Securing Northeast Forest Carbon Program:

Primer on Forest Carbon & Forest Carbon Markets

RI Land & Water Conservation Summit, March 9, 2024

Charles Levesque, Executive Director

North East *State* Foresters Association

www.northeastforestcarbon.org

Securing Northeast Forest Carbon Program

Goal is to provide forestry professionals and landowners the latest info on forest carbon and forest carbon markets so landowners can make informed forest carbon decisions about their land – including whether to sell forest carbon – FUNDED BY USDA FOREST SERVICE GRANT

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Securing Northeast Forest Carbon Program

www.northeastforestcarbon.org

About this project

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

Today's AGENDA

-Key Science Concepts on Forest Carbon

-Key Science Concepts of Carbon-Friendly and Climate Adaptation Forest Management

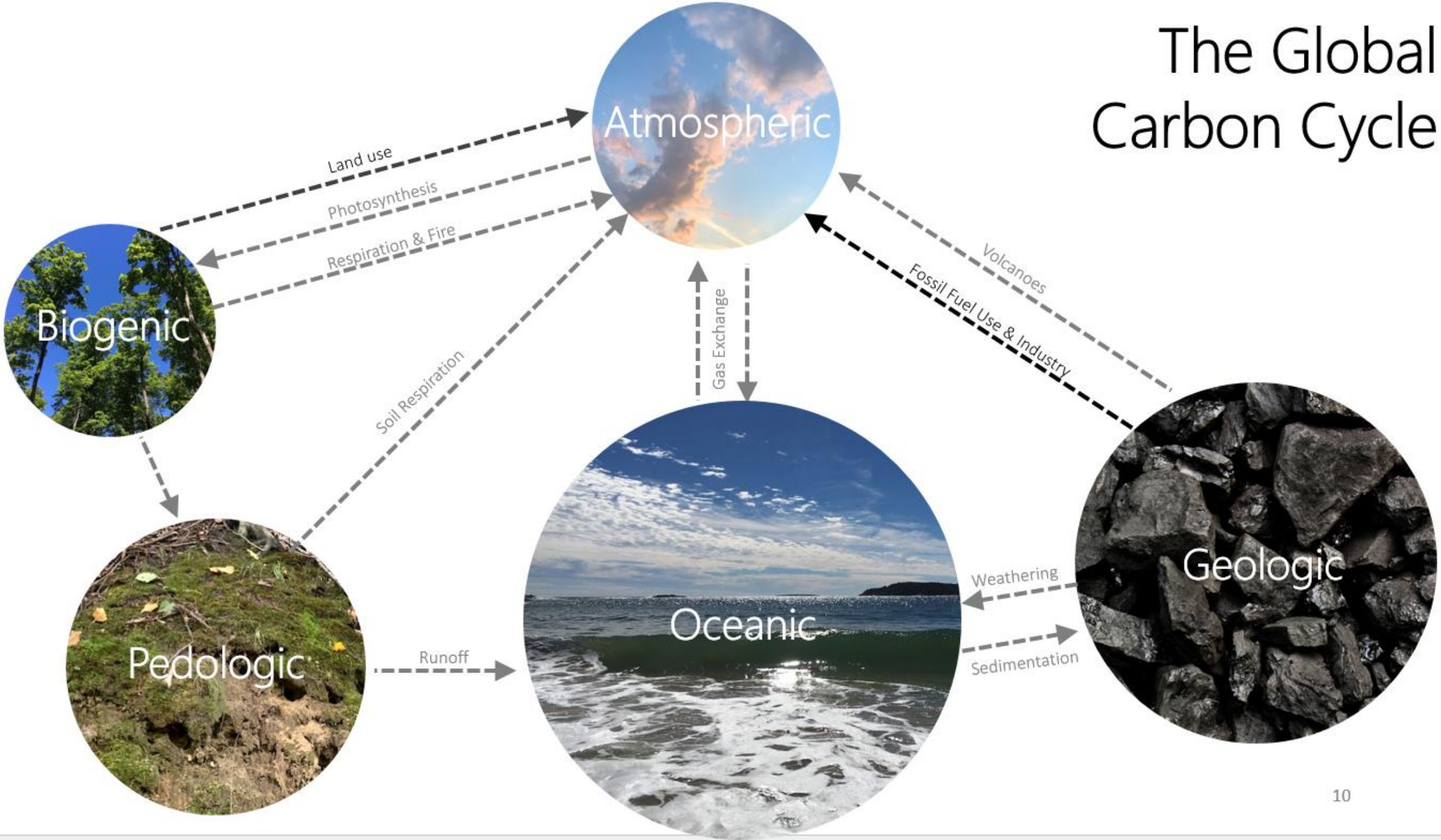
-Forest Carbon Markets Overview

Science of Forest Carbon

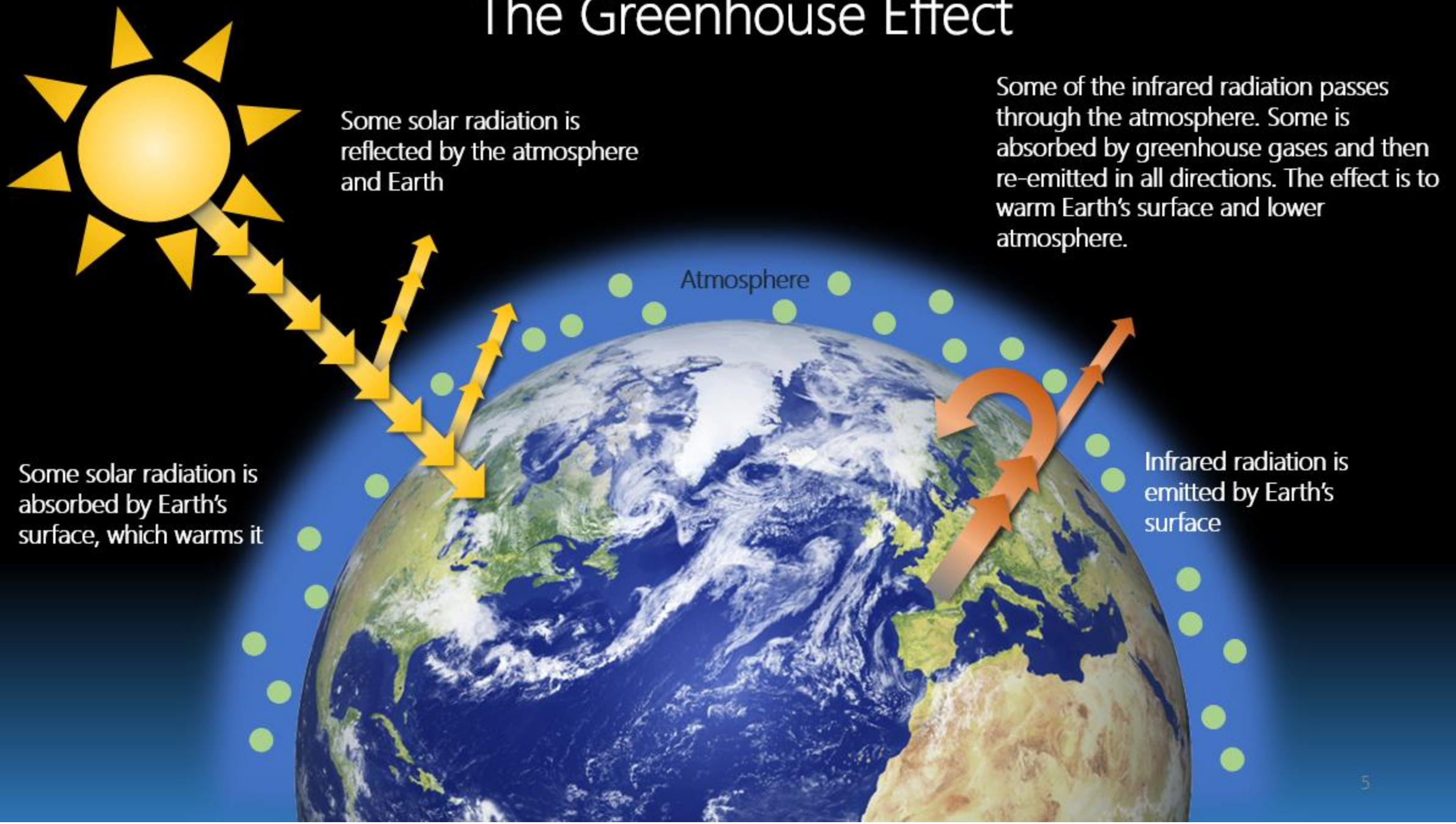
Dr. Alexandra Kosiba, University of Vermont Extension Forester

The Science of Forest Carbon

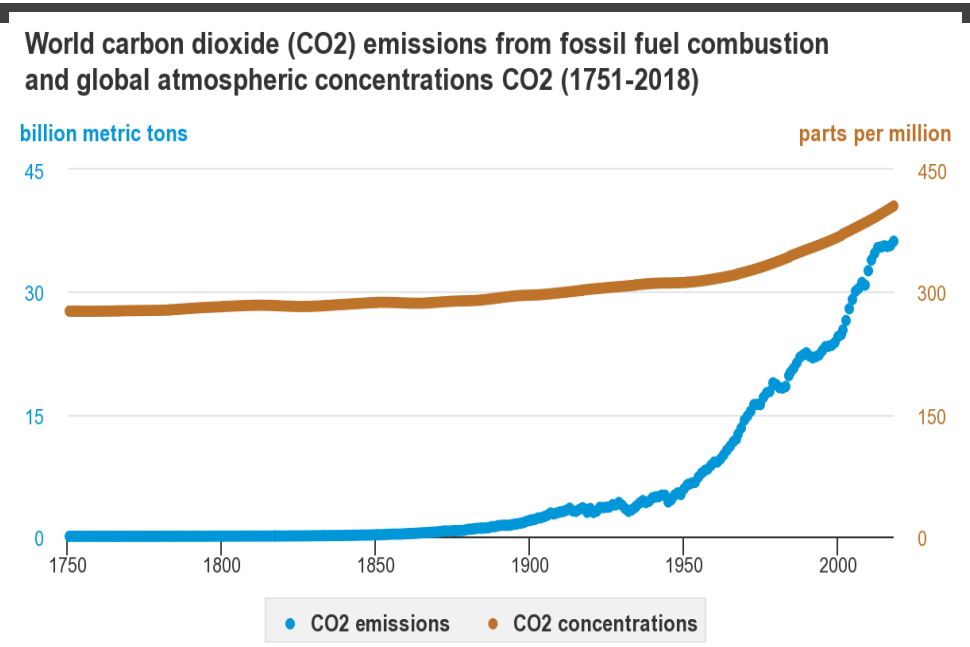
The Global Carbon Cycle



The Greenhouse Effect

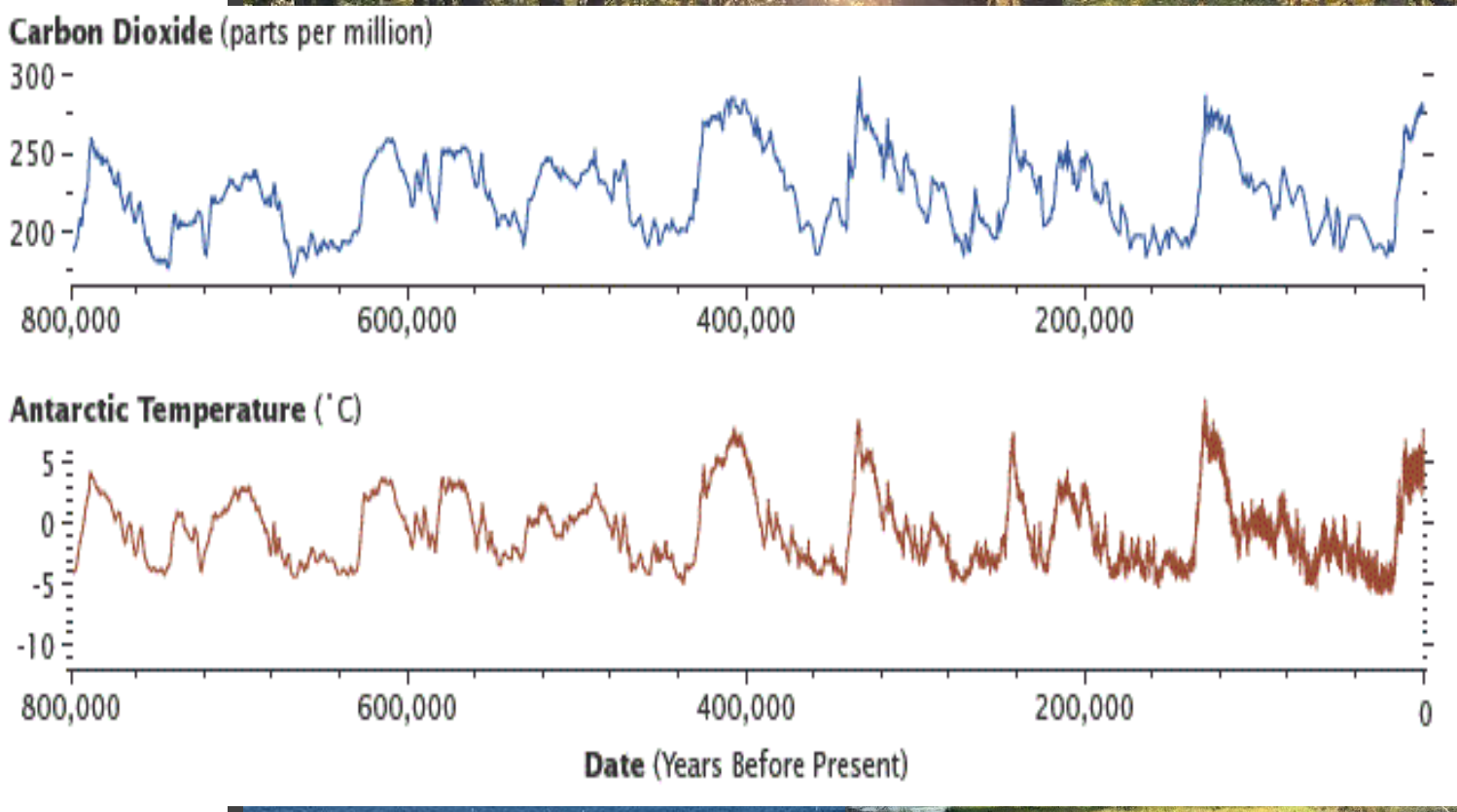


Carbon released to the atmosphere has an affinity to form carbon dioxide (CO_2) which is a powerful greenhouse gas, trapping the Earth's energy



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,

Atmospheric CO_2 concentrations are directly tied to global temperatures



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

Quick Carbon Terminology Primer

Carbon storage

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

Synonyms: stock, density

Carbon sequestration

the process of taking CO_2 from the atmosphere and storing it

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

Carbon emissions

the opposite of sequestration (CO_2 release back to atmosphere)

Cellular respiration (metabolism, CO_2)

Decomposition (CO_2, CH_4)

Combustion (CO_2, CH_4)

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 (CO_2e)**

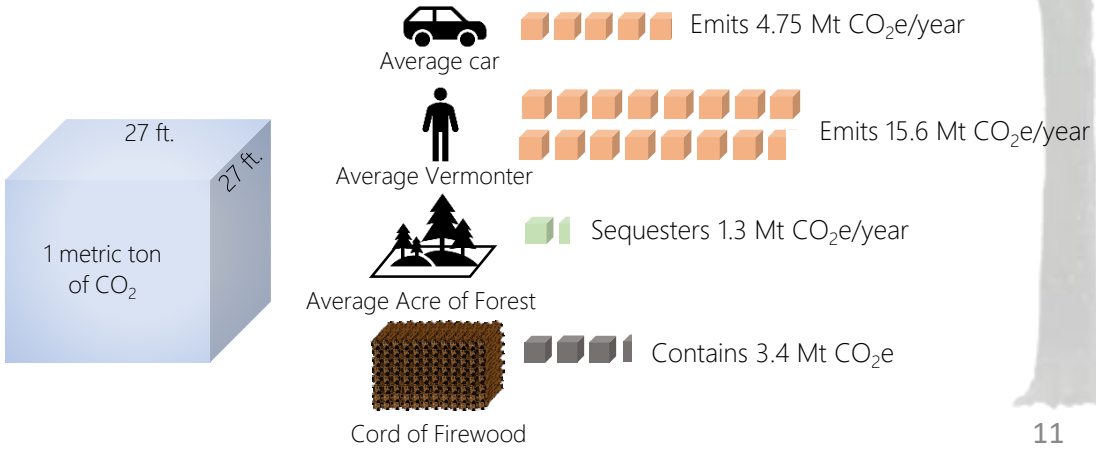
<u>Helpful conversions</u>

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

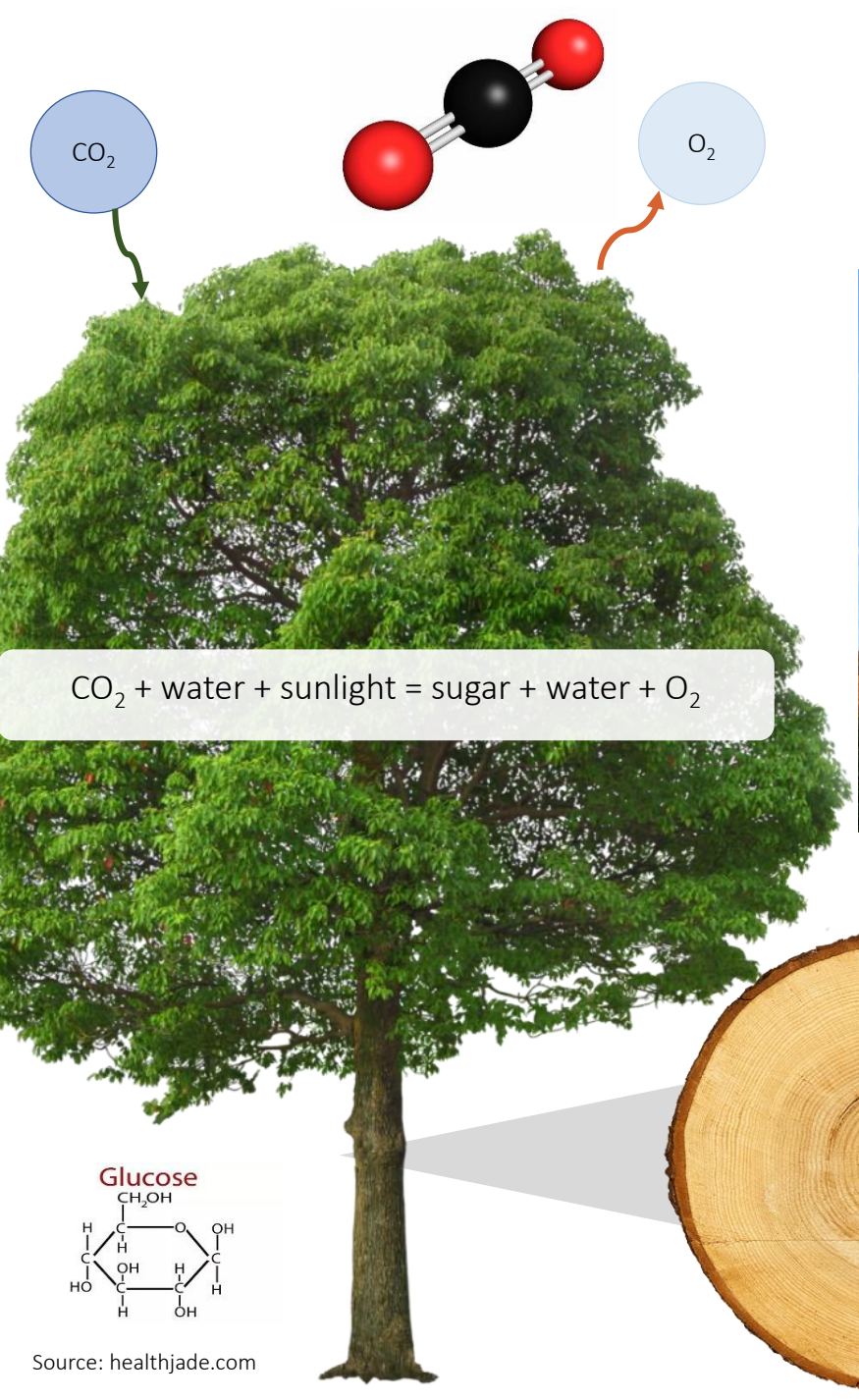
1 Mt C = 3.67 Mt carbon dioxide equivalent (CO_2e)

1 Mt C per ha = 1.49 Mt CO_2 per acre

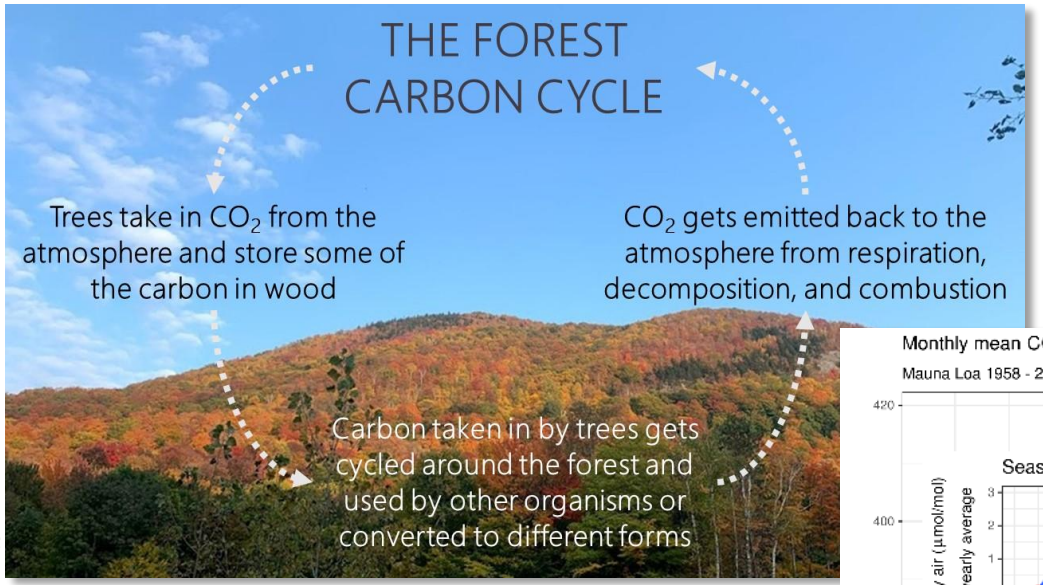
Wood is ~50% carbon by dry weight

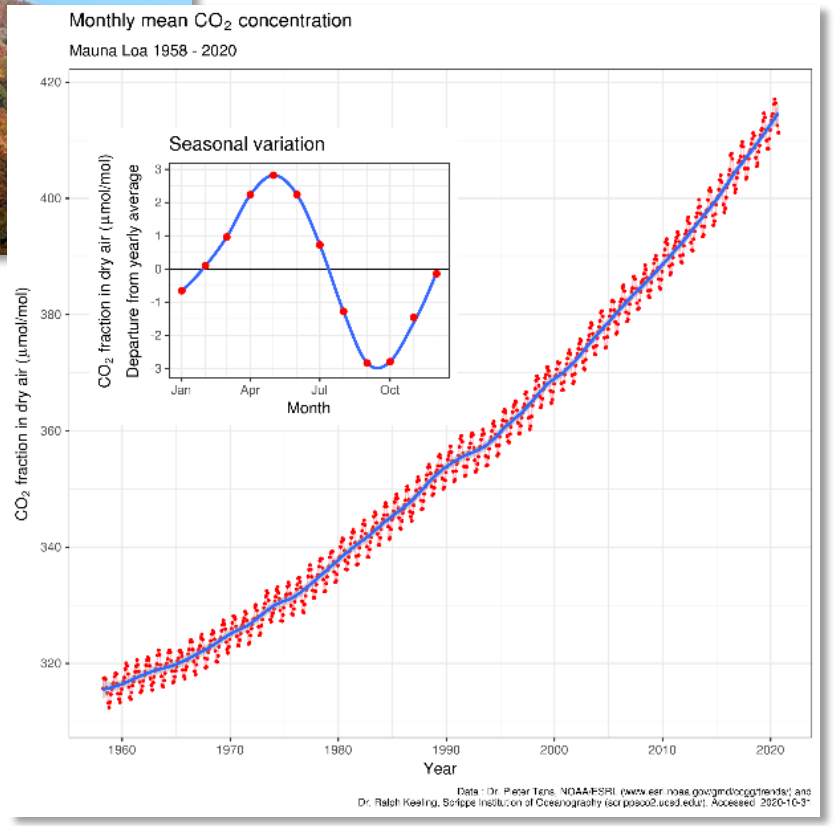


Trees can help mitigate climate change by sequestering CO_2 from the atmosphere and storing the carbon in wood and soil



Source: healthjade.com





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

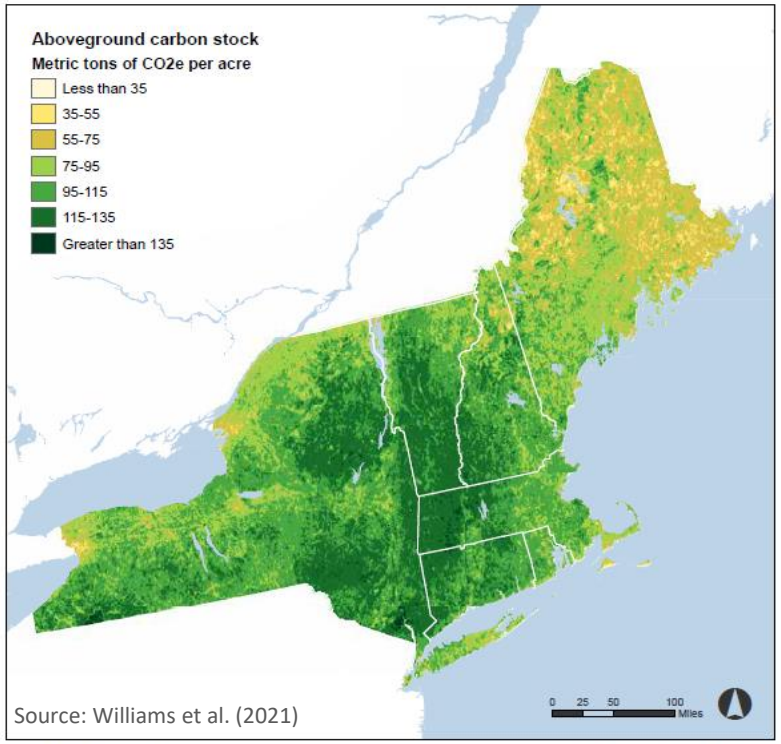
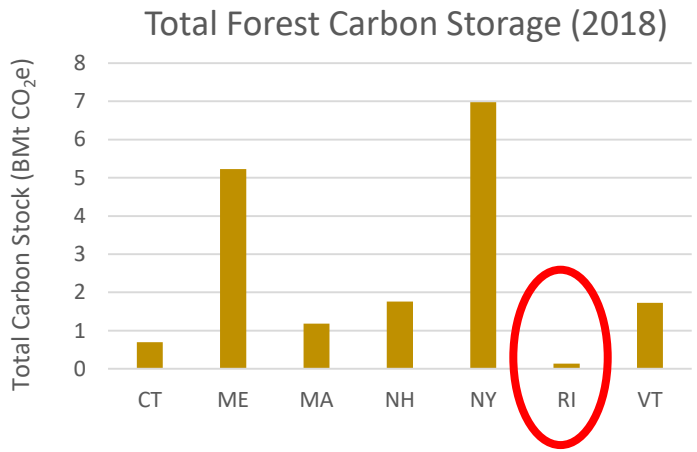
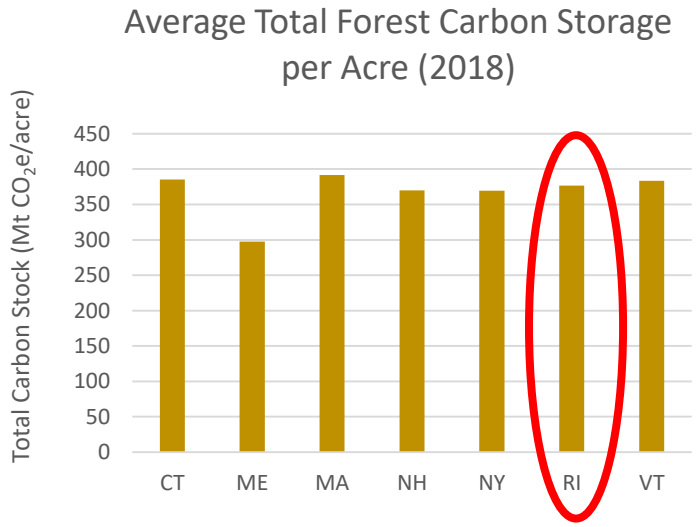


FIGURE 3. Above ground carbon stocks, expressed in metric tons of CO_2e per acre, smoothed from the original dataset with focal statistics that average over a 1 km x 1 km block. The highest value in the original, 30 m resolution map is 210 metric tons of CO_2e per acre.



As of 2020, the NE forests stored 17.5 billion Mt CO_2e



Or an average of 368 Mt CO_2e/acre

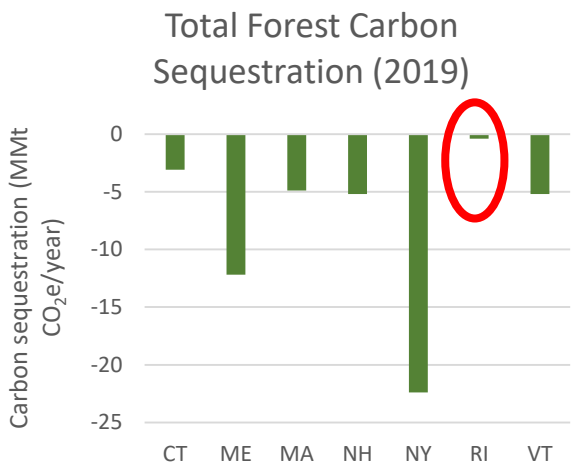
Carbon stock and flux data are for 2018, includes all forest carbon pools. Emissions data gathered per state and year varies; estimates are approximate. Carbon data source: Domke et al. 2020

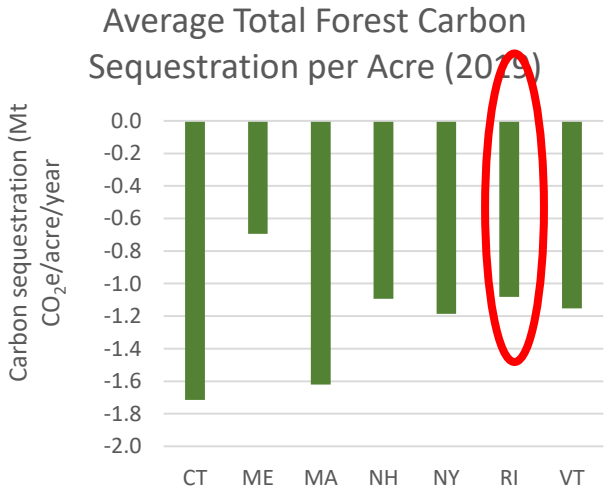
Collectively, NE/NY Forests are a Carbon Sink

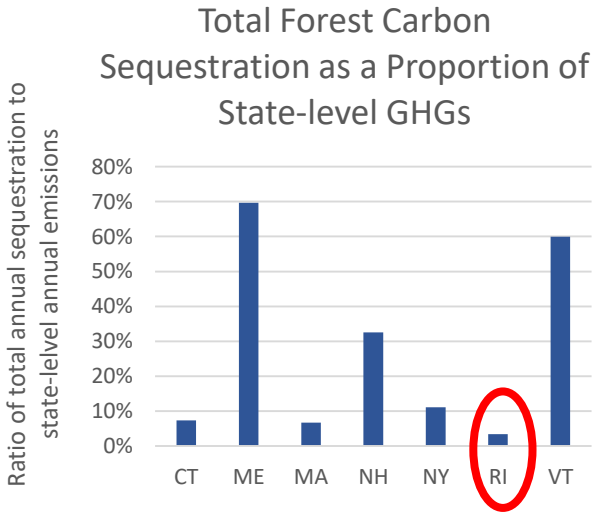
In 2019, NE forests sequestered **-53 MMt CO_2e**

Or an average of **-1.2 Mt CO_2e per acre**

In doing so, they offset ~**14%** of the region's annual GHG emissions

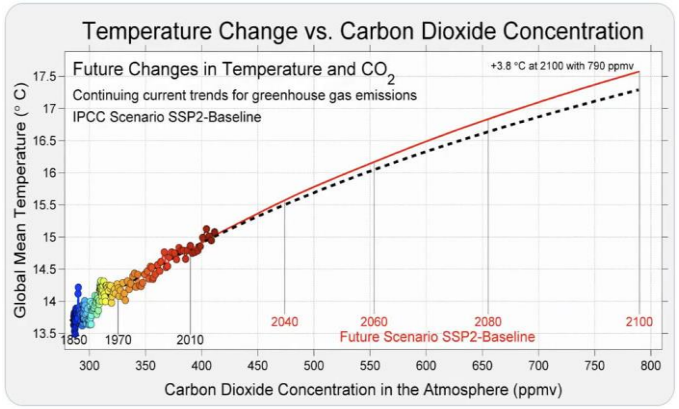






Carbon stock and flux data are for 2018. Emissions data gathered per state and year varies; estimates are approximate. Carbon data source: Domke et al. 2020

Climate change itself poses a risk to the ability of forests to sequester and store carbon, and to keep it stored for long periods of time



Source: Berkeley Earth

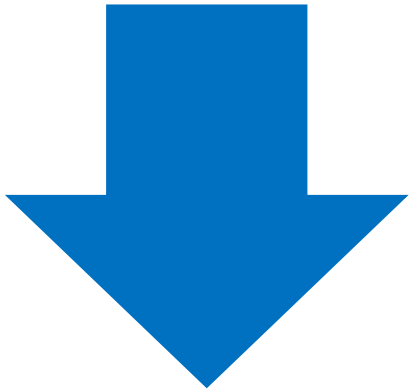
- Increased mortality?
- More stressors?
- Altered growth rates?
- More disturbances?
- More insects and diseases?
- Faster decomposition rates?
- Regeneration failure?

Climate-resilient forests are the best path to ensure a long-term climate mitigation effect

"Resilience" means the capacity of forests to withstand and recover from climatic events, trends, and disruptions.

"Adaptation" means reducing the vulnerability and advancing resilience through enhancements to, or avoiding degradation of, forests.

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

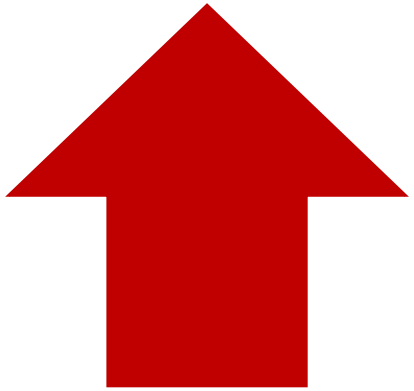


Carbon Sequestration

(photosynthesis, storage in forest pools)

Carbon Emissions

(respiration, decomposition, combustion)



CLIMATE FACTORS

- Moisture
- Temperature
- Length of growing season

SITE FACTORS

- Nutrients, light, water
- Soil type, depth, pH, microbial community
- Tree density
- Disturbance, harvests
- Elevation, aspect

TREE FACTORS

- Species, genetics
- Age, size
- Vigor, condition

Not all forest stands are carbon sinks

Carbon sink

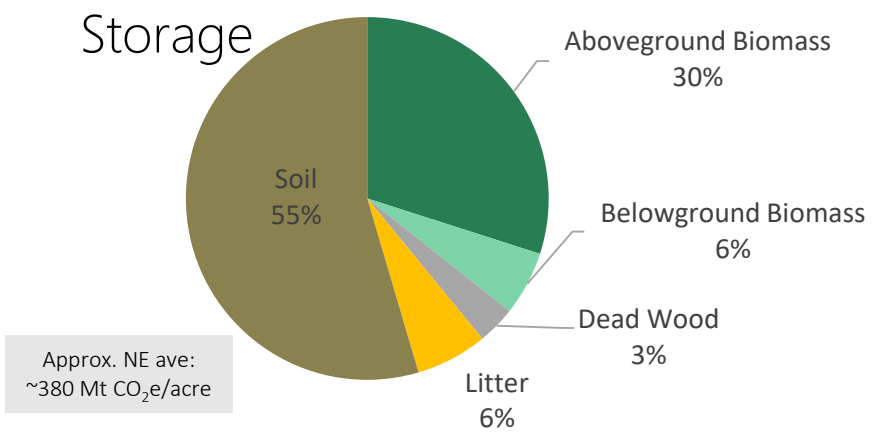
Sequestration > Emissions

Carbon source

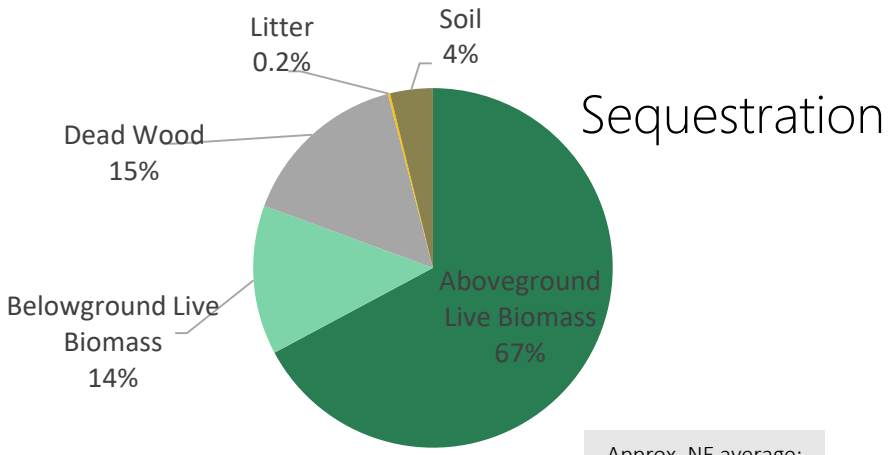
Sequestration < Emissions

Image: Naveen Nkadalaveni

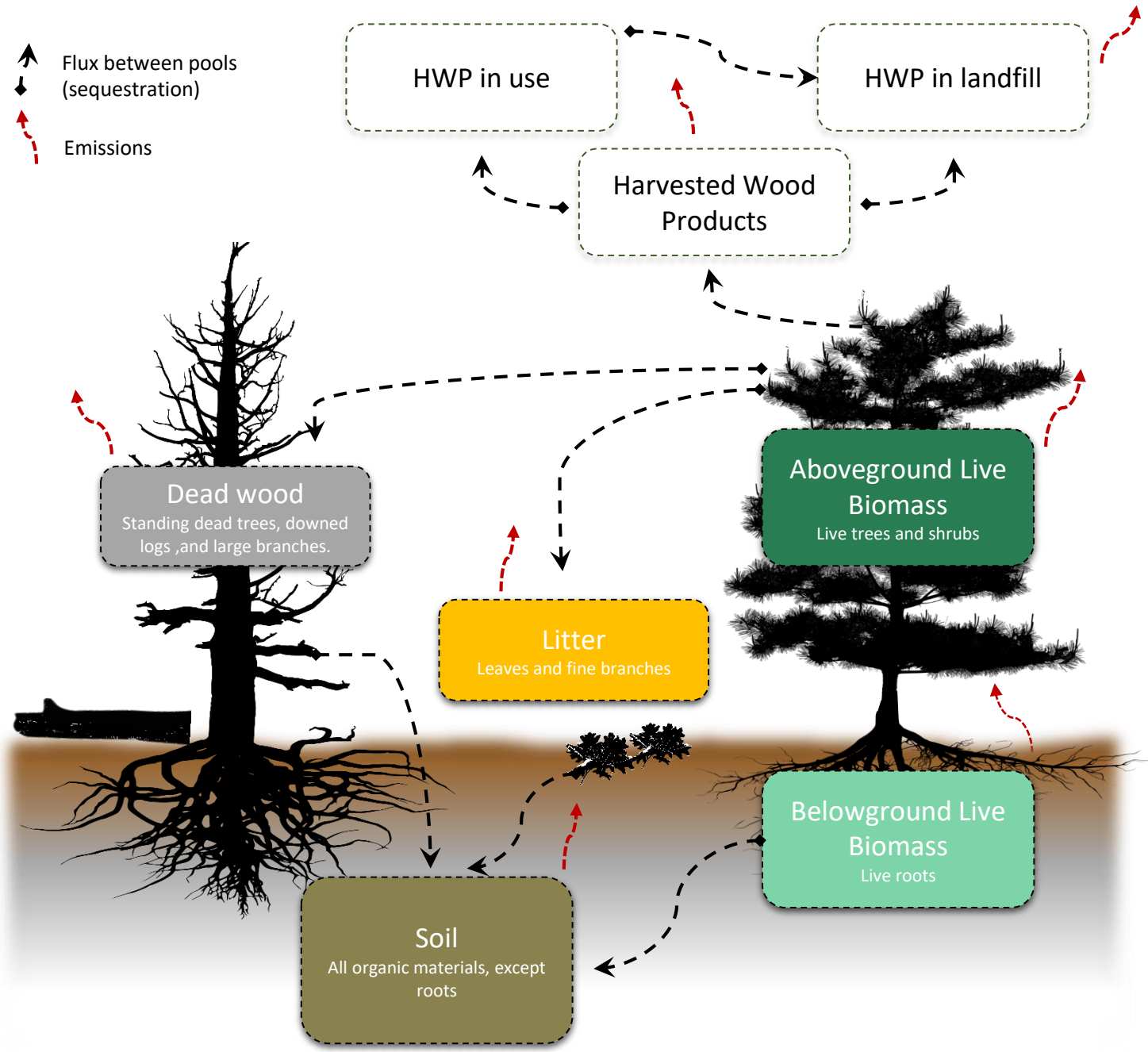
Forest carbon pools



Approx. NE ave:
~380 Mt CO_2e/acre



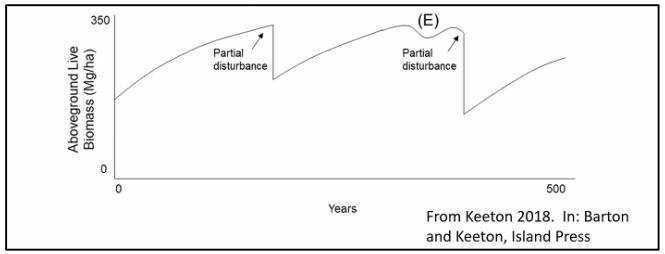
Approx. NE average:
-1.2 Mt CO_2e/acre

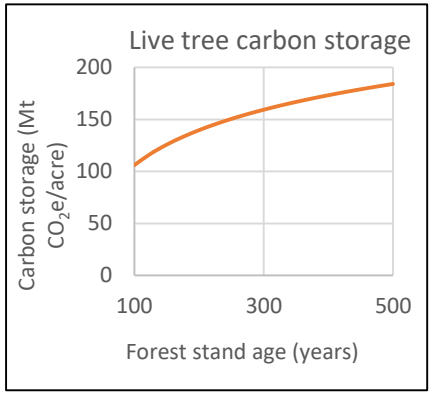


Data source: Domke et al. (2020)

Carbon storage varies over forest stand development

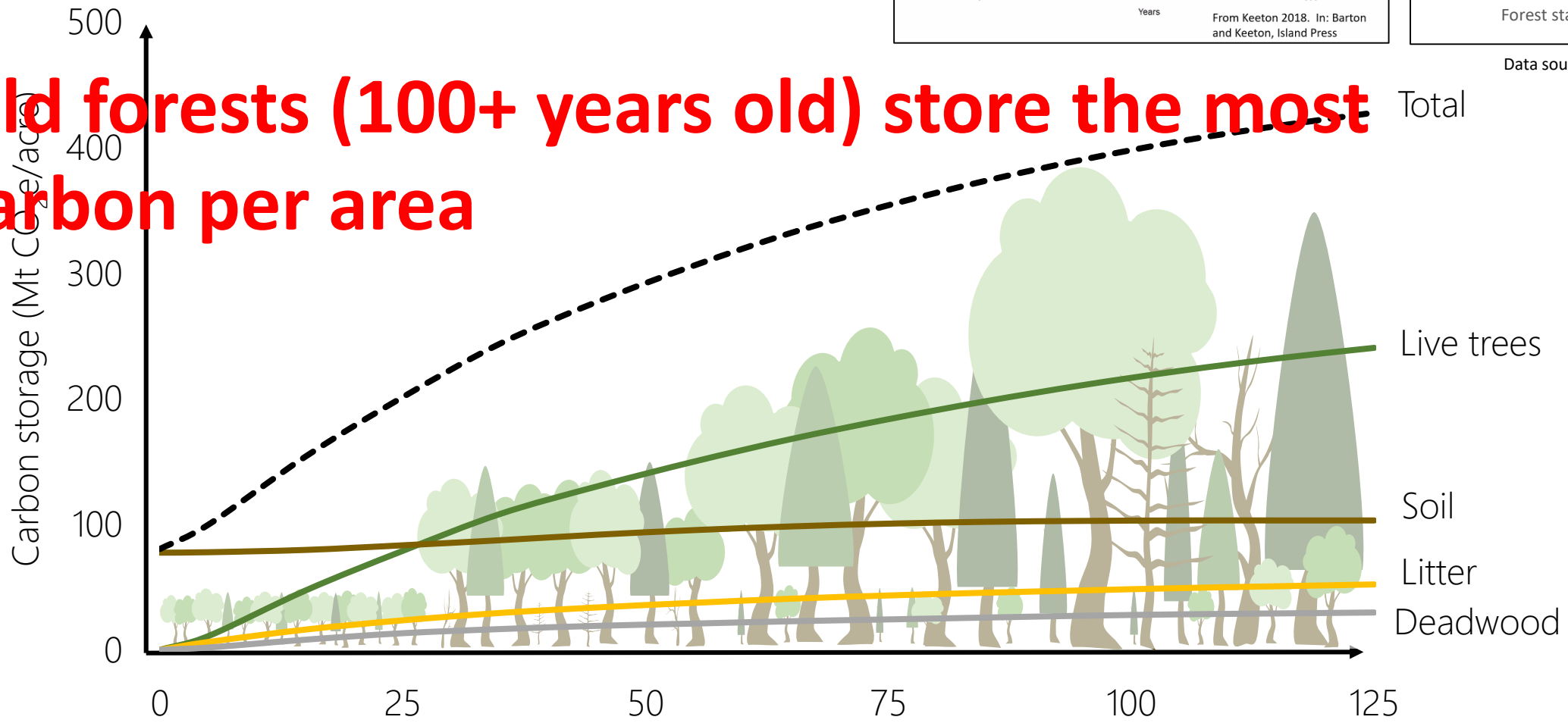
Carbon Data from Old Forests in the Northeast





Data source: Keeton et al. 2011

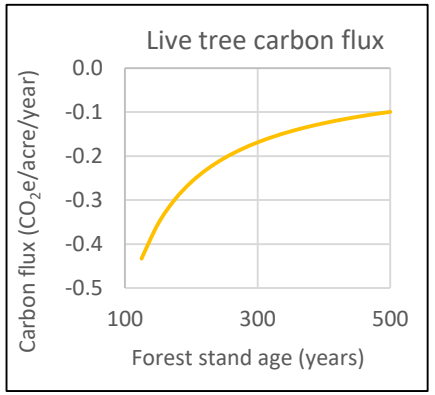
Old forests (100+ years old) store the most carbon per area



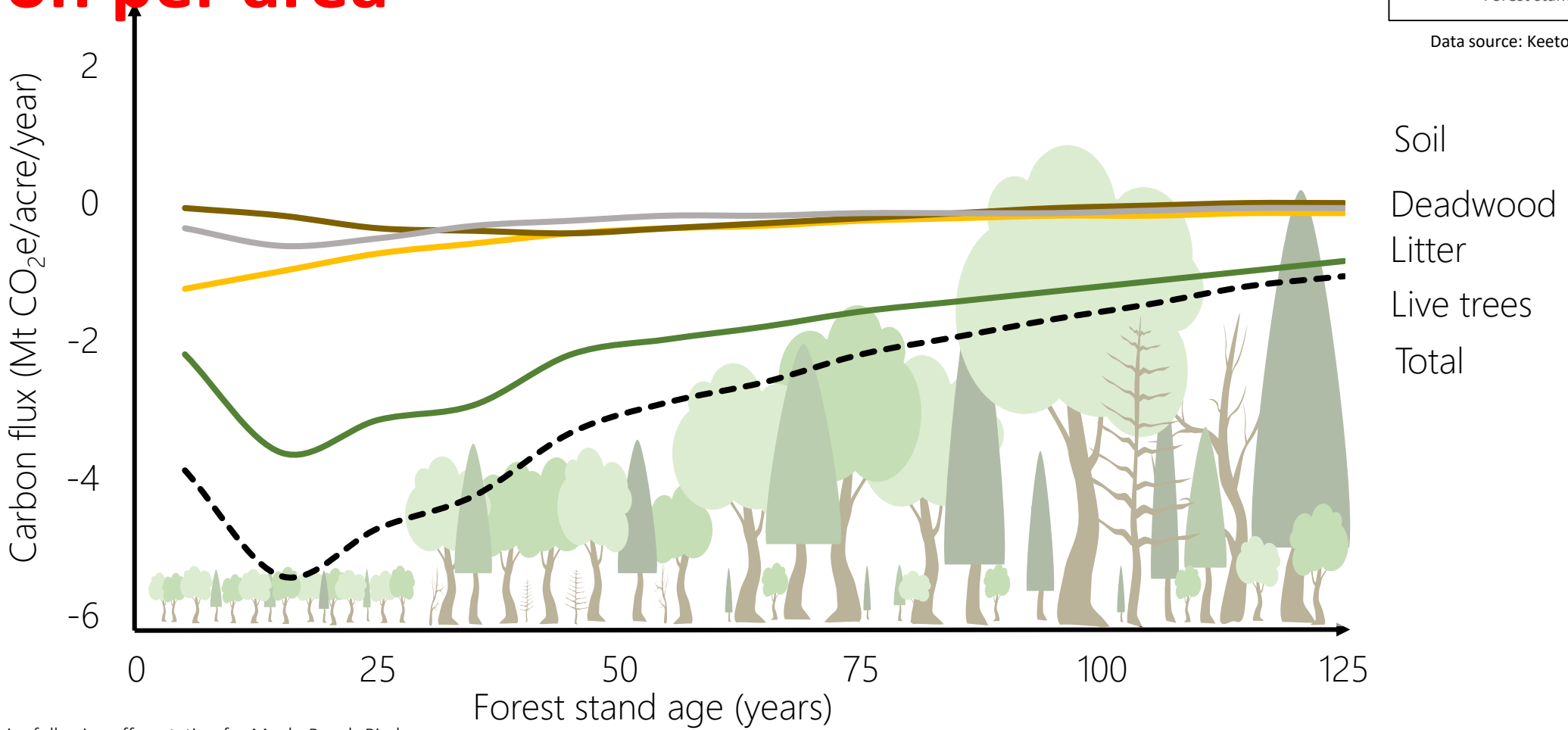
Note: carbon dynamics following afforestation for Maple-Beech-Birch forest, does not include management. Data source: Smith et al. 2006.

Carbon sequestration varies over forest stand development

Forests 25-70 years old sequester the most carbon per area



Data source: Keeton et al. 2011



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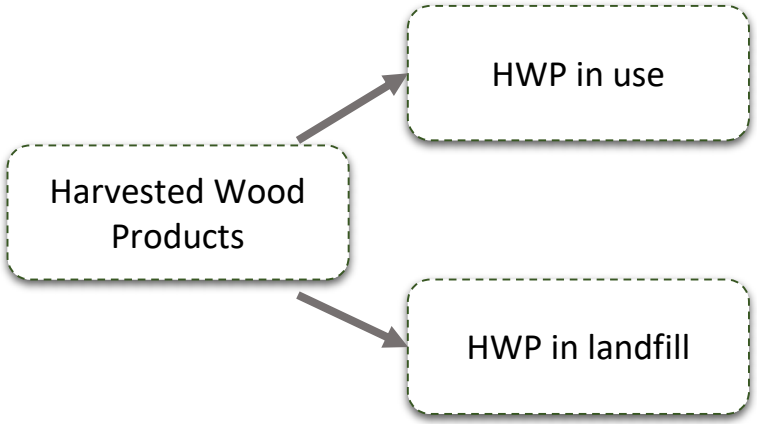


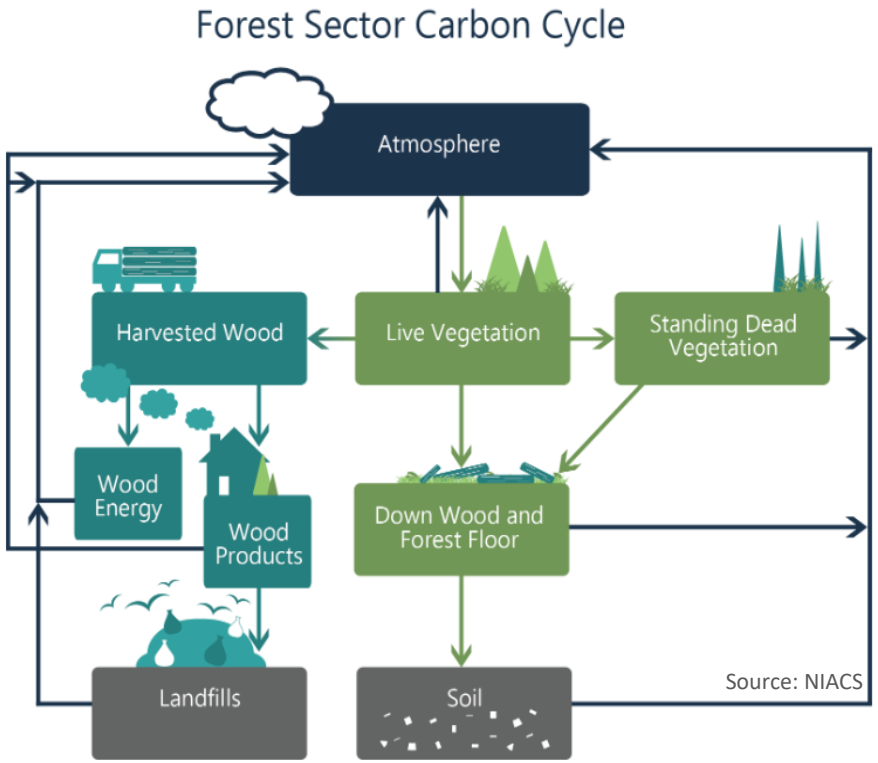


Figure: The forest sector carbon cycle includes forest carbon pools and carbon transfer between pools. Modified from Heath et al. (2) and United States Department of Agriculture (3).

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 CO_2 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

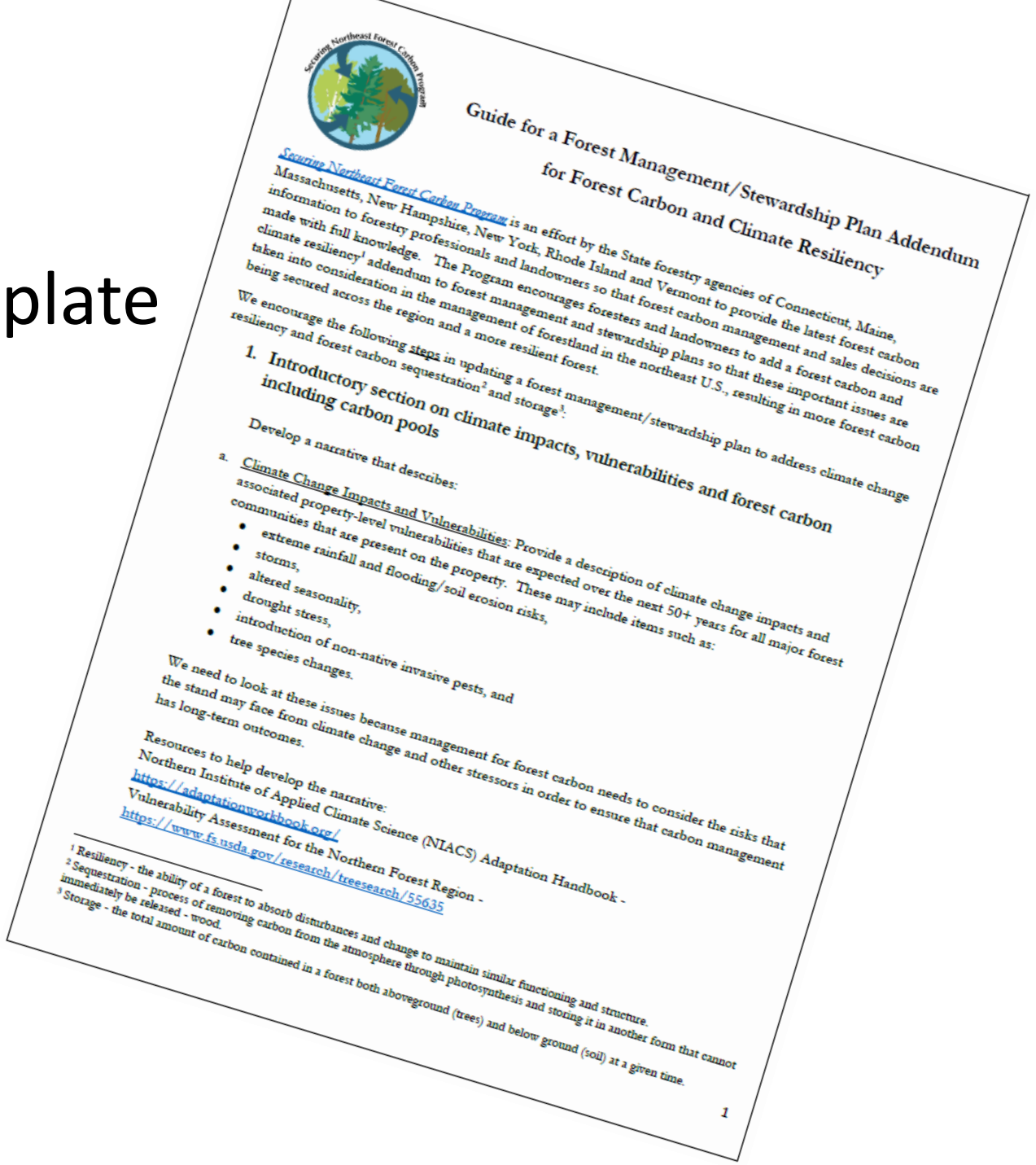
Some key forest management methods to increase carbon sequestration and storage:

- 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

Some key forest management methods to increase carbon sequestration and storage (cont.):

- 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

Forest Management Plan addendum template



Guide for a Forest Management/Stewardship Plan Addendum for Forest Carbon and Climate Resiliency

Securing Northeast Forest Carbon Program is an effort by the State forestry agencies of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont to provide the latest forest carbon information to forestry professionals and landowners so that forest carbon management and sales decisions are made with full knowledge. The Program encourages foresters and landowners to add a forest carbon and climate resiliency[1] addendum to forest management and stewardship plans so that these important issues are taken into consideration in the management of forestland in the northeast U.S., resulting in more forest carbon being secured across the region and a more resilient forest.

We encourage the following steps in updating a forest management/stewardship plan to address climate change resiliency and forest carbon sequestration[2] and storage[3]:

1. Introductory section on climate impacts, vulnerabilities and forest carbon including carbon pools

Develop a narrative that describes:

a. Climate Change Impacts and Vulnerabilities: Provide a description of climate change impacts and associated property-level vulnerabilities that are expected over the next 50+ years for all major forest communities that are present on the property. These may include items such as:

- extreme rainfall and flooding/soil erosion risks,
- storms,
- altered seasonality,
- drought stress,
- introduction of non-native invasive pests, and
- tree species changes.

We need to look at these issues because management for forest carbon needs to consider the risks that the stand may face from climate change and other stressors in order to ensure that carbon management has long-term outcomes.

Resources to help develop the narrative:
Northern Institute of Applied Climate Science (NIACS) Adaptation Handbook - https://adaptationworkbook.org/
Vulnerability Assessment for the Northern Forest Region - https://www.fs.usda.gov/research/treesearch/55635

[1] Resiliency - the ability of a forest to absorb disturbances and change to maintain similar functioning and structure.
[2] Sequestration - process of removing carbon from the atmosphere through photosynthesis and storing it in another form that cannot immediately be released - wood.
[3] Storage - the total amount of carbon contained in a forest both aboveground (trees) and below ground (soil) at a given time.

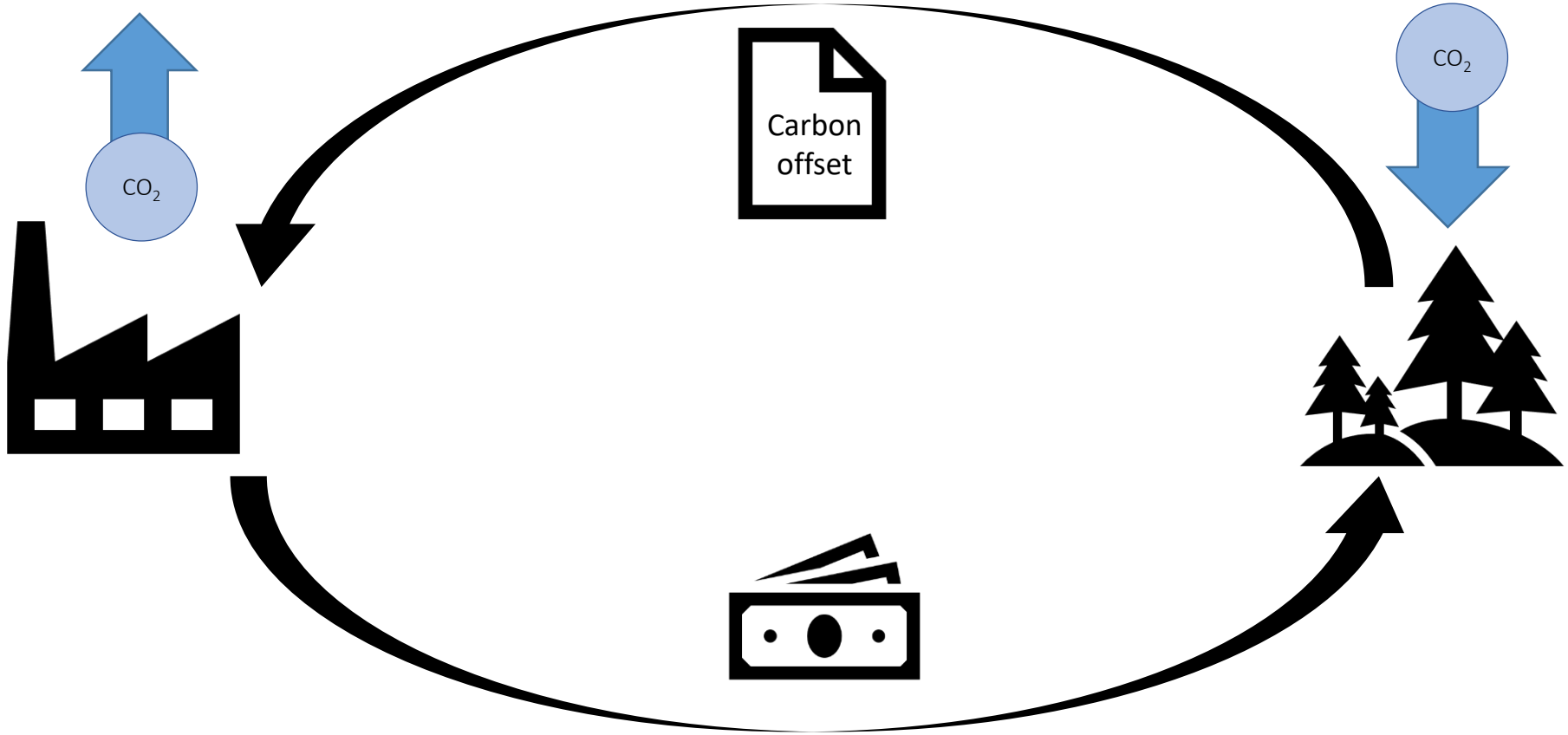
1

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

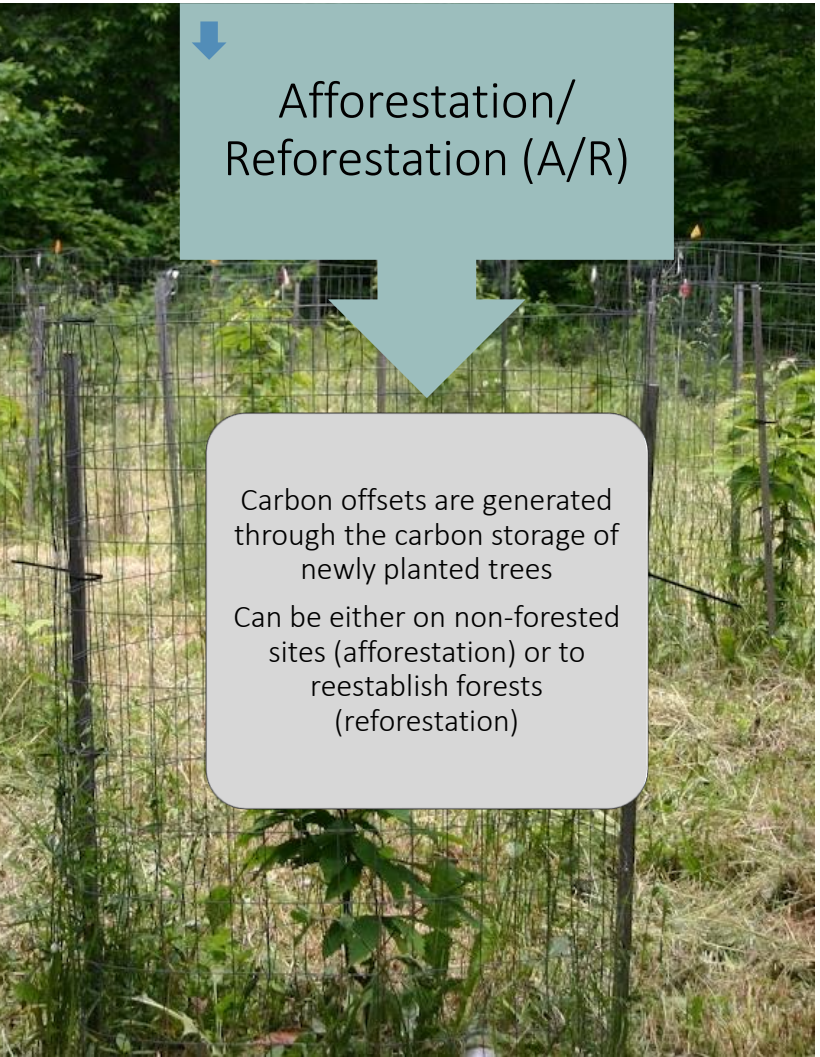
Helps to finance forest management, restoration, conservation, tree planting, and other activities



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

1

Afforestation/ Reforestation (A/R)

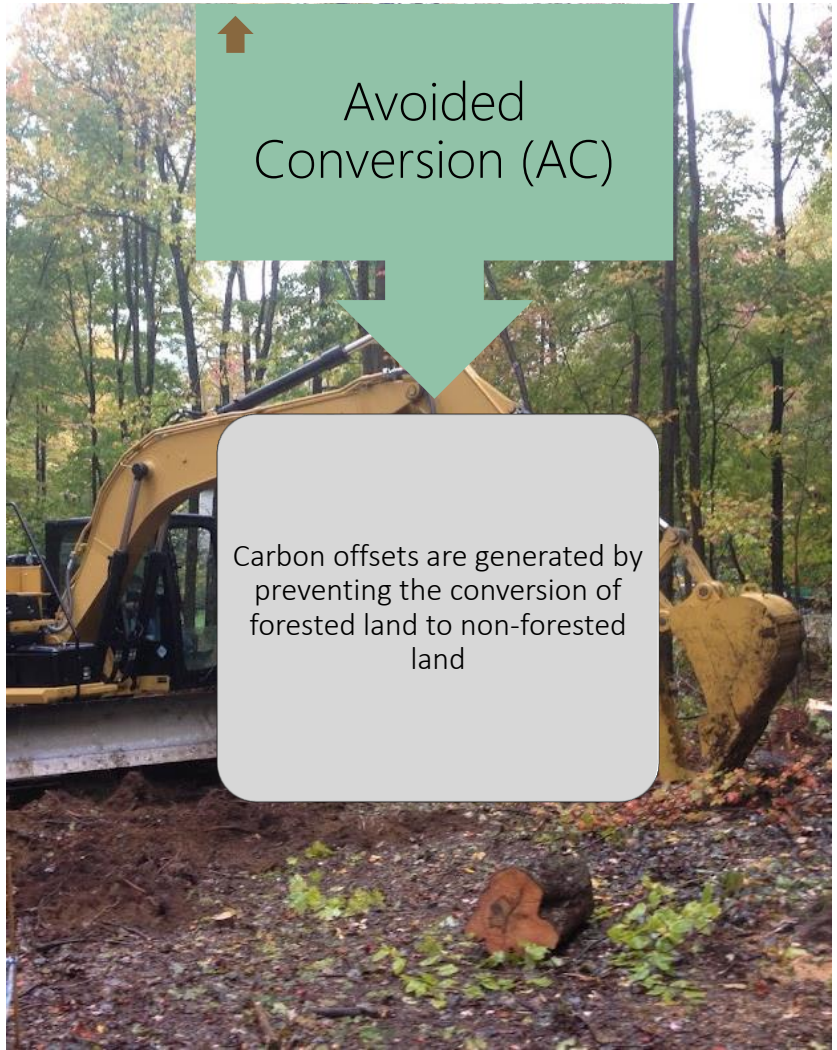


Carbon offsets are generated through the carbon storage of newly planted trees

Can be either on non-forested sites (afforestation) or to reestablish forests (reforestation)

2

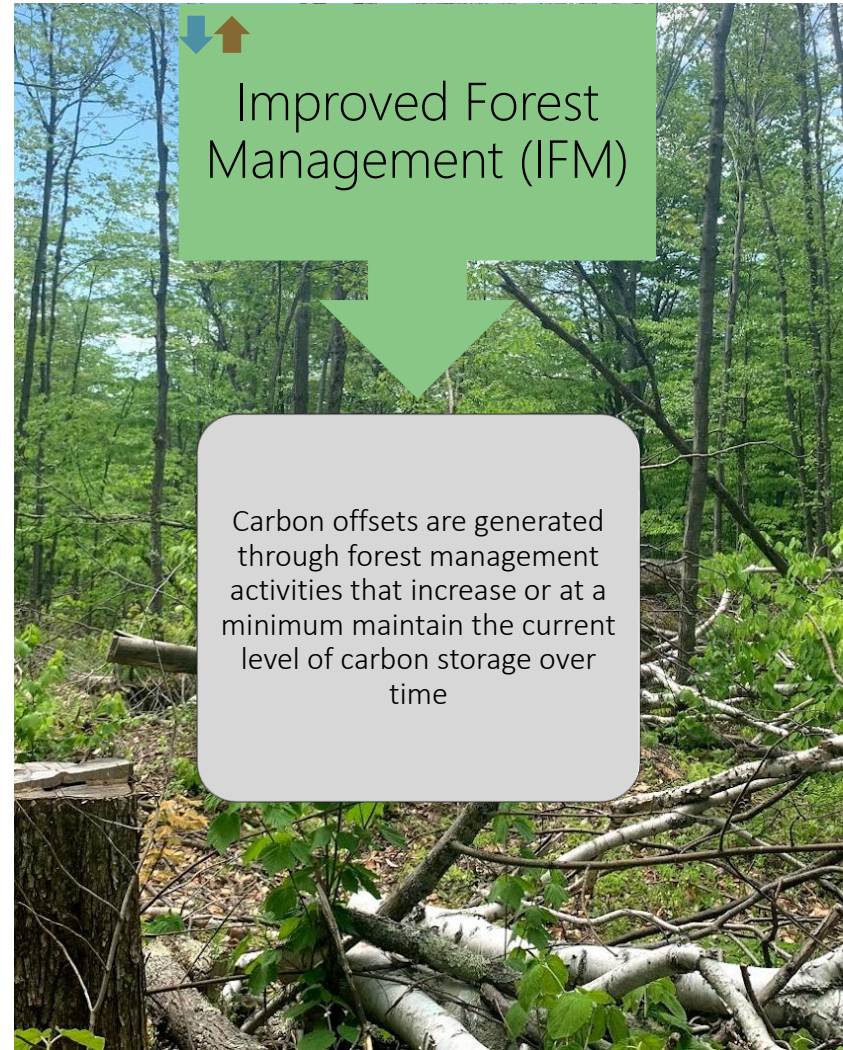
Avoided Conversion (AC)



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

3

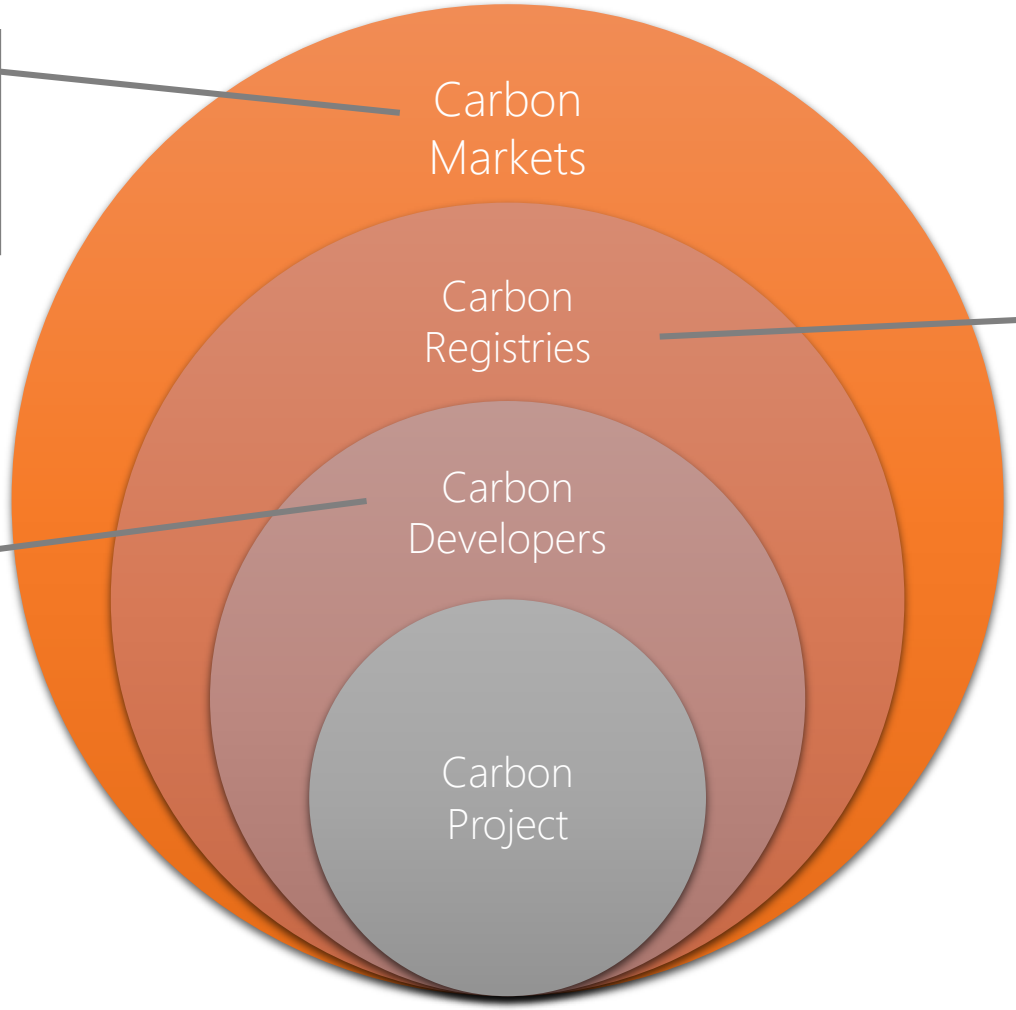
Improved Forest Management (IFM)



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

Virtual exchange of carbon offsets; may be required by law (regulatory/compliance) or voluntary (free market)



Issues, holds, and transfers carbon offsets; sets methodology for estimating carbon offsets

Private or non-profit company that helps a landowner develop a project and monetize offsets; may enroll projects in different registries

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

100 years + commitment

CALIFORNIA AIR RESOURCES BOARD

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

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

DEPARTMENT OF ECOLOGY
State of Washington

- 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

Carbon markets

40 years +/- commitment

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

Carbon markets

COMPLIANCE CARBON MARKET

Price is set by the market

CALIFORNIA AIR RESOURCES BOARD

Current price ceiling $72/Mt CO_2e

Current prices is $30+/Mt CO_2e

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

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

VOLUNTARY CARBON MARKET

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

Current selling price >$6/Mt CO_2e

Varies by type of offset

Some forest offsets in NE anecdotally selling for >$20

	2019			2020				2021 (through August)			
	Volume (MtCO2e)	Price per ton (USD)	Value (USD)	Volume (MtCO2e)	Volume % Change from Prior Year	Price per ton (USD)	Value (USD)	Volume (MtCO2e)	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 SWTICHING	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.

Ecosystem Marketplace
A FOREST TRENDS INITIATIVE


CALIFORNIA
AIR RESOURCES BOARD
CA Air Resources Board compliance carbon offset market – estimated 2022 value = $3.7 billion
Voluntary carbon offset market – estimated 2022 value = $2.5 billion
2020 voluntary market – $520 million
2021 voluntary market – nearly $2 billion

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

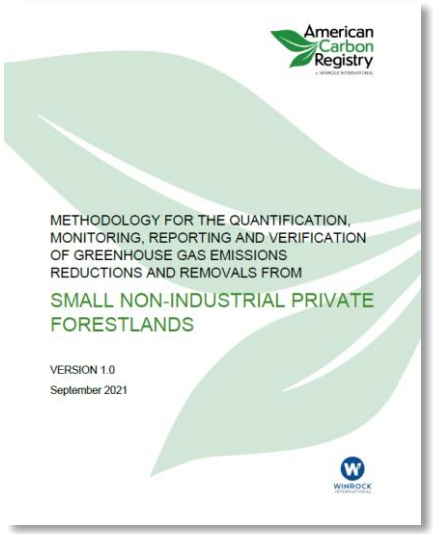
RGGI

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

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

anew

THE CLIMATE TRUST

FiniteCarbon

ep carbon

NewForests

SIG Carbon

GreenAssets

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

Forest Carbon Works

Approved under California's ARB market/registry

~~NCX~~

~~Independent market, registry, and developer~~

~~In process of approval with VCS registry~~

CORE CARBON By FiniteCarbon

Approved under ACR registry

FAMILY FOREST CARBON PROGRAM

American Forest Foundation

The Nature Conservancy

Protecting nature. Preserving life.

In process of approval with VCS registry

Urban Forests

CITY FOREST CREDITS

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 ??

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

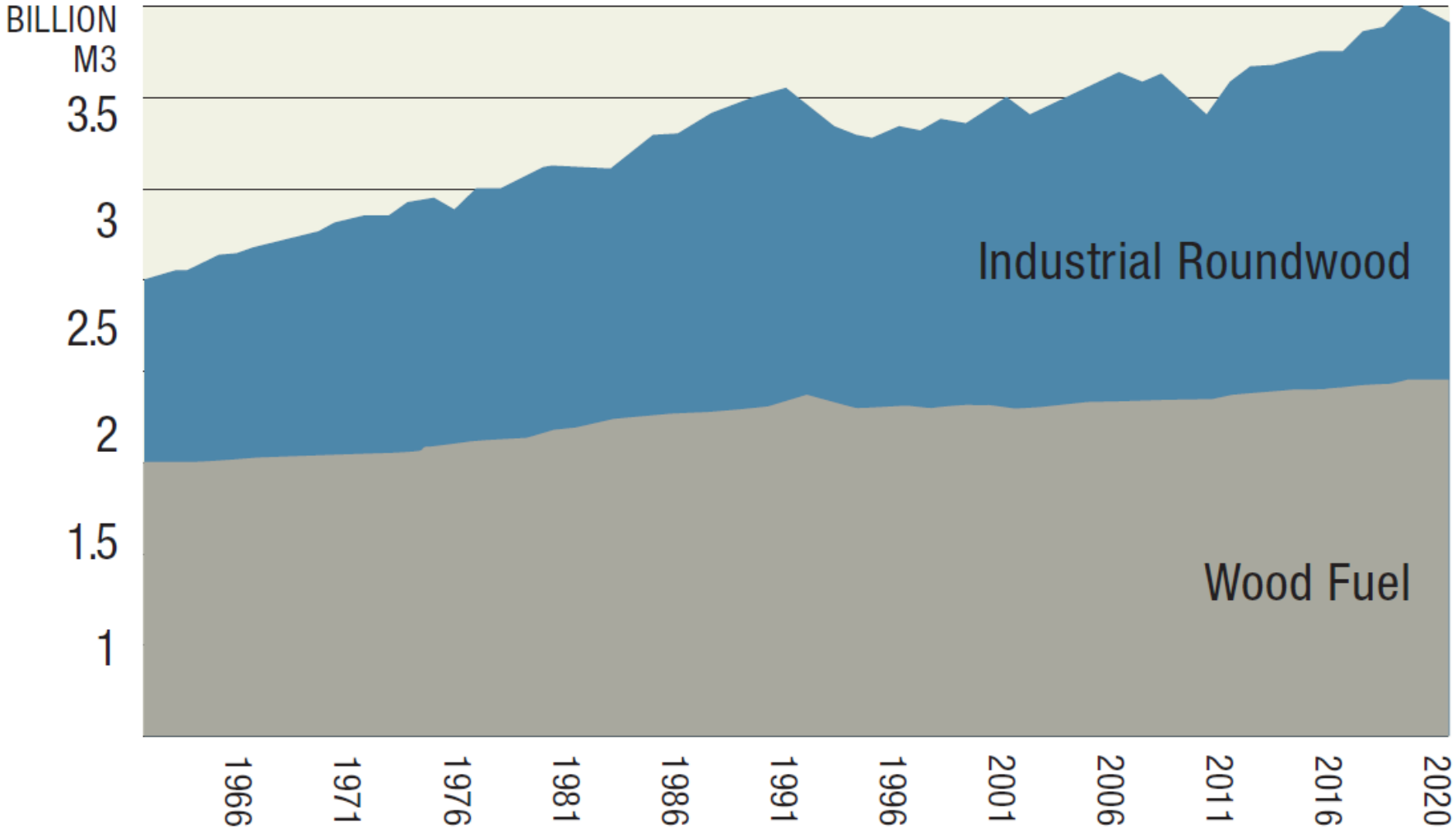
- Real
- Additional
- Verifiable
- Permanent
- Enforceable

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

Global roundwood and fuelwood production/consumption 1961-2020



Source: UN - FAO

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:

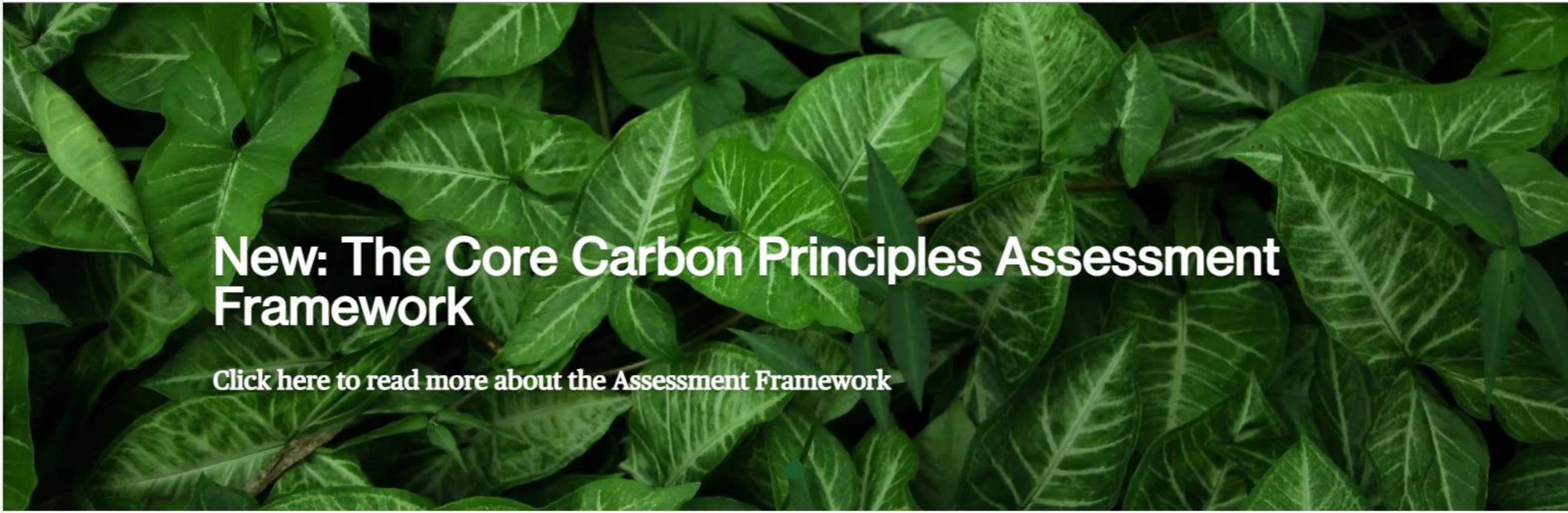
Carbon project results in an increase in harvest on another property or location

- 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



New: The Core Carbon Principles Assessment Framework

Click here to read more about the Assessment Framework

A high-integrity voluntary carbon market is a key complementary tool to reduce and remove emissions above and beyond what would otherwise be possible and to channel finance towards climate resilient development.

Who We Are5

The Integrity Council for the Voluntary Carbon Market (Integrity Council) is an independent governance body for the voluntary carbon market.

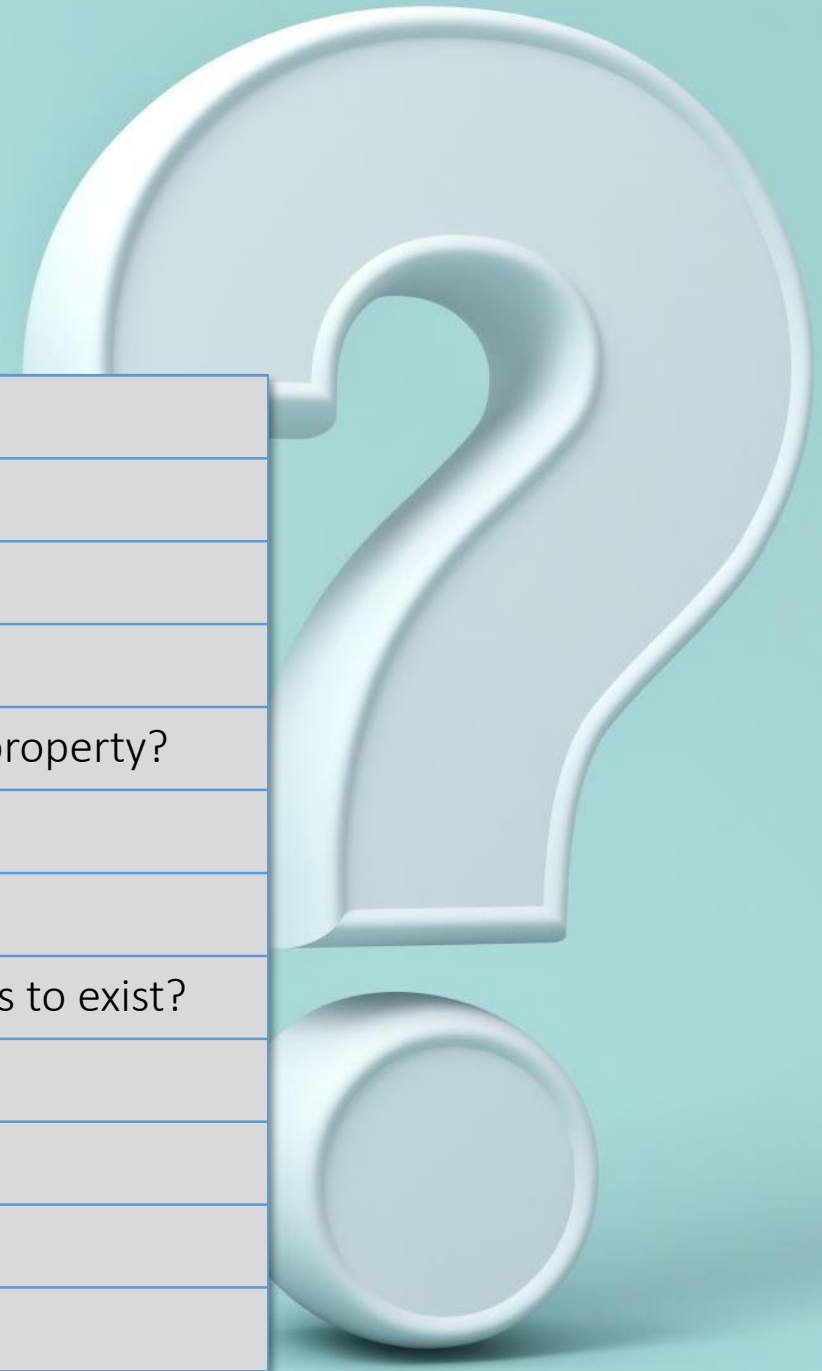
What We Do5

We will set and enforce a definitive global threshold, drawing on the best science and expertise available, so high-quality carbon credits efficiently mobilize finance towards urgent mitigation and climate resilient development.

Encourage landowners to engage with developers before entering a program

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

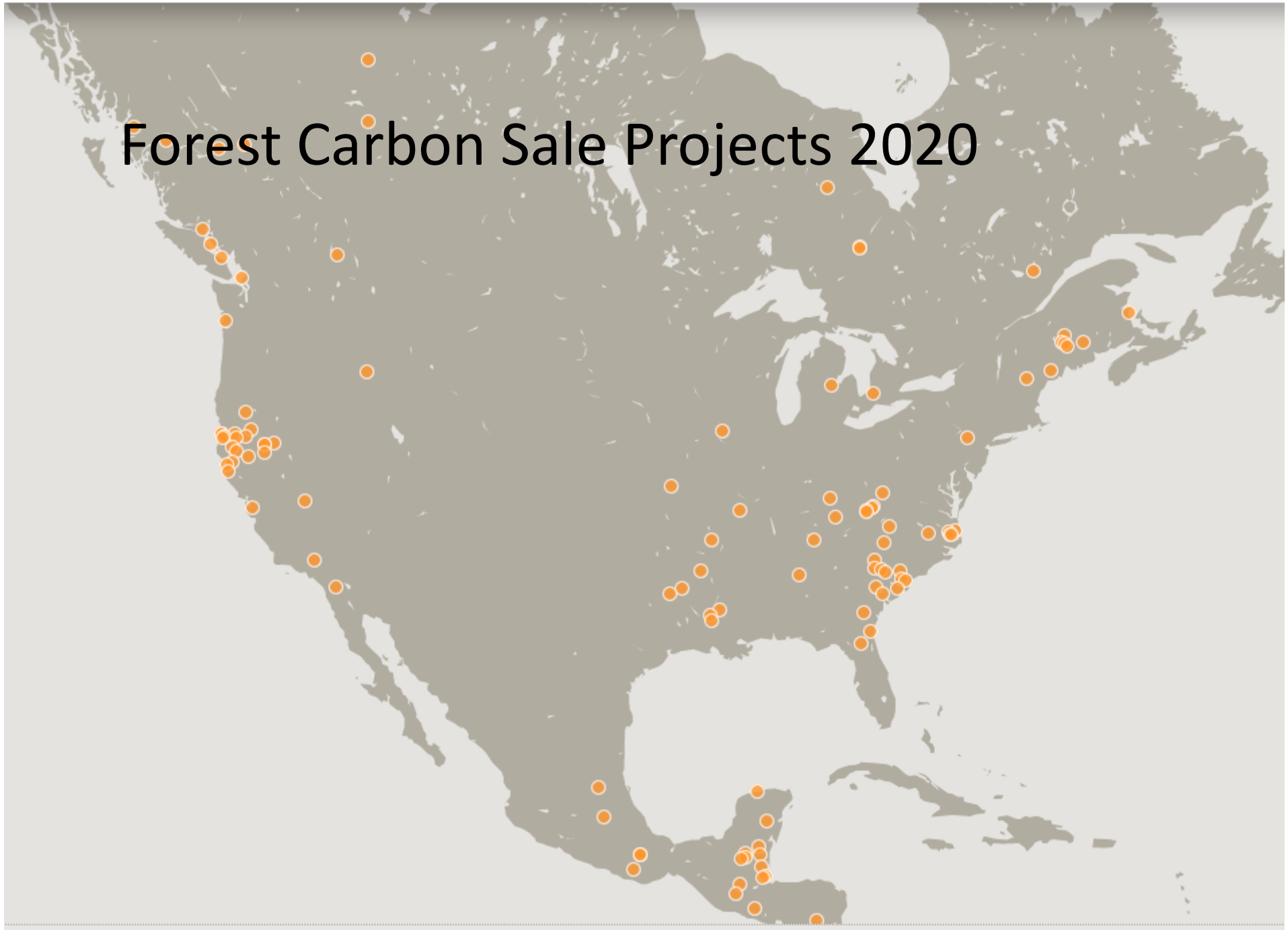
What types of management activities are allowed?
How is verification done?
Does the contract stay with the property if I sell?
What happens if I need to exit the contract early?
What happens if there is a natural disturbance on the property?
Is salvage harvesting allowed?
Are harvest wood product carbon 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?



How much forestland is in forest carbon offset markets so far?

Forest Carbon Sale Projects 2000

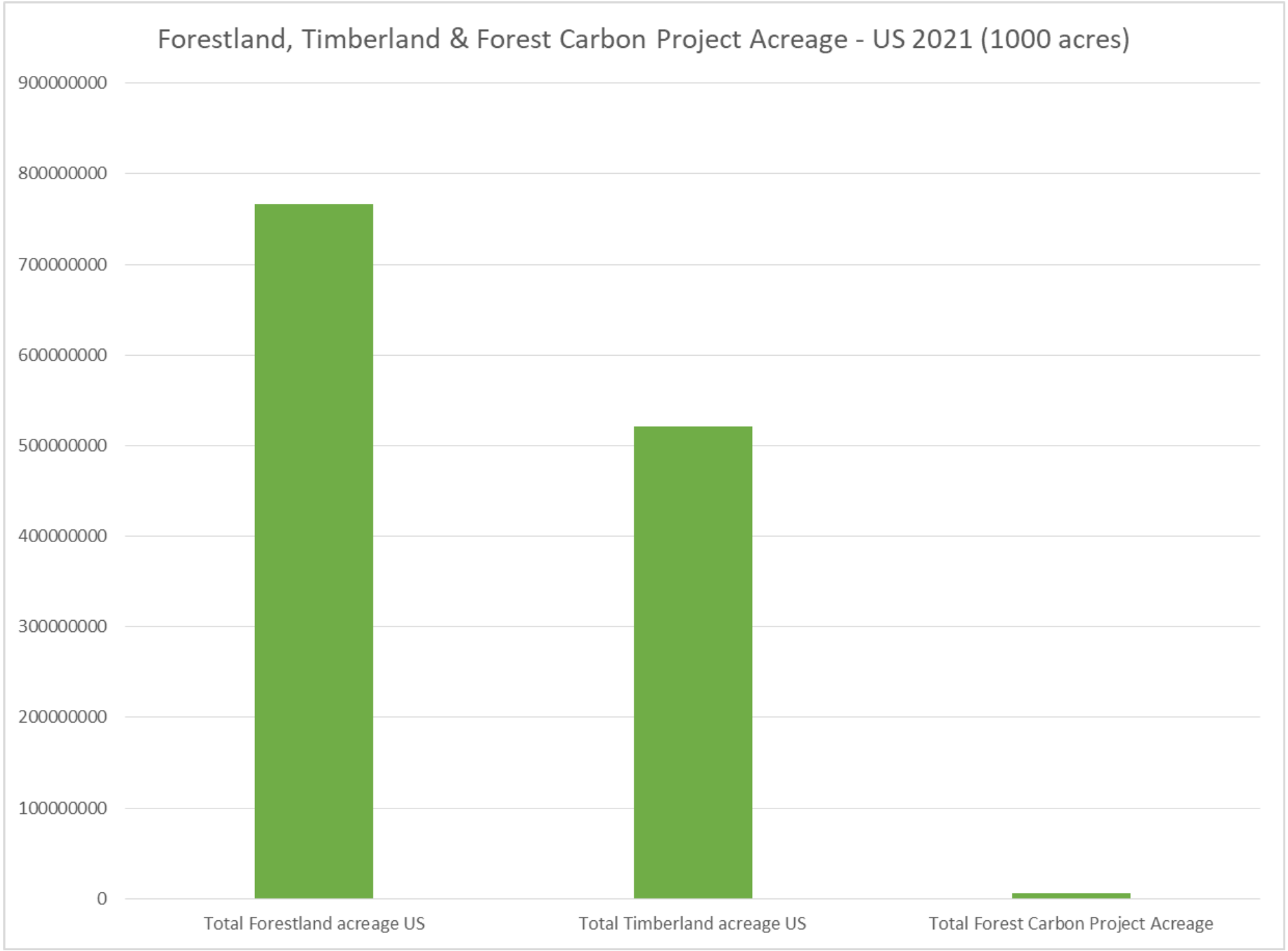
Source: Forest Trends

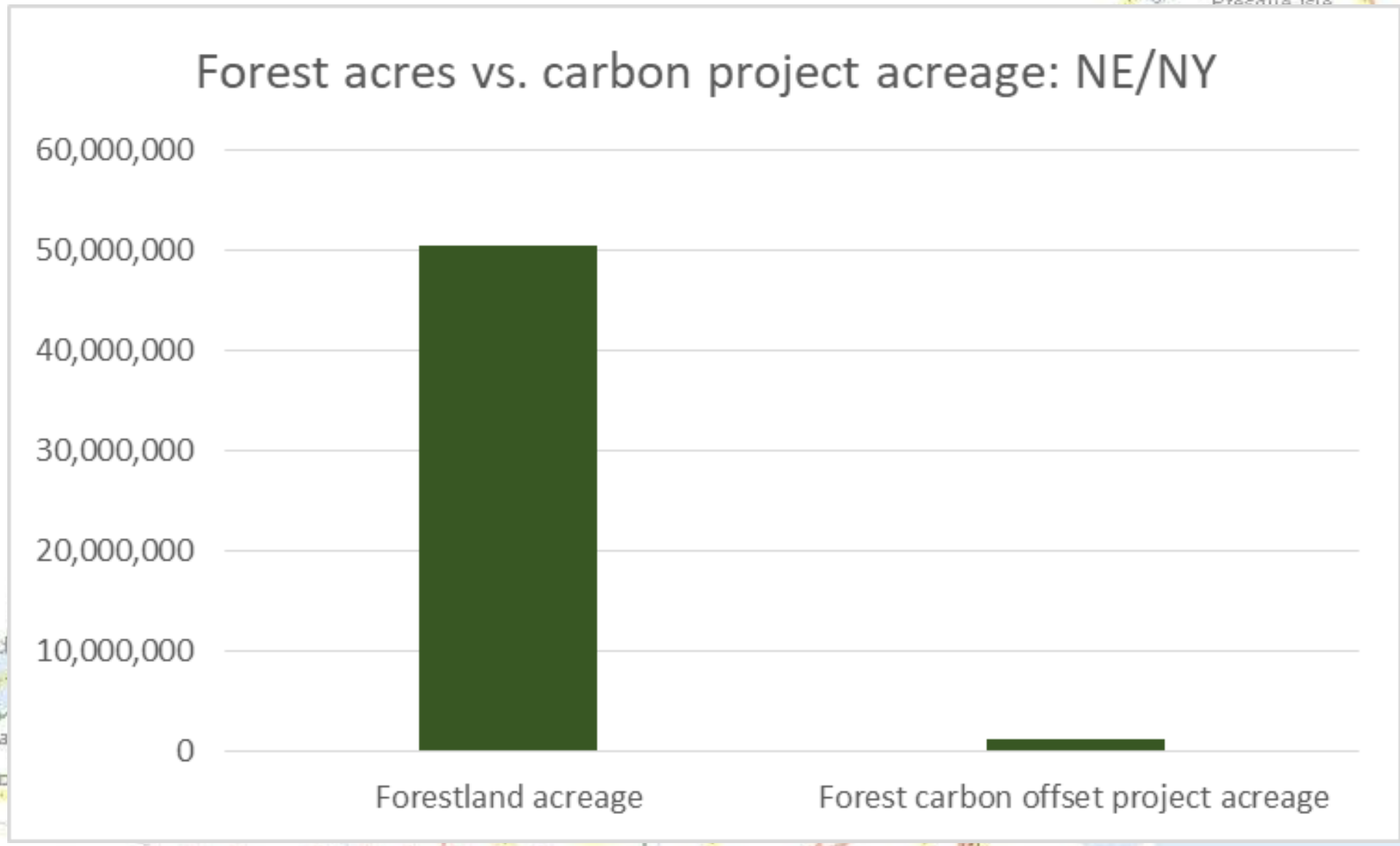

Forest Carbon Sale Projects 2020

How much forestland is in forest carbon offset markets so far?

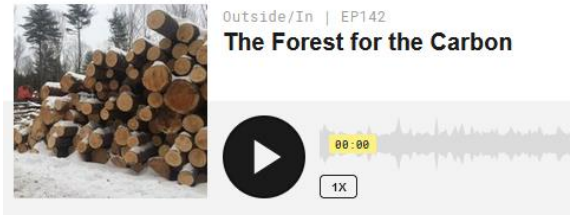
New England/New York – 1.4 Million acres

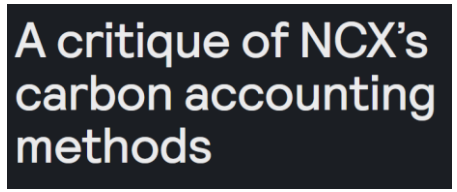
U.S. – 6.5 million acres


Forestland, Timberland & Forest Carbon Project Acreage - US 2021 (1000 acres)
900000000
800000000
700000000
600000000
500000000
400000000
300000000
200000000
100000000
0
Total Forestland acreage US
Total Timberland acreage US
Total Forest Carbon Project Acreage


Forest acres vs. carbon project acreage: NE/NY
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
Forestland acreage
Forest carbon offset project acreage

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

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 enewsletter 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

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