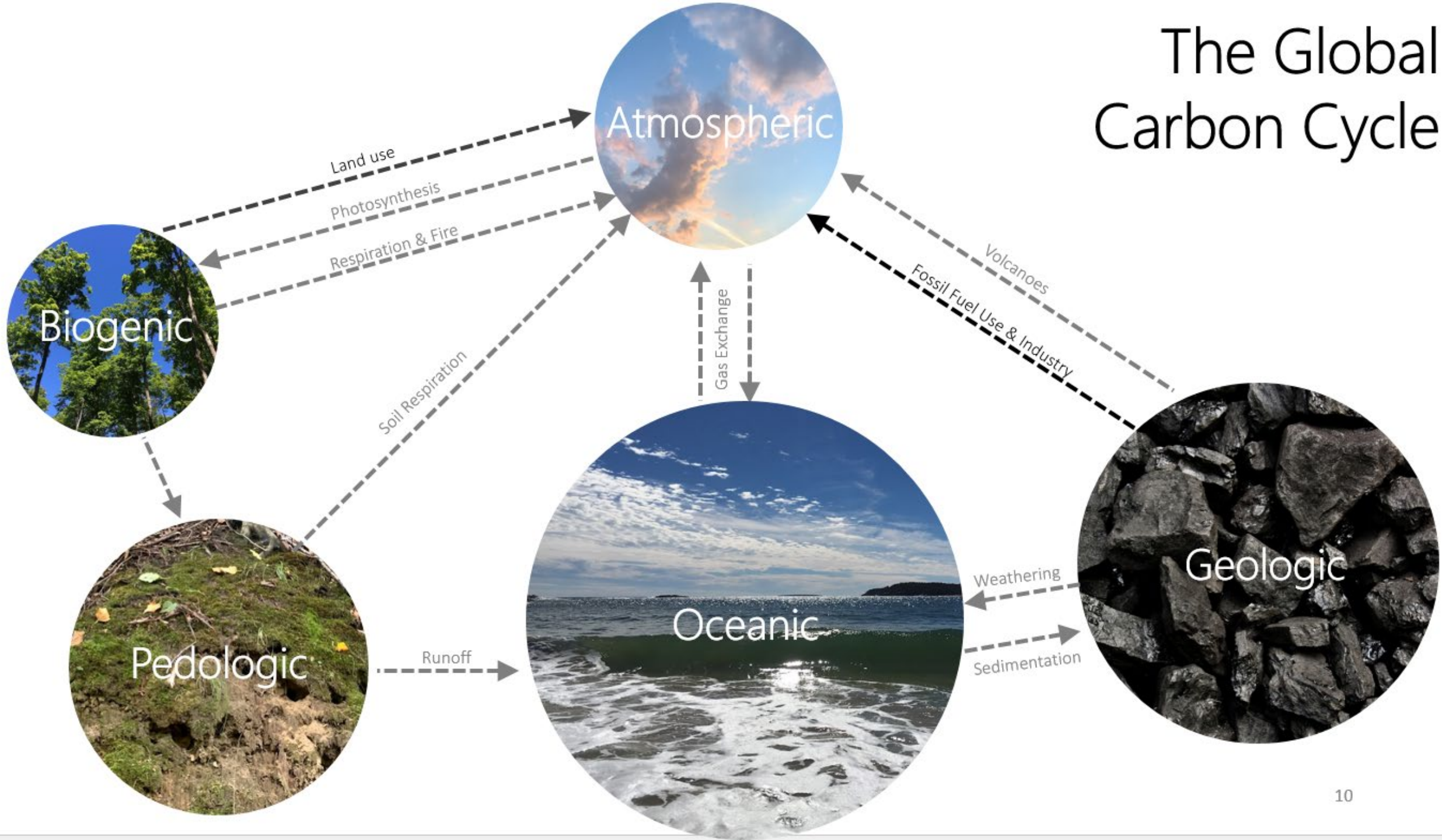
Science of Forest Carbon



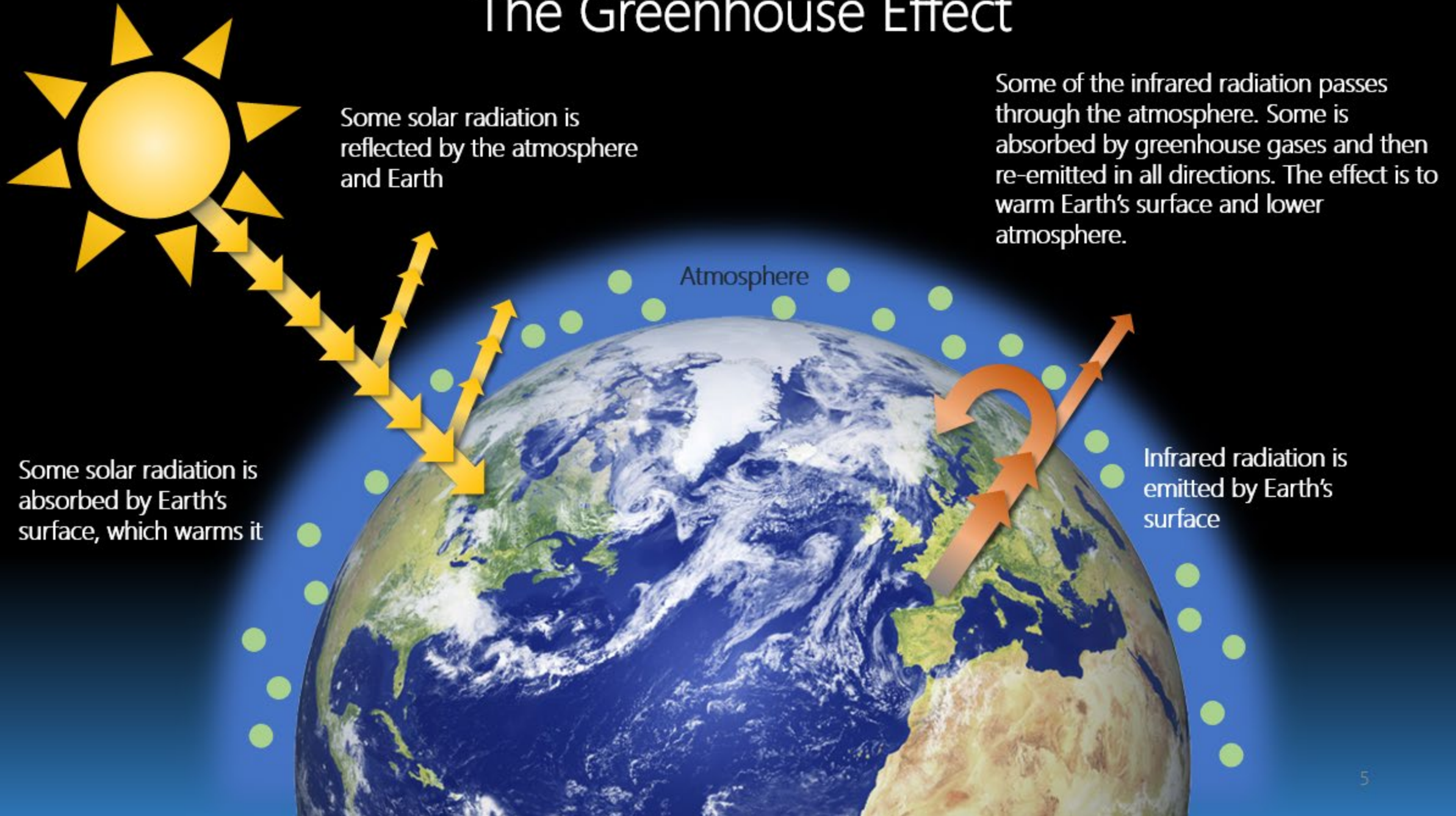
Dr. Alexandra Kosiba, University of Vermont Extension Forester

The Science of Forest Carbon

The Global Carbon Cycle



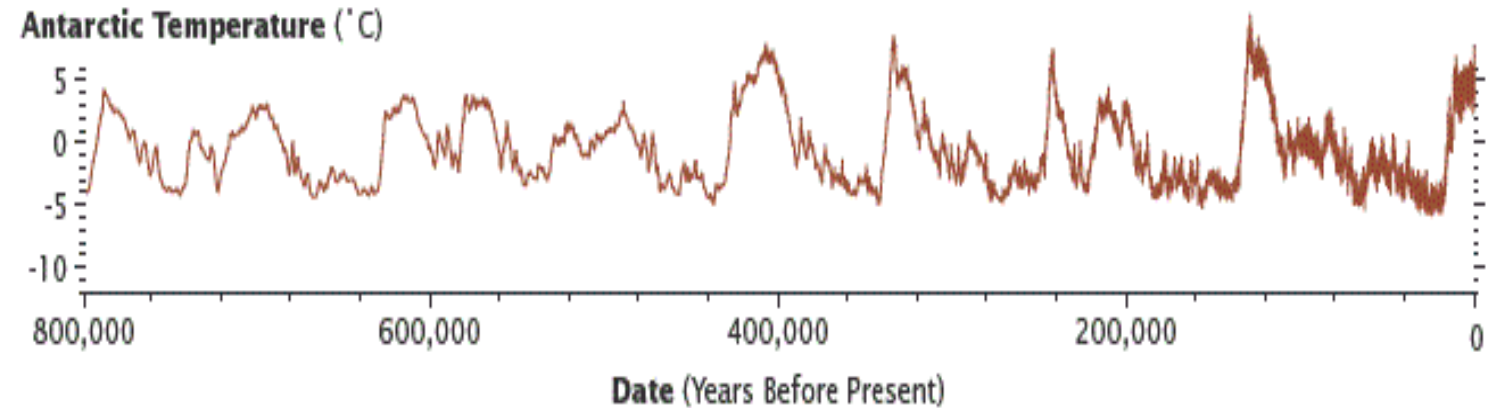
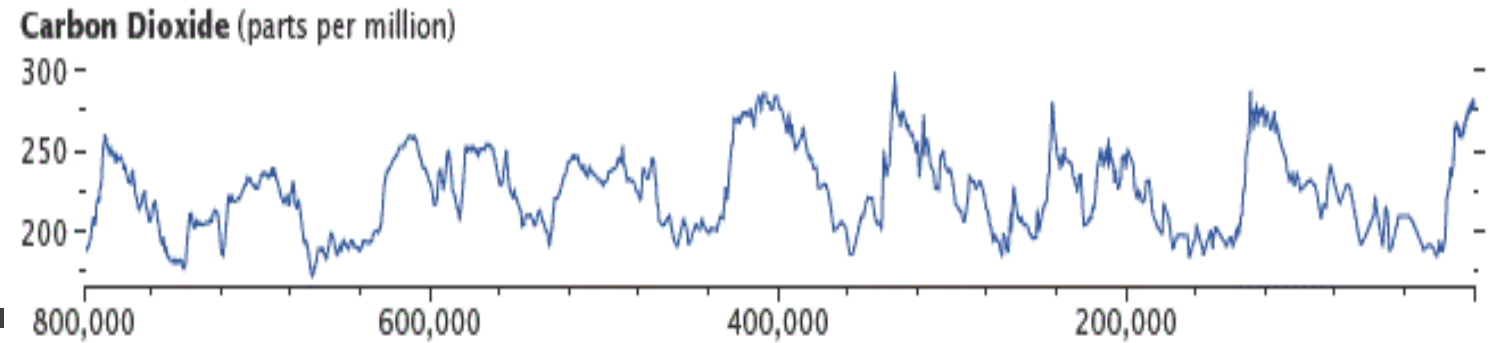
The Greenhouse Effect



Carbon released to the atmosphere has an affinity to form carbon dioxide (CO₂) which is a powerful greenhouse gas, trapping the Earth's energy



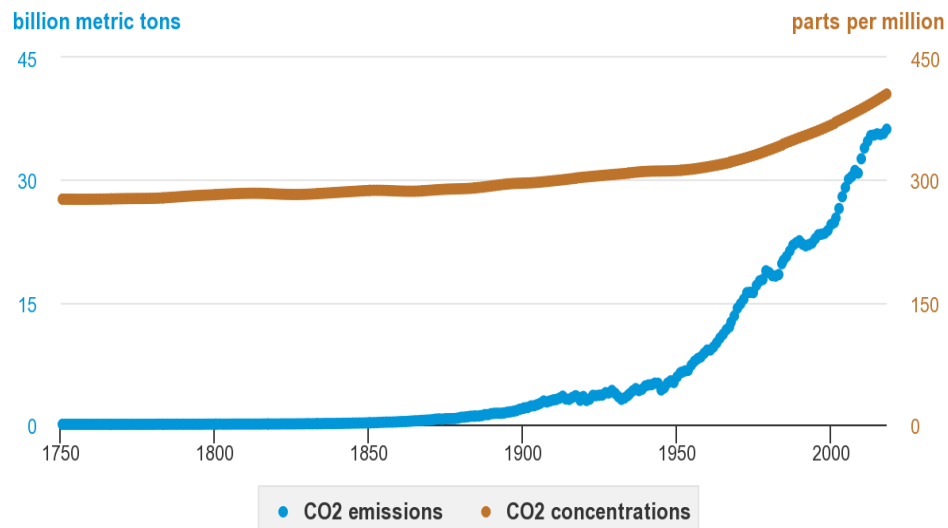
Atmospheric CO₂ concentrations are directly tied to global temperatures



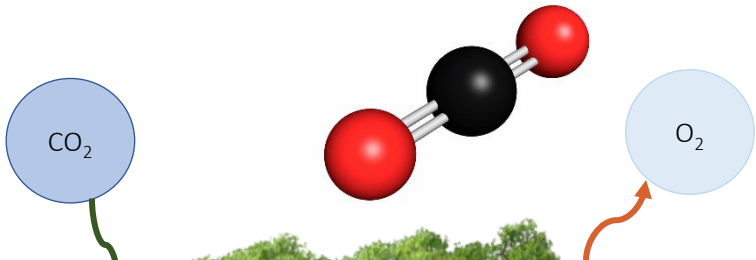
Source: <https://www.feedbackreigns.net/evidence/temperature-co2/>



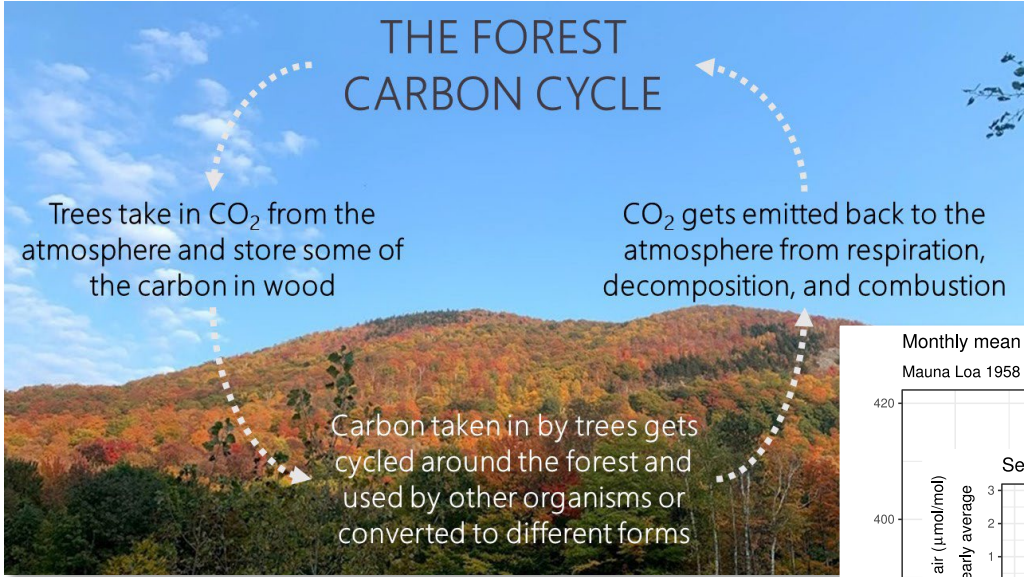
World carbon dioxide (CO₂) emissions from fossil fuel combustion and global atmospheric concentrations CO₂ (1751-2018)



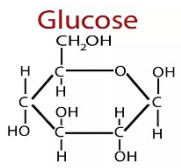
Source: Oak Ridge National Laboratory, Carbon Dioxide Information Analysis Center, Scripps Institute of Oceanography CO₂ program, and the U.S. Energy Information Administration, International Energy Statistics, accessed December 7, 2020.



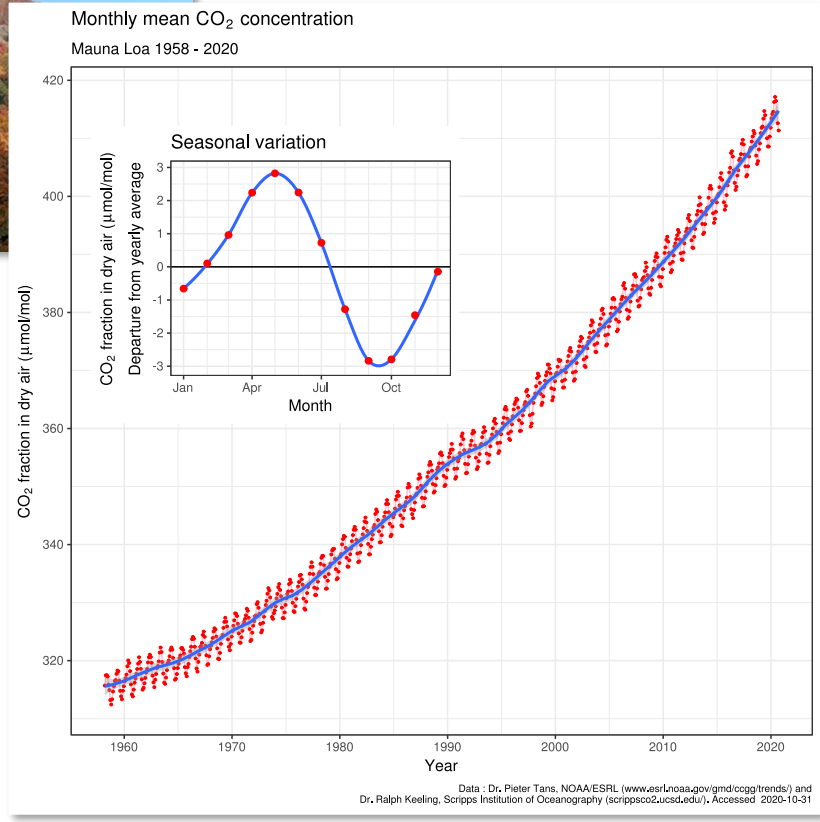
Trees can help mitigate climate change by sequestering CO₂ from the atmosphere and storing the carbon in wood and soil



CO₂ + water + sunlight = sugar + water + O₂



HALF
of the dry weight of wood is carbon that was removed from the atmosphere by the growing tree



Quick Carbon Terminology Primer

Carbon storage

total the amount of carbon in an entity (tree, acre of forest, cord of wood)

Synonyms: stock, density

Carbon sequestration

the process of taking CO₂ from the atmosphere and storing it

Synonyms: absorbed, took in, storage rate, change in storage

Carbon emissions

the opposite of sequestration (CO₂ release back to atmosphere)

Cellular respiration (metabolism, CO₂)

Decomposition (CO₂, CH₄)

Combustion (CO₂, CH₄)

Carbon sequestration + carbon emissions = carbon flux

the change in carbon storage

Negative flux = net sequestration = **carbon sink**

Positive flux = net emissions = **carbon source**

For easier comparisons, we convert carbon and other greenhouse gases to the same units = **carbon dioxide equivalent (CO₂e)**

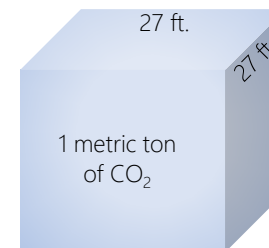
Helpful conversions

1 metric ton (Mt) = 1 Mg = 1000 Kg = 2,205 lbs

1 Mt C = 3.67 Mt carbon dioxide equivalent (CO₂e)

1 Mt C per ha = 1.49 Mt CO₂ per acre

Wood is ~50% carbon by dry weight



Forests of the Northeast store the equivalent of ~54 years of the region's current annual GHG emissions

Collectively, NE/NY Forests are a Carbon Sink – 14% of emissions annually taken up by trees

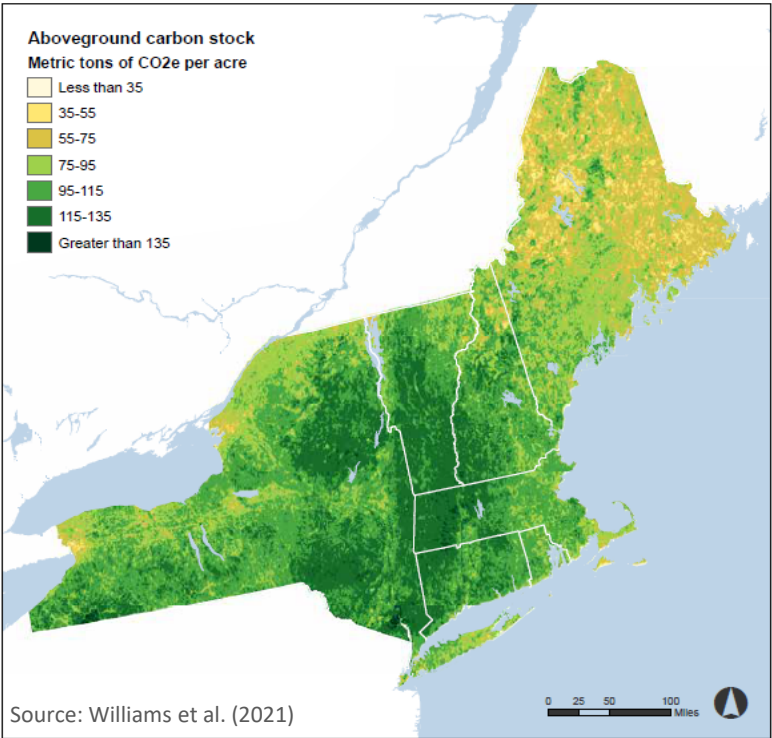
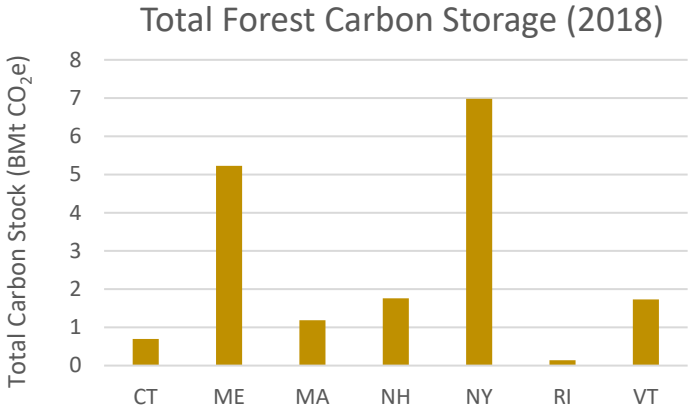
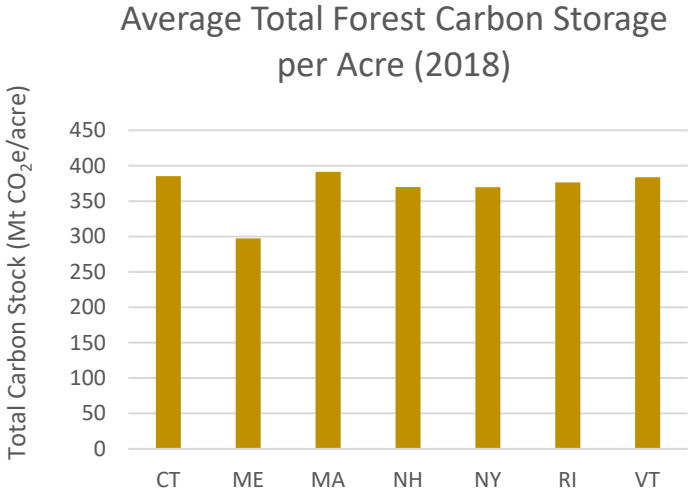


FIGURE 3. Above ground carbon stocks, expressed in metric tons of CO₂e per acre, smoothed from the original dataset with focal statistics that average over a 1 km x 1 km block. The highest value in the original, 30 m resolution map is 210 metric tons of CO₂e per acre.



As of 2018, the NE forests stored 17.5 billion Mt CO₂e

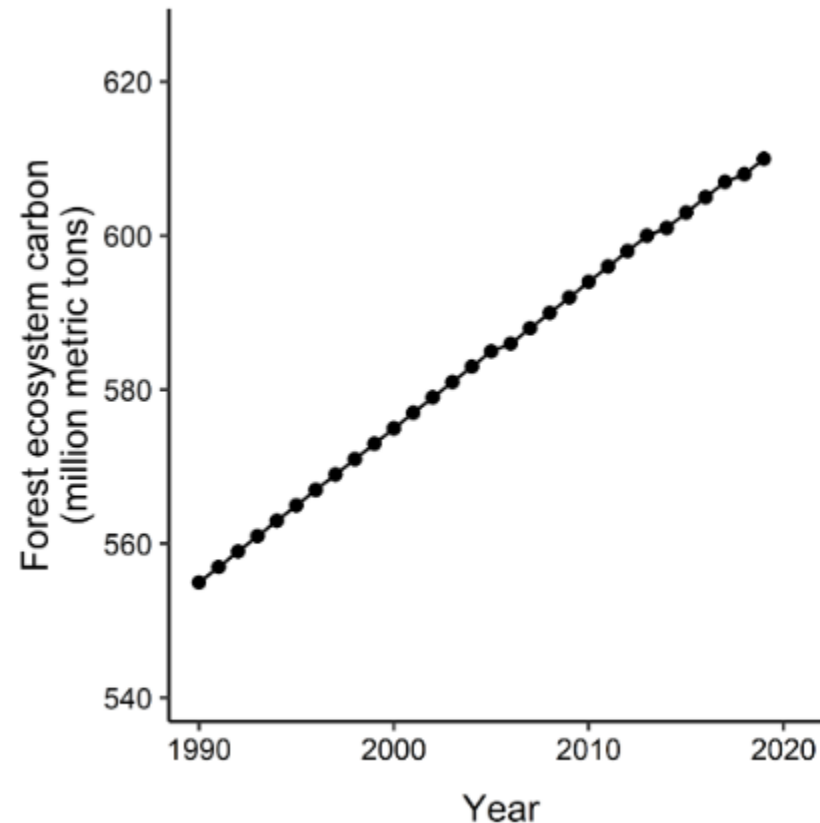


Or an average of 368 Mt CO₂e/acre

Forests of the Ohio store the equivalent of ~11 years of the region's current annual GHG emissions

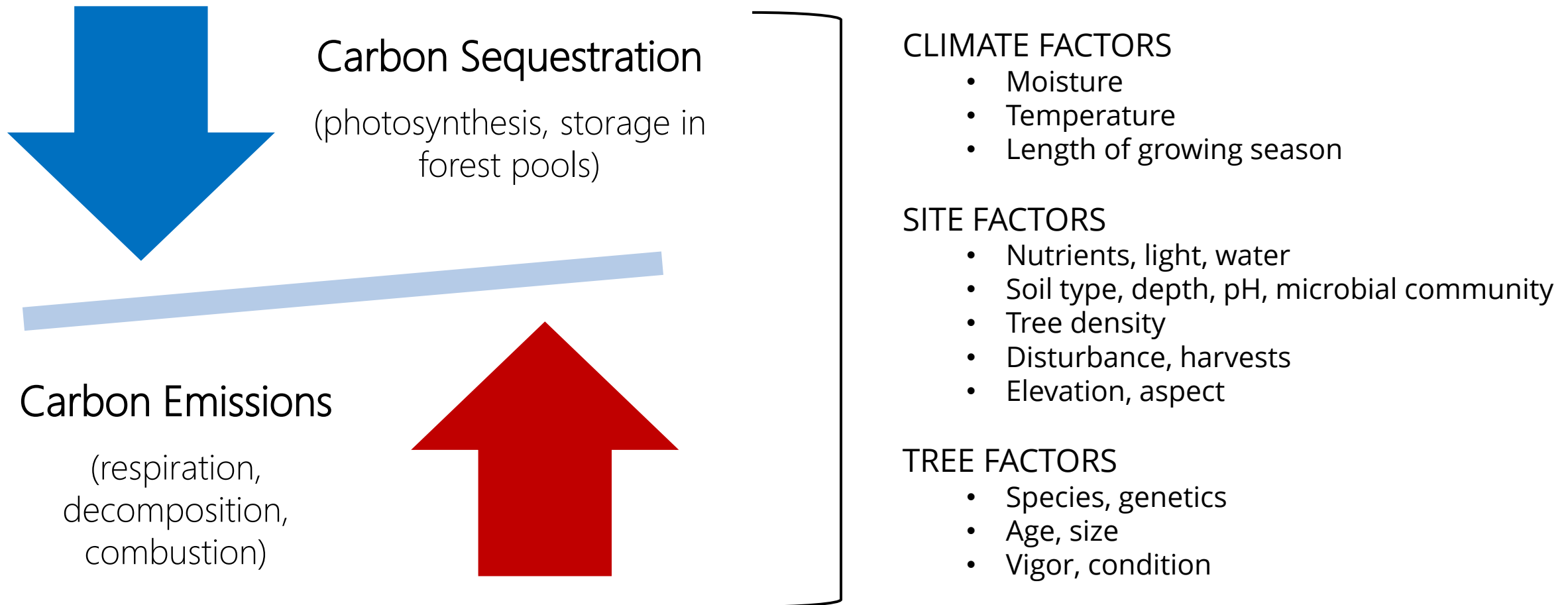



Collectively, Ohio Forests are a Carbon Sink – 3% of annual emissions



Ohio forest carbon 1990-2020 on 8 million acres of forest

Whether a forest is a sink or source of carbon depends on the balance between uptake and release





Not all forest
stands are
carbon sinks

Carbon sink

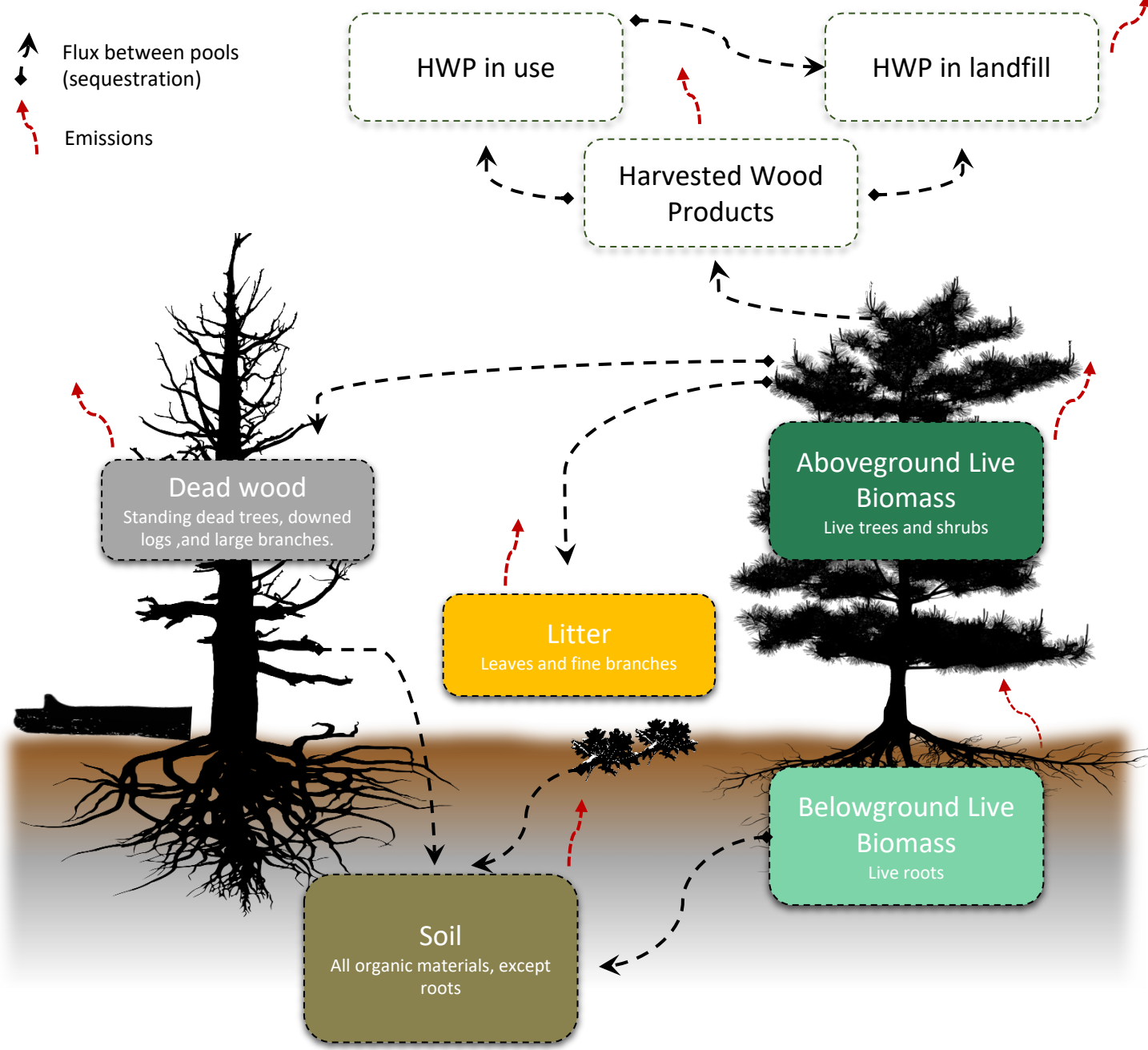
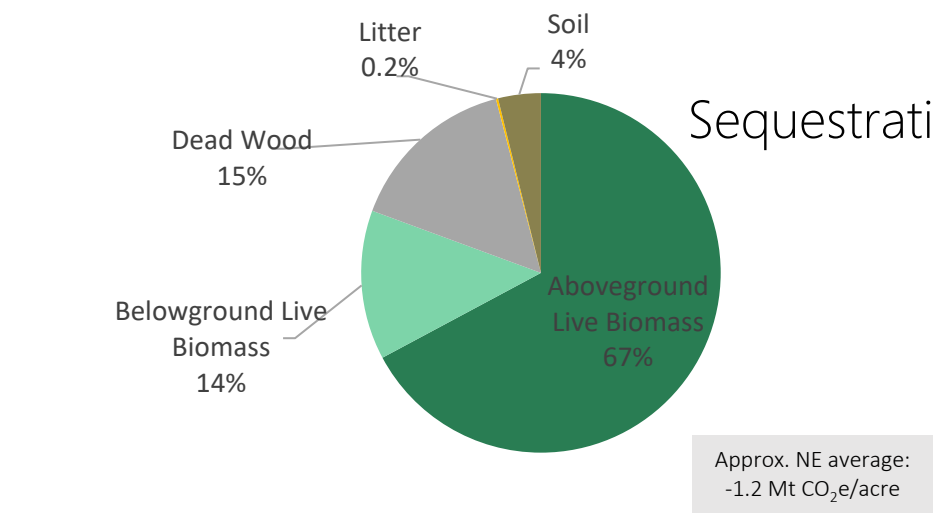
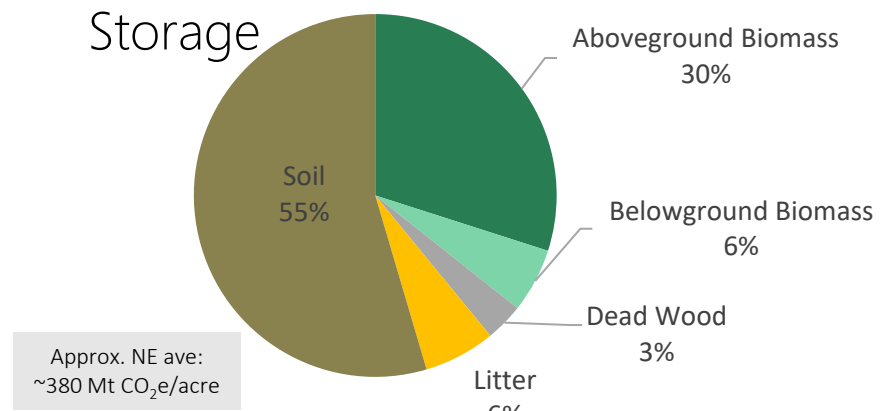
Sequestration > Emissions

Carbon source

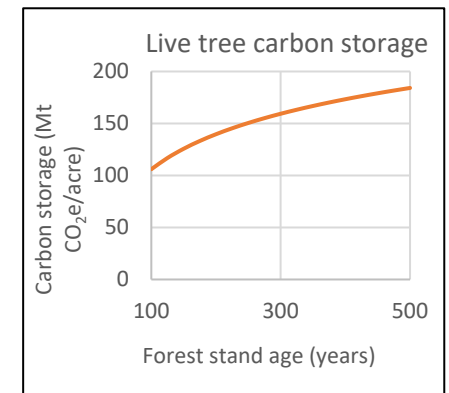
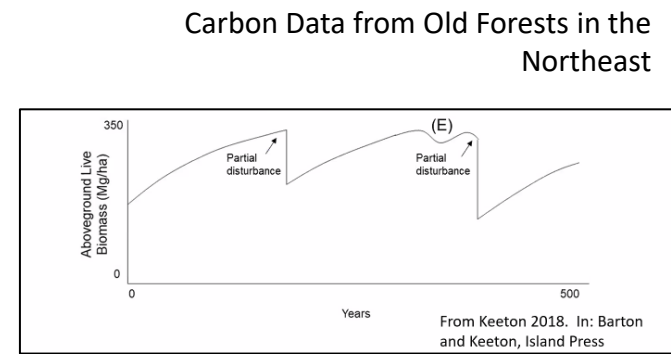
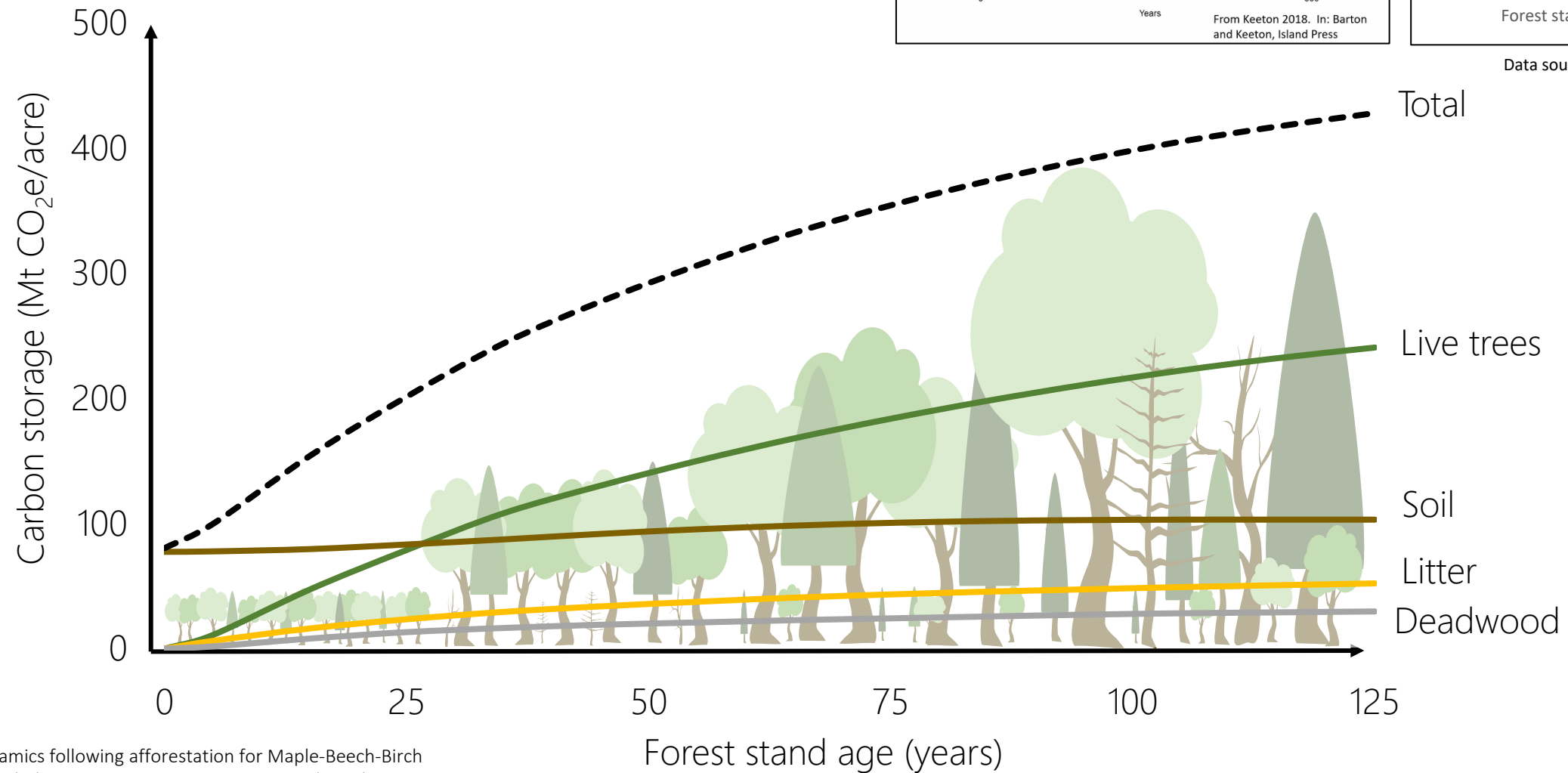
Sequestration < Emissions



Forest carbon pools



Carbon storage varies over forest stand development

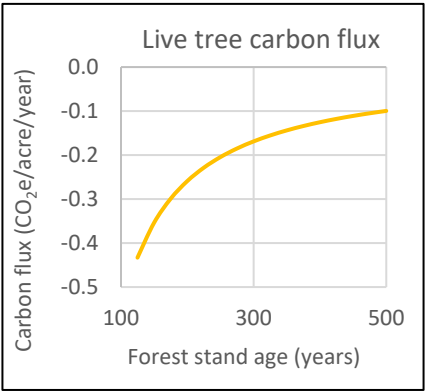
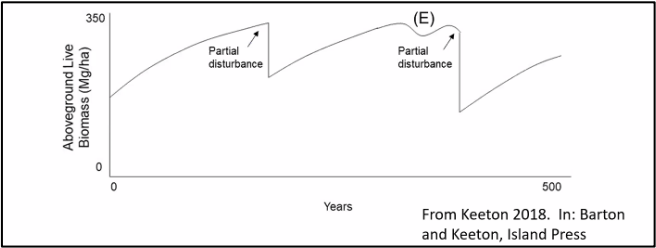


Data source: Keeton et al. 2011

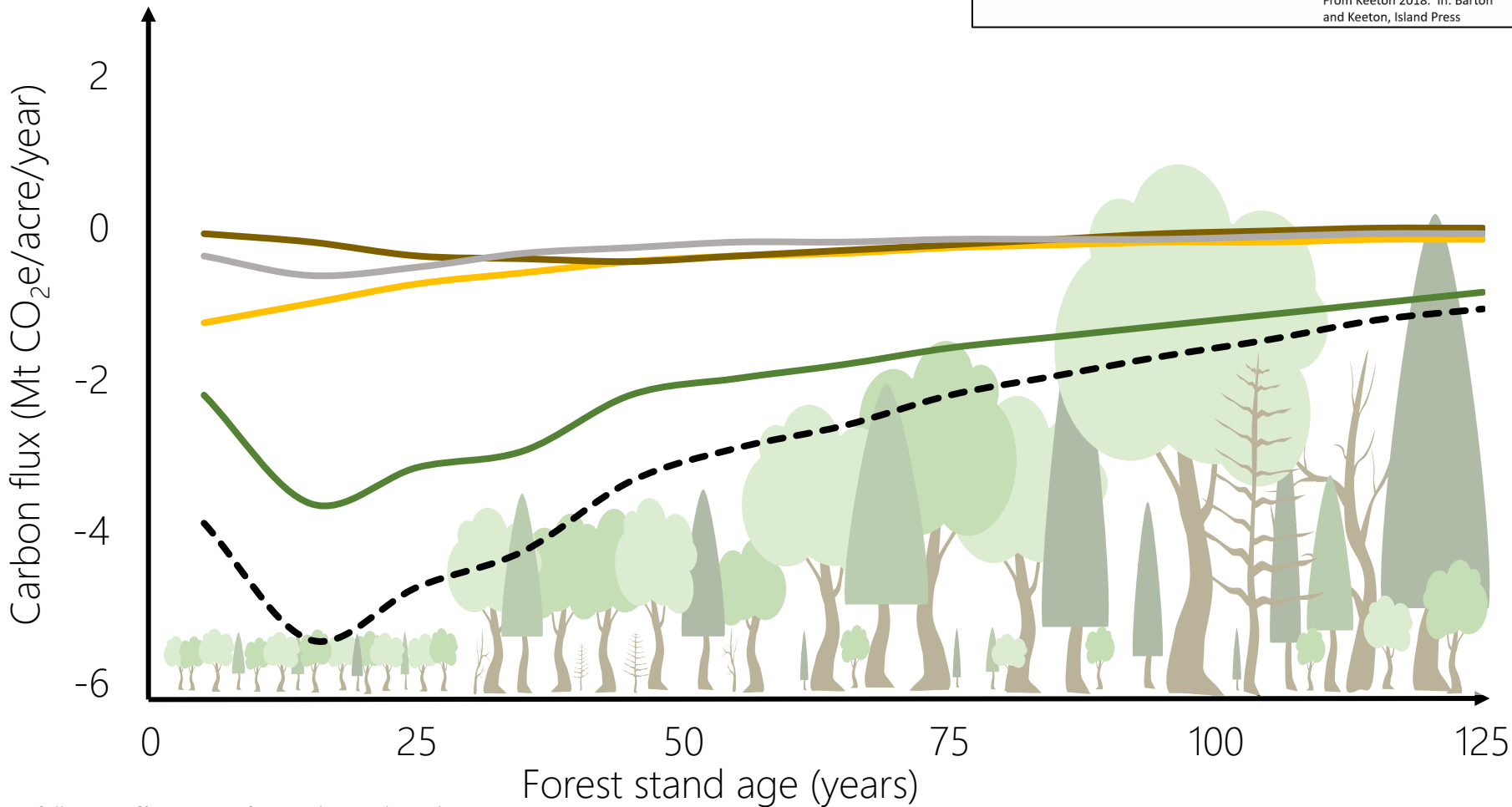
Note: carbon dynamics following afforestation for Maple-Beech-Birch forest, does not include management. Data source: Smith et al. 2006.

Carbon sequestration varies over forest stand development

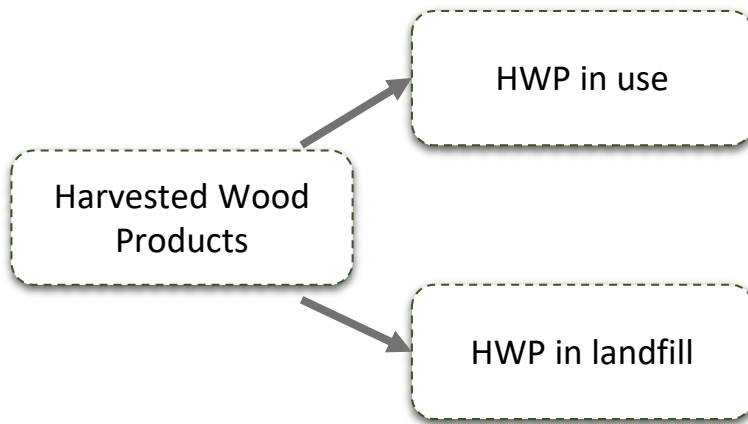
Carbon Data from Old Forests in the Northeast



Data source: Keeton et al. 2011



Note: carbon dynamics following afforestation for Maple-Beech-Birch forest, does not include management. Data source: Smith et al. 2006.



Forest Sector Carbon Cycle

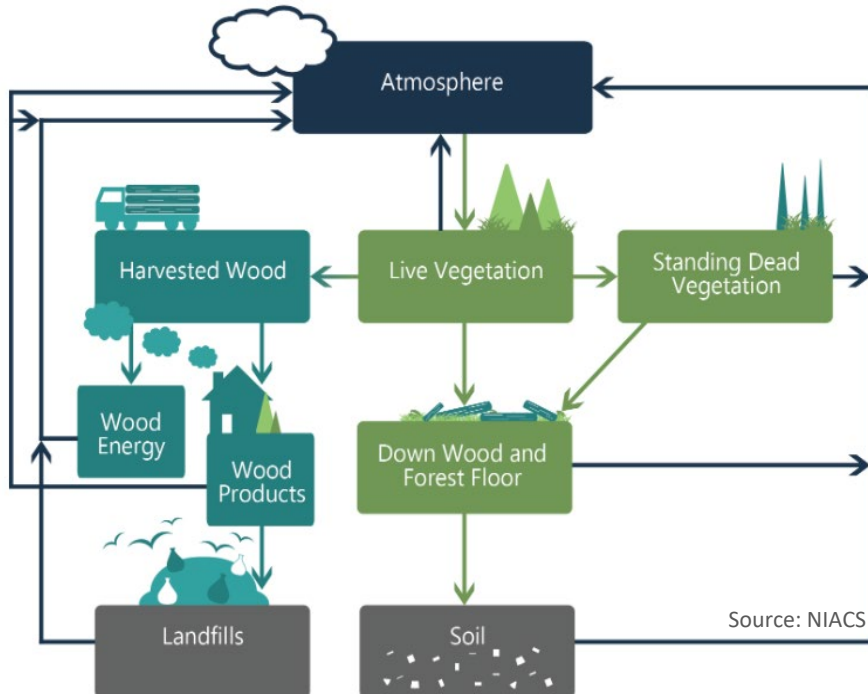


Figure: The forest sector carbon cycle includes forest carbon pools and carbon transfer between pools. Modified from Heath et al. (2) and United States Department of Agriculture (3).

Wood Products

Carbon storage for as long as product is in use, and when it is no longer in use and is in a landfill slowly decomposing.

Can provide additional CO₂ reduction benefits by acting as a **substitute** for high GHG products (steel, concrete, plastics, fossil fuels)

When considering the carbon impacts of HWP we must consider LEAKAGE



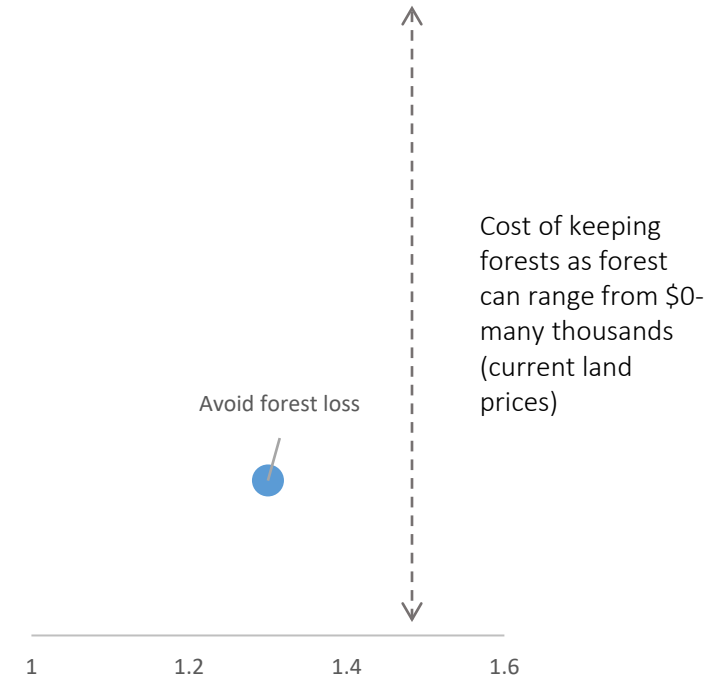
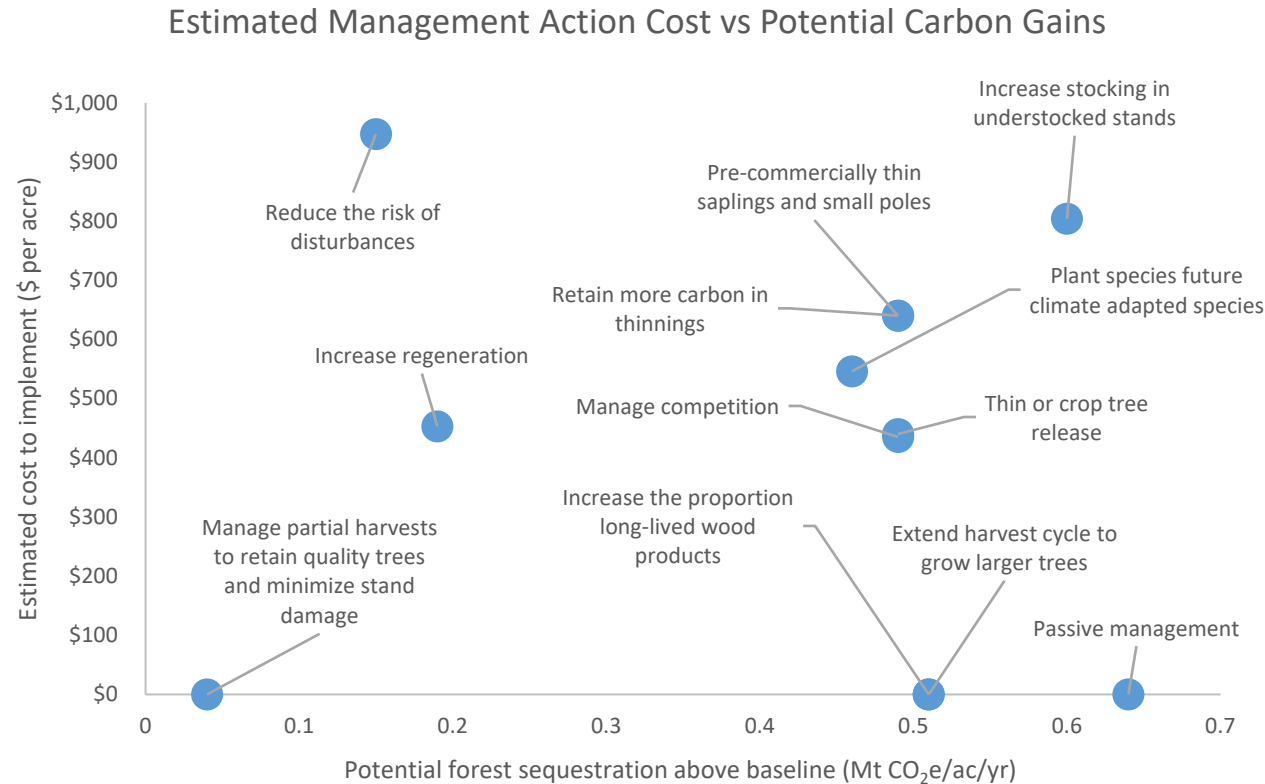
Science of Carbon-Friendly and Climate Adaptation Forest Management

Some key forest management methods to increase carbon sequestration and storage:

- Avoid forest loss
- Establish reserves – permanent or temporary
- Extend forest rotations: from regeneration to harvest. Partial harvest best.
- Careful forest thinning to increase growth rates
- Increase areas with younger forests (but not by clearing really old forests)
- Retain some big trees
- Increase stocking in forest areas that are not dense or reforest areas with no trees
- Increase tree species diversity so there is a tree to fill all niches
- Make sure you limit damage to remaining trees when harvesting
- Protect soil during harvesting
- Get as much timber harvested into durable wood products – boards and timbers
- Reduce emissions from the forest products harvesting supply chain – the machines that get the timber from the woods to the mill

Cost benefits – bang for the buck

Data Source: Modified slightly from data in the Maine Carbon Task Force Final Report (2021)
Note that costs and potential carbon gains are estimates and may be based on data from a limited number of locations or forest types, and may be hypothetical from modeling studies. Cost to implement does not include possible revenue generated from timber sales.

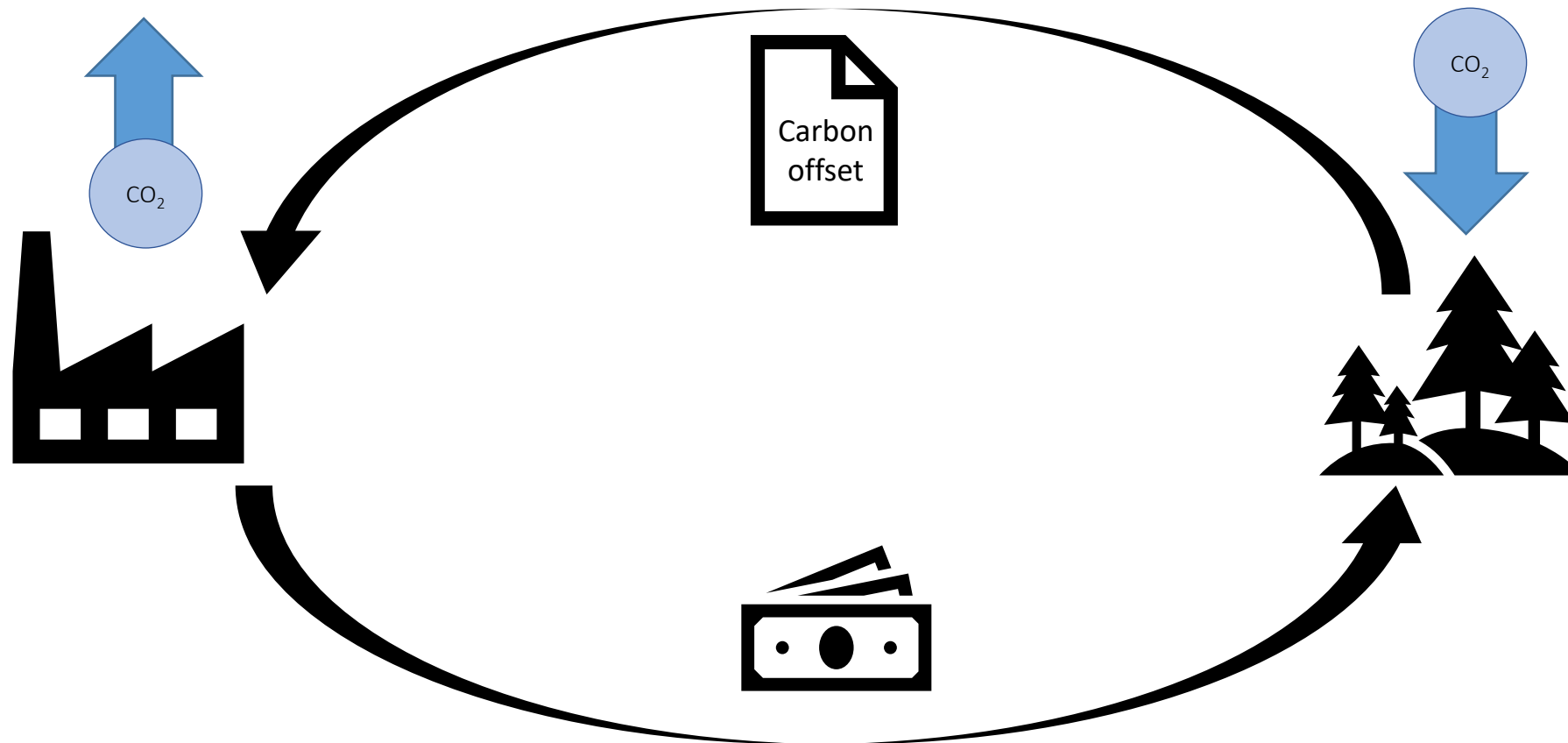


Forest Carbon Markets Overview

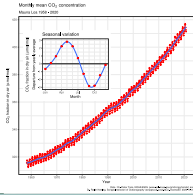
What is the purpose of forest carbon offsets?

Allows entities to reduce emissions more quickly than they could otherwise by purchasing offsets where carbon is actively being sequestered or emissions avoided

Helps to finance forest management, restoration, conservation, tree planting, and other activities



Currently, there are three categories of actions for forest carbon offsets



2

3

Afforestation/ Reforestation (A/R)

Carbon offsets are generated through the carbon storage of newly planted trees
Can be either on non-forested sites (afforestation) or to reestablish forests (reforestation)

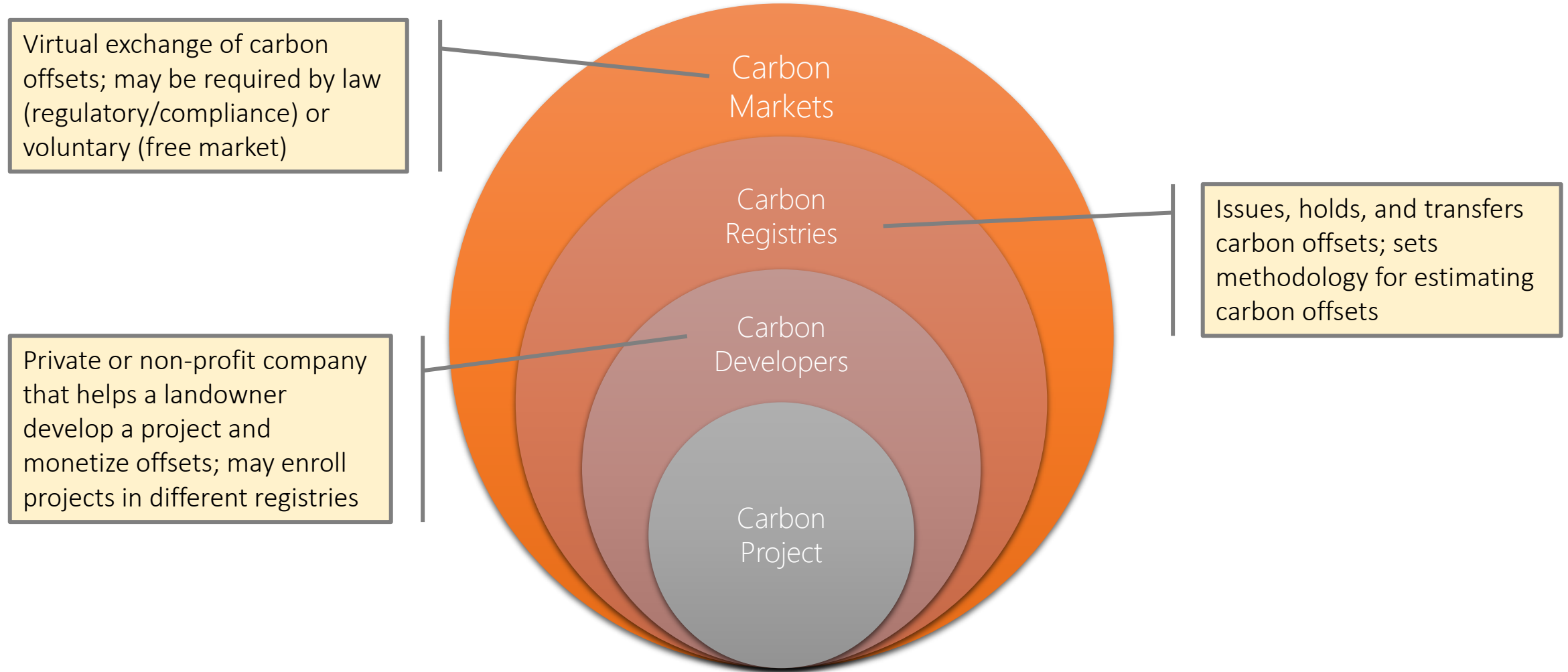
Avoided Conversion (AC)

Carbon offsets are generated by preventing the conversion of forested land to non-forested land

Improved Forest Management (IFM)

Carbon offsets are generated through forest management activities that increase or at a minimum maintain the current level of carbon storage over time

Carbon market terminology



Two Types of Carbon Markets

- Required by law in some states
- Regulated transaction of offsets
- Centralized market, registry, and standard
- Set offset price
- Emitters are required to reduce their emissions but can either buy allowances from other regulated emitters or carbon offsets
- Allowances decline over time for gradual reductions in emissions



Forest offsets are allowed, but to date, no enrolled forest projects

The Regional Greenhouse Gas Initiative
an initiative of Eastern States of the US

Carbon markets



COMPLIANCE
CARBON
MARKET



VOLUNTARY
CARBON
MARKET

- Not required by law
- Not regulated
- No centralized market or registry
- No requirement for the use of a registry or standard
- No set offset price, depends on what buyers will pay
- Open to everyone: individuals, companies
- No requirement for buyers to reduce emissions over time

How much does it cost to buy a forest carbon offset?

Price is set by the market



Current price is \$13/Mt CO₂e

Forest offsets are allowed, but to date, no enrolled forest projects

The Regional Greenhouse Gas Initiative
an initiative of Eastern States of the US

Current price is \$13/Mt CO₂e
(Increase from \$9.30 in early 2021)



COMPLIANCE
CARBON
MARKET



VOLUNTARY
CARBON
MARKET

Voluntary reporting by brokers and buyers
Price is determined by what buyers will pay

Current selling price >\$6/Mt CO₂e

Varies by type of offset

Some forest offsets in NE anecdotally selling for >\$20

	2019			2020				2021 (through August)			
	Volume (MtCO ₂ e)	Price per ton (USD)	Value (USD)	Volume (MtCO ₂ e)	Volume % Change from Prior Year	Price per ton (USD)	Value (USD)	Volume (MtCO ₂ e)	Volume % Change from Prior Year	Price per ton (USD)	Value (USD)
FORESTRY AND LAND USE	36.7	\$4.33	\$159.1M	48.1	30.9%	\$5.60	\$269.4M	115.0	139.4%	\$4.73	\$544.0M
RENEWABLE ENERGY	42.4	\$1.42	\$60.1M	80.3	89.4%	\$0.87	\$70.1M	80.0	-0.3%	\$1.10	\$88.4M
ENERGY EFFICIENCY/ FUEL SWITCHING	3.1	\$3.87	\$11.9M	31.4	921.0%	\$1.03	\$32.3M	16.1	-48.9%	\$1.57	\$24.2M
AGRICULTURE	-	-	-	0.3	-	\$9.23	\$2.8M	3.4	876.8%	\$1.36	\$4.6M

Source: Ecosystem Marketplace, a Forest Trends Initiative.



Carbon markets

Carbon Registries

- Carbon projects are registered and tracked through carbon registries that monitor offset trading and retirement
- Registries have specific protocols for developing, verifying, and selling carbon offsets that must be adhered to
- Registries are not required in the voluntary market, but help buyers trust the integrity of the offset

ARB



RGGI



CAR



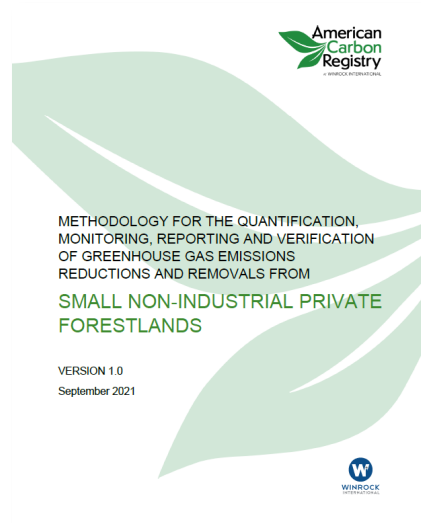
ACR



VCS



Projects must follow detailed methods that have been approved by the registry and open to public comment



Not just forests – there are methods for a range of project types



Registries allow the public to view carbon projects, documentation, and offsets traded

American Carbon Registry

Home										
Projects										
Project ID	ARB ID	Project Developer	Project Name	Project VVB	Project Type	Voluntary Status	ARB Status	Project Site Location	Project Site State	Project Site Country
ACR284	CAFR5235	Massachusetts Audubon Society, Inc.	Finite Carbon - Massachusetts Audubon Society IFM		Forest Carbon	N/A	Listed - Active ARB Project	Berkshire, Hampshire, Franklin, Worcester Counties in Commonwealth of Massachusetts	MASSACHUSETTS	US
ACR376	NA	Blue Source	Blue Source - Massachusetts Tri-City Improved Forest Management Project	SCS Global Services (Scientific Certification Systems)	Forest Carbon	Registered	Not ARB Eligible	Hampden and Tolland Counties, Massachusetts	MASSACHUSETTS	US

Carbon Developers

- private or non-profit company that helps a landowner develop a project and sell offsets

Larger forestlands

Smaller forestlands



Approved under California's ARB market/registry



Approved under ACR registry



Independent market, registry, and developer
In process of approval with VCS registry



In process of approval with VCS registry

For larger forestlands, projects may be able to enroll under California ARB market/registry or in voluntary market registries (e.g., ACR)

*not exhaustive; there may be newer developers or developers for specific types of projects there are not included here

Urban Forests



For more information and links to these developers, see www.northeastforestcarbon.org

Current Offset Programs for Smaller Landowners



Forest Carbon Works

- 40+ acres
- 100-year commitment (CA compliance market)
- Similar to large project, but reduces costs with inventory approach



CORE Carbon (Finite Carbon)

- 40-5,000 acres
- 40-year commitment
- Use FIA plots and sub-sampling to reduce costs



Family Forest Carbon Program

- Payment for carbon-friendly forest management practices
- 30 - 2,400 acres
- 20-year commitment
- Monitors practices on each property; carbon on a sub-set, compare to FIA
- Awaiting acceptance in VCS registry
- Plan to launch in some parts of NE region this spring



NCX: Natural Capital Exchange

- 1-year deferred harvest, unique methods
- 'Harvest deferral credits' = % of a traditional offset
- No acreage threshold
- 1-year commitment
- Independent marketplace for buying/selling credits, awaiting acceptance in VSC registry

Forest Carbon Developers and Programs Operating in the U.S.

Developer/Program	Website	Registry standard(s) ¹	Landowner Commitment	Min. Parcel Size
American Forest Foundation & The Nature Conservancy – Family Forest Carbon Program	https://www.familyforestcarbon.org Limited states: PA, WV, MD with some northeast states to be added in 2022	VCS	10-20-year minimum	30-2,400 acres
Blue Source	http://www.bluesource.com	ACR, VCS, CAR, ARB	40 or 100 years	3,000+ acres
EP Carbon	http://www.epcarbon.com	ACR, VCS, CAR, ARB	40 or 100 years	5,000+ acres
Finite Carbon	https://finitecarbon.com	ACR, ARB	40 or 100 years	2,000+ acres
Finite Carbon – Core Carbon Program	https://corecarbon.com	ACR	40 years	40-5,000 acres
Forest Carbon Works	https://forestcarbonworks.org	ARB	100+ years	40+ acres
Forest Carbon Partners https://newforests.com.au/forests-carbon-partners/		ARB	100 years	2,000+ acres
Green Assets	http://www.green-assets.com	ARB	100 years	10,000+ acres
NCX – Natural Capital Exchange	https://www.ncx.com	RISE	1 year	None
Ostrom Climate	http://www.ostromclimate.com	BCCR, ACR	40 years	2,000+ acres
SIG Carbon https://www.sigcarbon.com/		ACR, ARB, CAR, VCS	40 or 100 years	100+/- (aggregator)
The Climate Trust	http://climatetrust.org	ACR, ARB	40 or 100 years	2,000+ acres
The Nature Conservancy & Blue Source – Working Woodlands https://www.nature.org/en-us/about-us/where-we-work/united-states/working-woodlands		VCS	40 years	2000+ acres

Key Requirements for Carbon Offsets

Real

Additional

Verifiable

Permanent

Enforceable

Because a carbon offset

- 1) Is not a physical object that is bought and sold
- 2) Is used to offset actual emissions made elsewhere

Measuring, tracking, and evaluating forest carbon must adhere to strict criteria

Two types of leakage

Activity-shifting leakage:

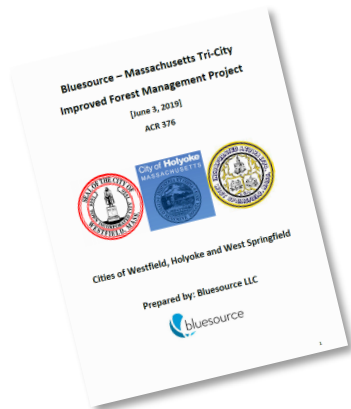
Carbon project results in an increase in harvest on another property owned by the landowner

- In all programs, must enroll or at least declare all other properties owned

Market leakage:

Carbon project results in an increase in harvest on another property or location

- Varies by program, most require % of offsets for leakage deduction based on reduction in harvest



Period	Baseline wood products summed over 20-yr crediting period (tons CO ₂)	Project wood products summed over 20-yr crediting period (tons CO ₂)	Project decrease in wood products relative to baseline (%)	Applicable leakage factor (%)
2017-2037	340,725	22,603	-93%	40%

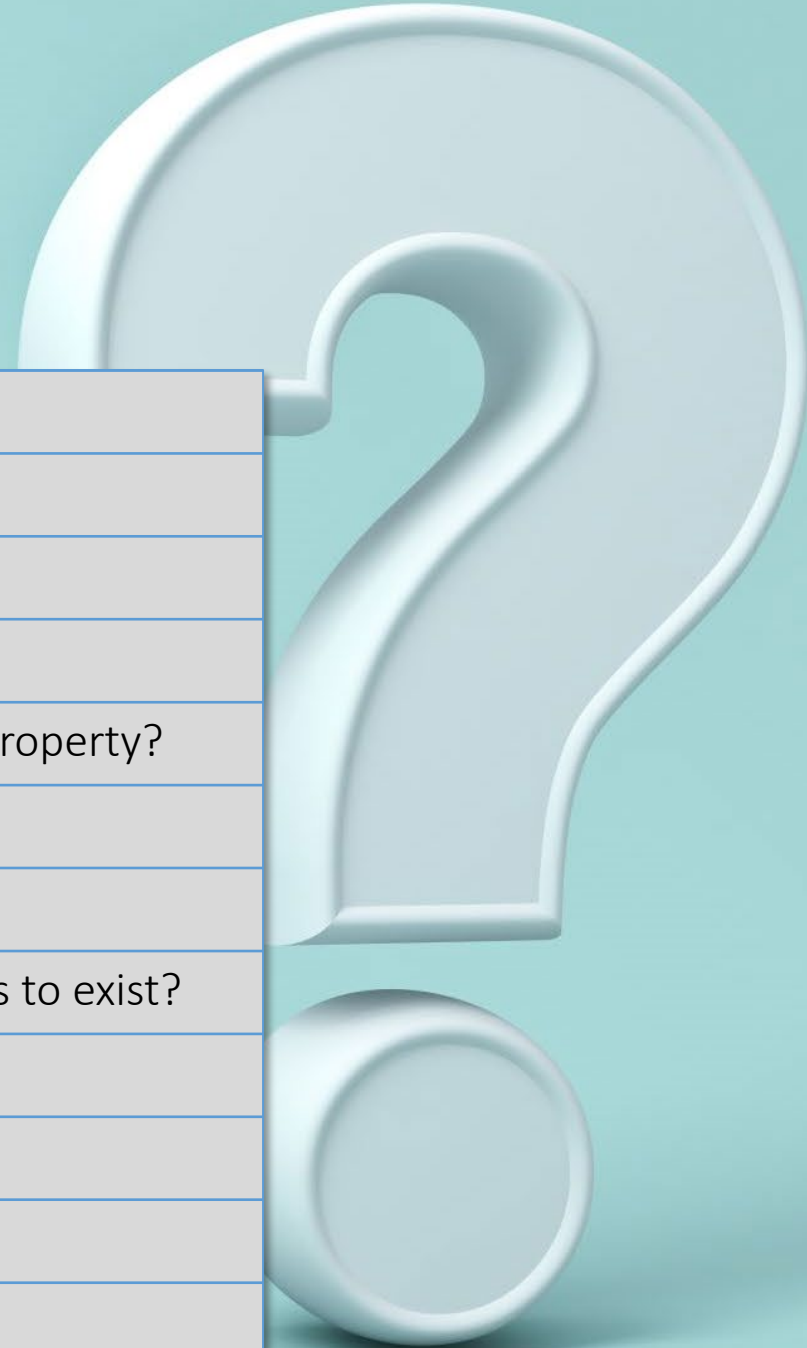
Example of market leakage deduction for MA Tri-City Carbon Project

- 13,536-acre project in cities of Westfield, Holyoke, and West Springfield

Encourage landowners to engage with developers before entering a program

Example questions a landowner may want to ask
before entering a carbon program

What types of management activities are allowed?
How is verification done?
Does the contract stay with the property if I sell?
What happens if I need to exit the contract early?
What happens if there is a natural disturbance on the property?
Is salvage harvesting allowed?
Are harvest wood product carbon stocks included?
What happens if the developer goes bankrupt or ceases to exist?
What is the payment schedule?
What is the expected revenue for my land?
How do you assure the integrity of carbon offsets?
Who buys the offsets?

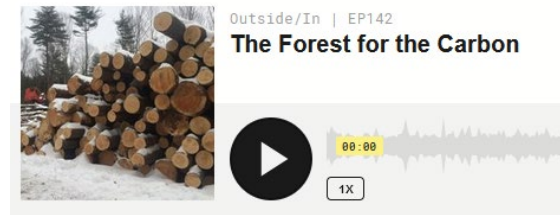


There is a lot of debate over carbon offsets right now, which likely means that they will continue to evolve...



A Nonprofit Promised to Preserve Wildlife. Then It Made Millions Claiming It Could Cut Down Trees.

The Massachusetts Audubon Society has managed its land as wildlife habitat for years. Here's how the carbon credits it sold may have fueled climate change.



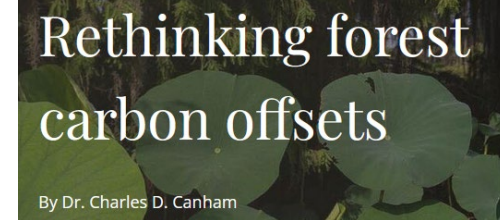
Systematic over-crediting in California's forest carbon offsets program

Grayson Badgley, Jeremy Freeman, Joseph J. Hamman, Barbara Haya, Anna T. Trugman, William R.L. Anderegg, Danny Cullenward

doi: <https://doi.org/10.1101/2021.04.28.441870>

Now published in *Global Change Biology* doi: [10.1111/gcb.15943](https://doi.org/10.1111/gcb.15943)

A critique of NCX's carbon accounting methods



REPORT

A framework to ensure that voluntary carbon markets will truly help combat climate change

Robert O. Mendelsohn, Robert E. Litan, and John Fleming · Thursday, September 16, 2021

The U.S. Is About to Go All in on Paying Farmers and Foresters to Trap Carbon

The problem is, it's unclear if "Carbon Offsets" even work

1. These Trees Are Not What They Seem: www.bloomberg.com/
2. A Nonprofit Promised to Preserve Wildlife. Then It Made Millions Claiming It Could Cut Down Trees: www.propublica.org/
3. The U.S. Is About to Go All in on Paying Farmers and Foresters to Trap Carbon: www.rollingstone.com
4. Rethinking Forest Carbon Offsets: www.caryinstitute.org/
5. Systematic Over-crediting in California's Forest Carbon Offsets Program: www.biorxiv.org/
6. A Critique of NCX's Carbon Accounting Methods: www.carbonplan.org/
7. A Framework to Ensure that Voluntary Carbon Markets Will Truly Help Combat Climate Change: www.brookings.edu/
8. The Forest for the Carbon: <http://outsideinradio.org/>
9. John Oliver: <https://www.youtube.com/watch?v=6p8zAbFKpW0>



www.northeastforestcarbon.org

Sign up for
new forest
carbon
newsletter
and links to
4 forest
carbon
webinars:



In this Issue:

Issue 1, 2022

- [What's this? A new effort - all about forest carbon in the Northeast -](#)
- [Who to contact in your state on forest carbon](#)
- [The Securing Northeast Forest Carbon Program website](#)
- [What's to come?](#)

**What's this? A new effort - all
about forest carbon in the
Northeast - *Securing Northeast
Forest Carbon Program***

www.northeastforestcarbon.org

Charles Levesque

North East *State* Foresters Association

levesque@inrsllc.com

603-588-3272

