Forest Carbon and Timber Supply Modeling & Forest Carbon Incentive Programs

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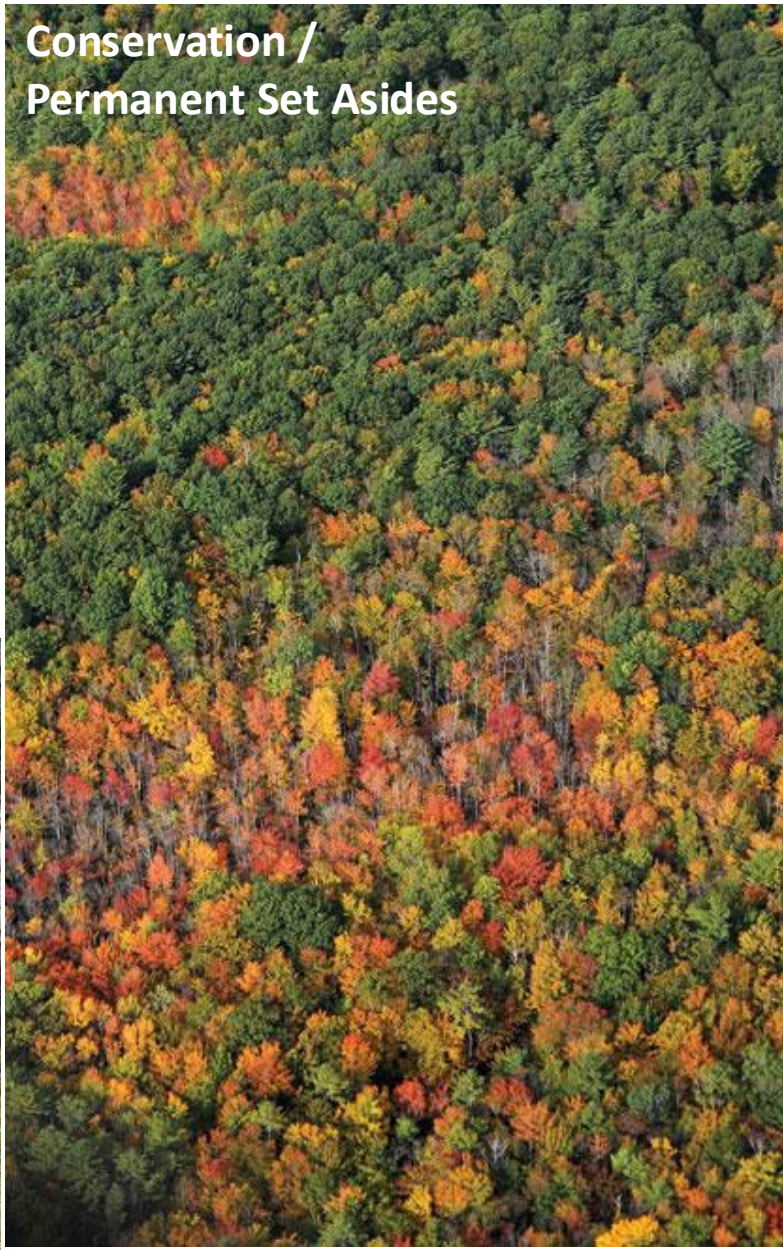
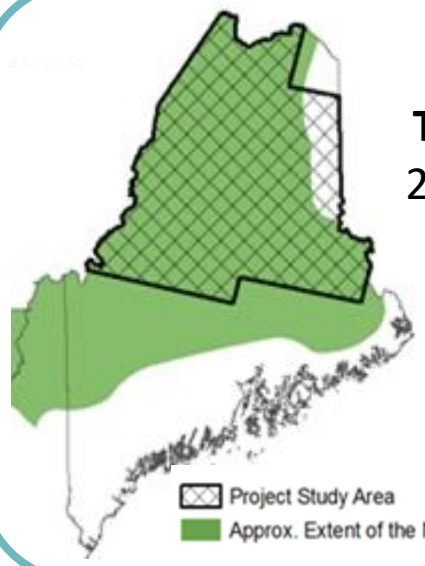
Background

- Maine's forests currently remove 90%+ of annual state's GHG emissions
- State considering incentives for increasing forest carbon via management, conservation, & products
- Varied economic impacts & climate benefits of implementing silvicultural practices to target carbon
- Concern whether Maine can increase forest carbon & maintain timber supply and support rural economies

Some forest management practices to consider…





Time span:
2020 - 2100

Objective:
Maximize
Carbon

Scenario + Policy Inputs

Land use constraints:

No harvest | Clearcuts

> Current
> Relaxed
> None

Harvest targets:

> Very Low | 1.6 MtC/yr
> Low
> Med-Low
> Med-High
> High

current trends

> Very High | 2.6 MtC/yr

Management practices:

> Partial harvest
> Extended rotation
> Clearcut – natural regen
> Clearcut – plant
> Thin – clearcut – plant
> Regular shelterwood
> Continuous cover
> Irregular gap
> No harvest set aside

Biodiversity indicators:

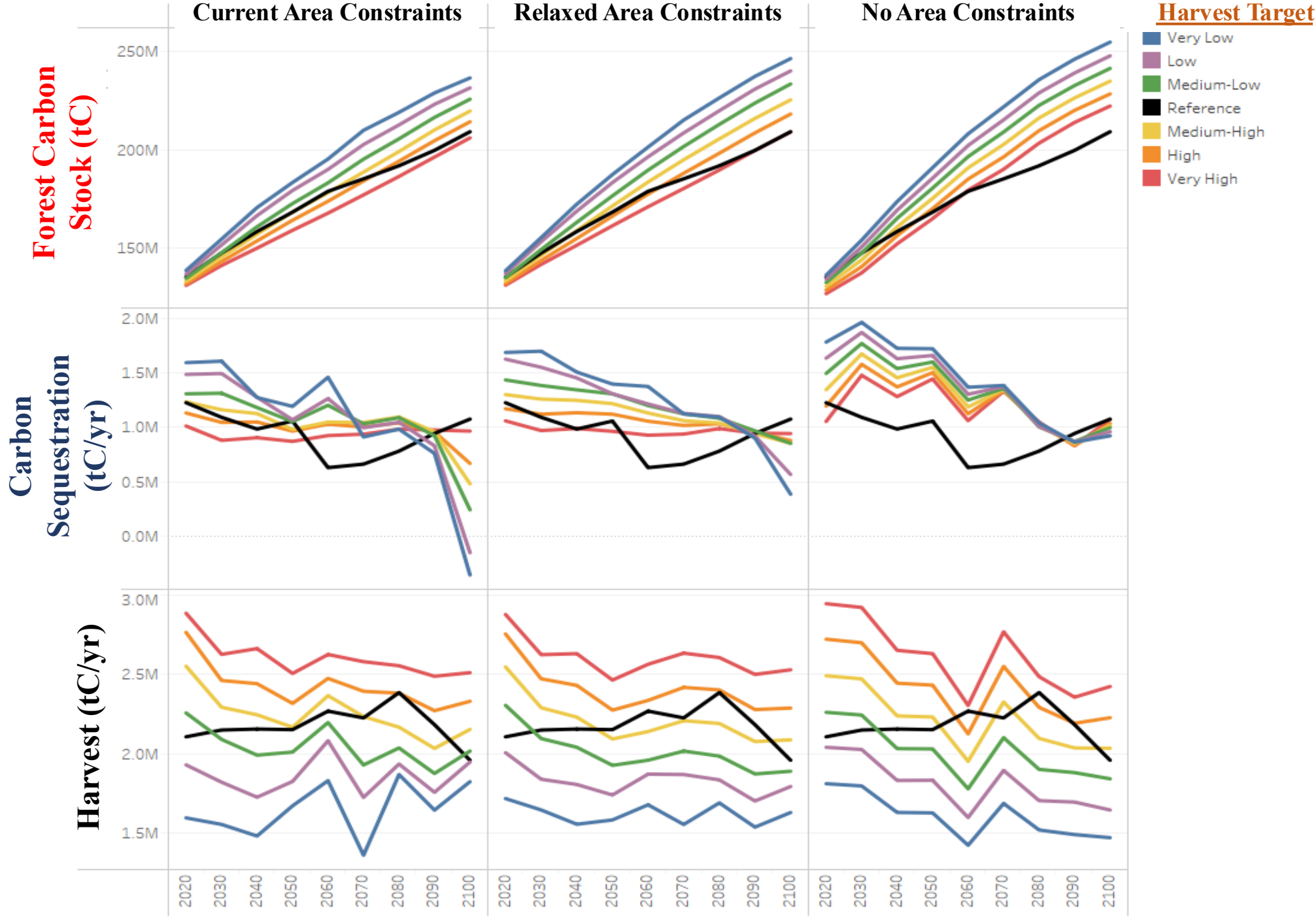
> Late successional northern hardwoods
> Late successional spruce-fir
> Mid successional American marten habitat
> Early successional bird habitat
> Early successional Canada lynx/snowshoe hare habitat

Maine Integrated Forest System Model

Carbon
Timber
$$$

Bioeconomic Inputs

Forest carbon stock, **carbon sequestration**, and **harvest** impacts under alternative **harvest targets** and **forest management constraints**, 2020-2100



Average of key model outputs per scenario, 2020 – 2100

Scenario	Forest C Seq (MMtC/yr)	Timber Harvest (MMtC/yr)	Net Revenue (Mil $/yr)	LS Spruce-Fir Area (k ha)	LS NHW Area (k ha)	Lynx Area (k ha)	Marten Area (k ha)	ES Bird Area (k ha)
BAU-Reference	0.92	2.15	$65.5	34.4	69.4	477	1,870	272
	Percent Change from BAU-Reference Case							
Max C - Current Area Lim - VL Harv	30%	-26%	-29%	-38%	90%	-24%	11%	-1%
Max C - Current Area Lim - L Harv	26%	-16%	-17%	-38%	73%	1%	-1%	18%
Max C - Current Area Lim - ML Harv	20%	-7%	-6%	-39%	15%	13%	-10%	39%
Max C - Current Area Lim - MH Harv	15%	2%	5%	-36%	-17%	40%	-21%	57%
Max C - Current Area Lim - H Harv	8%	12%	16%	-33%	-27%	62%	-29%	74%
Max C - Current Area Lim - VH Harv	-3%	21%	23%	-38%	-27%	85%	-38%	94%
Max C - Relaxed Area Lim - VL Harv	39%	-26%	-26%	-37%	138%	-6%	4%	5%
Max C - Relaxed Area Lim - L Harv	33%	-16%	-15%	-35%	109%	22%	-7%	23%
Max C - Relaxed Area Lim - ML Harv	27%	-7%	-2%	-31%	42%	31%	-15%	43%
Max C - Relaxed Area Lim - MH Harv	20%	2%	10%	-29%	-24%	42%	-22%	60%
Max C - Relaxed Area Lim - H Harv	11%	12%	18%	-31%	-27%	57%	-28%	73%
Max C - Relaxed Area Lim - VH Harv	1%	21%	26%	-40%	-27%	78%	-37%	91%
Max C - No Area Lim - VL Harv	46%	-26%	-24%	158%	42%	69%	-4%	-15%
Max C - No Area Lim - L Harv	39%	-16%	-14%	157%	-6%	87%	-10%	-6%
Max C - No Area Lim - ML Harv	32%	-7%	-5%	125%	-20%	101%	-16%	7%
Max C - No Area Lim - MH Harv	25%	2%	5%	51%	-20%	120%	-23%	18%
Max C - No Area Lim - H Harv	18%	12%	15%	-23%	-20%	139%	-30%	28%
Max C - No Area Lim - VH Harv	11%	21%	24%	-51%	-22%	156%	-37%	41%

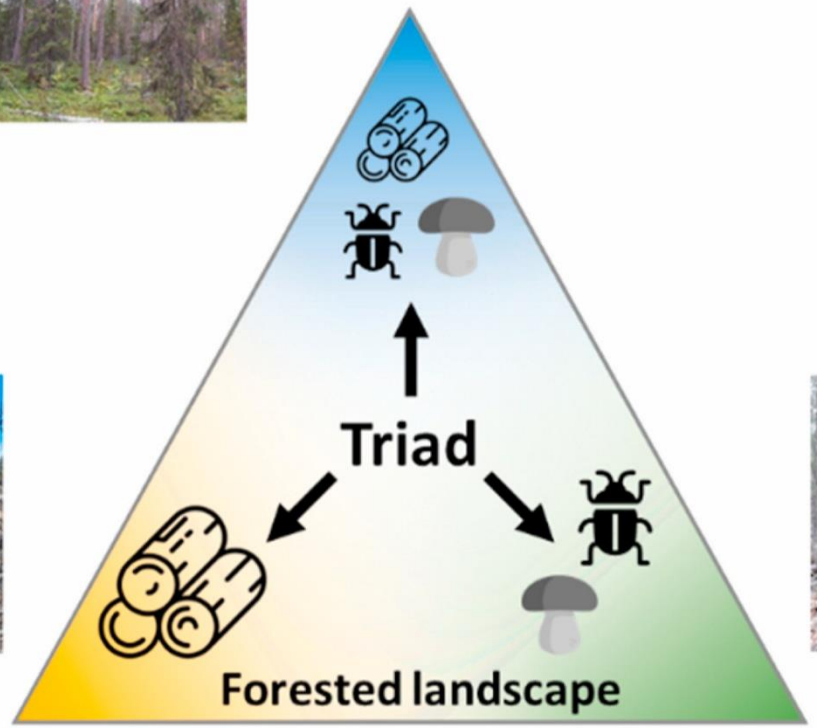
Change from Business-as-Usual (BAU) Reference Case:

Less than -30%	-15 to -30%	0 to -15%	0 to 15%	15% to 30%	More than 30%

Maine's forests can increase carbon sequestration by 15-25% without reducing timber harvest via a "Triad" Landscape Management Approach

Extensive management

Land sharing



Land sparing-sharing continuum

Intensive management

Forest reserves

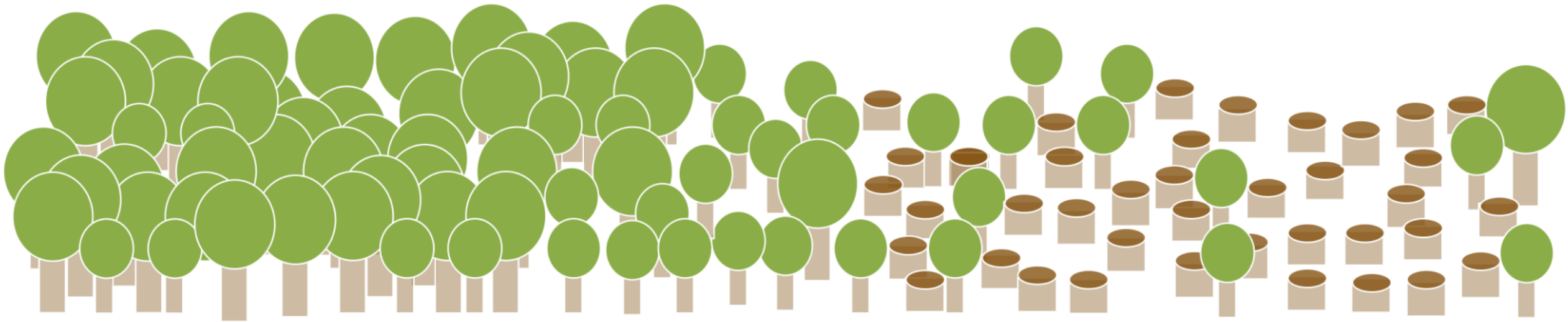
Land sparing

Figure: Blattert et al. (2023)

Same approach could increase timber harvests by 20%+ and still maintain historical carbon sequestration rates

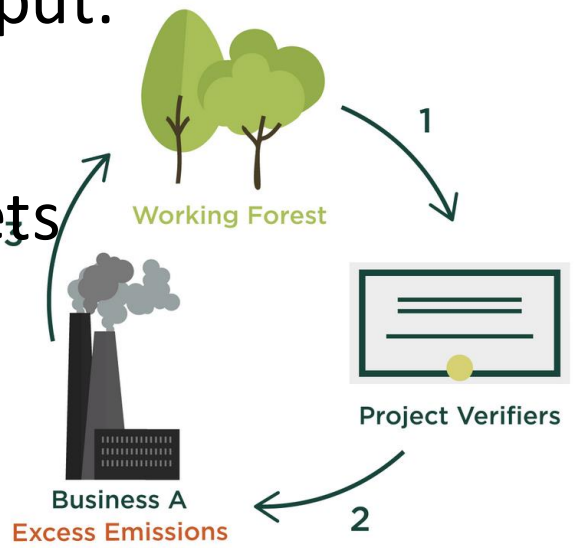
Forest sharing: low logging intensity spread across entire landscape

Forest sparing: high logging intensity concentrated in part of landscape



Forest Carbon Incentive Programs

- Traditionally, landowners receive payments for **Forest Carbon Credits** earned by changing management to increase carbon storage.
- Credits typically measured in tonnes of CO_2e (~½ cord of wood).
- **Developers** who help coordinate projects to produce credits tracked by **Registries** and sold to **Emitters** to 'offset' their GHG output.
- Key considerations:
  - Options for Voluntary (ACR) or Compliance (ARB) markets
  - Typically requires sequestering more carbon than regional averages
  - Enrollment periods of 20-100 years
  - Not all applicable for small landowners



Project developer	Registries Used	Enrollment Period (years)	Parcel Size (acres)	Out-of-pocket fees	Enrollment of all acres required	Screening of credit buyers?
Family Forest Carbon Program (https://www.familyforestcarbon.org)	VCS	20	30-2,400	None	No	Yes
Core Carbon Program (a program of Finite Carbon) (https://corecarbon.com/)	ACR	40	40-5,000	None	No	No
Forest Carbon Works (https://forestcarbonworks.org/)	VCS	35	40+	Small fee	**Yes**	No
Renoster / Apollo	Isometric	20	30	None	No	No
Finite Carbon (https://finitecarbon.com)	ACR, ARB	40 or 100	2,000+	**Yes**	No	**Yes**
SIG Carbon (https://www.sigcarbon.com/) (can be an aggregator of small ownerships)	ACR, ARB, CAR	40 or 100	100+/-	**Yes**	No	**Yes**
The Climate Trust (http://climatetrust.org)	ACR, ARB	40 or 100	2,000+	**Yes**	No	**Yes**
Anew Carbon (formerly Blue Source) (https://anewclimate.com/solutions/carbon)	ACR, ARB, CAR	40 or 100	3,000+	**Yes**	No	**Yes**
Private landowners that administered their own project development (e.g., Manulife)	ACR, CAR	40 or 100	1,000+ (?)	**Yes**	No	**Yes**

Non-Credit Opportunities

- Non-credit programs focused on forest management with productivity and carbon benefits:
  - New England Forestry Foundation programs
  - NRCS cost share programs
  - MFS cost share program (soon to be announced)
- Pay by the acre, not the tCO_2e

Thanks…Questions?

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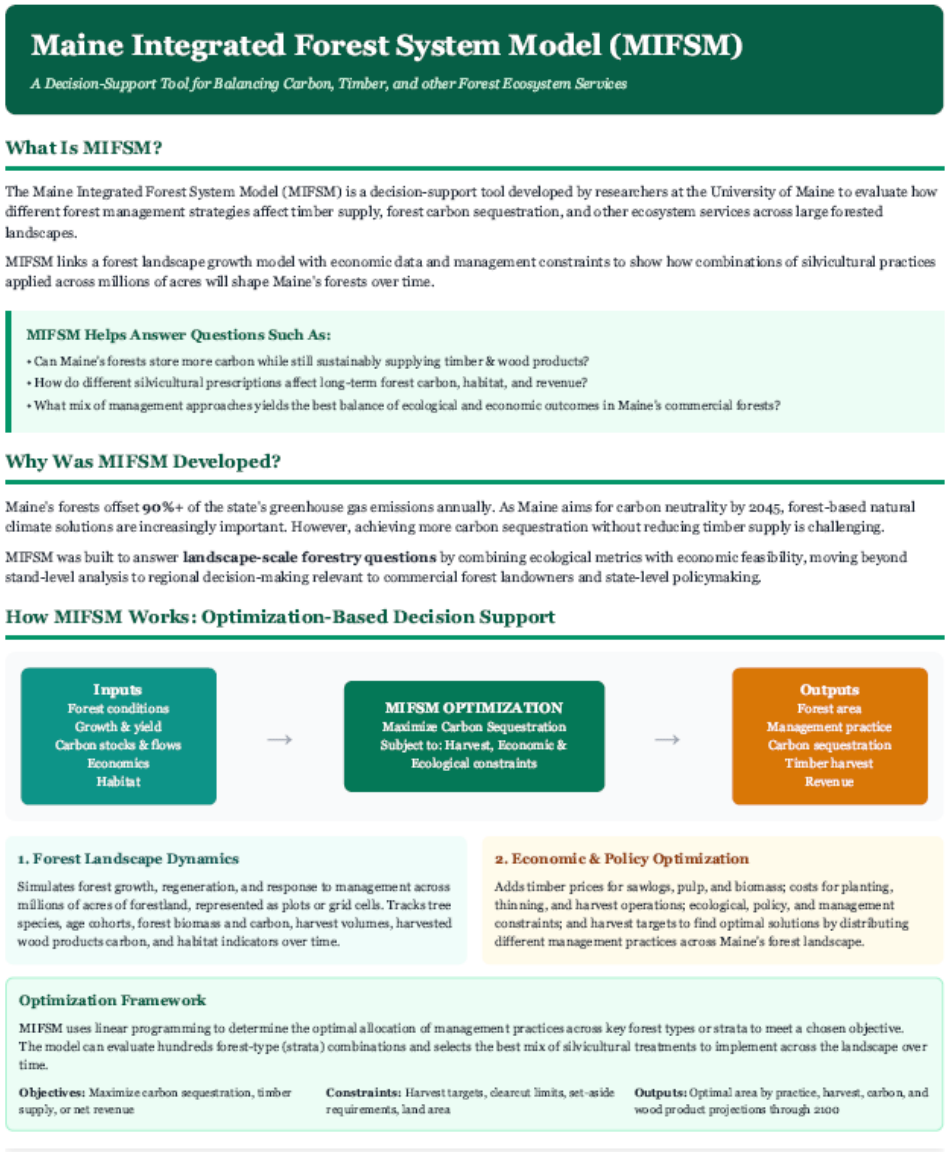
Want to Know More?

- Northeast Forest Carbon and Climate Partnership website.
- UMaine forest carbon model website.
- Model application publication in *Forest Policy and Economics*.
- Forest Carbon for Commercial Landowners Project report available .
- Modeled silvicultural practices and forest types available here.



Maine Integrated Forest System Model (MIFSM)

A Decision-Support Tool for Balancing Carbon, Timber, and other Forest Ecosystem Services

What Is MIFSM?

The Maine Integrated Forest System Model (MIFSM) is a decision-support tool developed by researchers at the University of Maine to evaluate how different forest management strategies affect timber supply, forest carbon sequestration, and other ecosystem services across large forested landscapes.

MIFSM links a forest landscape growth model with economic data and management constraints to show how combinations of silvicultural practices applied across millions of acres will shape Maine's forests over time.

MIFSM Helps Answer Questions Such As:

- Can Maine's forests store more carbon while still sustainably supplying timber & wood products?
- How do different silvicultural prescriptions affect long-term forest carbon, habitat, and revenue?
- What mix of management approaches yields the best balance of ecological and economic outcomes in Maine's commercial forests?

Why Was MIFSM Developed?

Maine's forests offset **90%+** of the state's greenhouse gas emissions annually. As Maine aims for carbon neutrality by 2045, forest-based natural climate solutions are increasingly important. However, achieving more carbon sequestration without reducing timber supply is challenging.

MIFSM was built to answer **landscape-scale forestry questions** by combining ecological metrics with economic feasibility, moving beyond stand-level analysis to regional decision-making relevant to commercial forest landowners and state-level policymaking.

How MIFSM Works: Optimization-Based Decision Support

Inputs
Forest conditions
Growth & yield
Carbon stocks & flows
Economics
Habitat

→

MIFSM OPTIMIZATION
Maximize Carbon Sequestration
Subject to: Harvest, Economic & Ecological constraints

→

Outputs
Forest area
Management practice
Carbon sequestration
Timber harvest
Revenue

1. Forest Landscape Dynamics

Simulates forest growth, regeneration, and response to management across millions of acres of forestland, represented as plots or grid cells. Tracks tree species, age cohorts, forest biomass and carbon, harvest volumes, harvested wood products carbon, and habitat indicators over time.

2. Economic & Policy Optimization

Adds timber prices for sawlogs, pulp, and biomass; costs for planting, thinning, and harvest operations; ecological, policy, and management constraints; and harvest targets to find optimal solutions by distributing different management practices across Maine's forest landscape.

Optimization Framework

MIFSM uses linear programming to determine the optimal allocation of management practices across key forest types or strata to meet a chosen objective. The model can evaluate hundreds forest-type (strata) combinations and selects the best mix of silvicultural treatments to implement across the landscape over time.

Objectives: Maximize carbon sequestration, timber supply, or net revenue

Constraints: Harvest targets, clearcut limits, set-aside requirements, land area

Outputs: Optimal area by practice, harvest, carbon, and wood product projections through 2100