Optimizing the Climate Mitigation Potential of Connecticut's Forests: Policy Recommendations

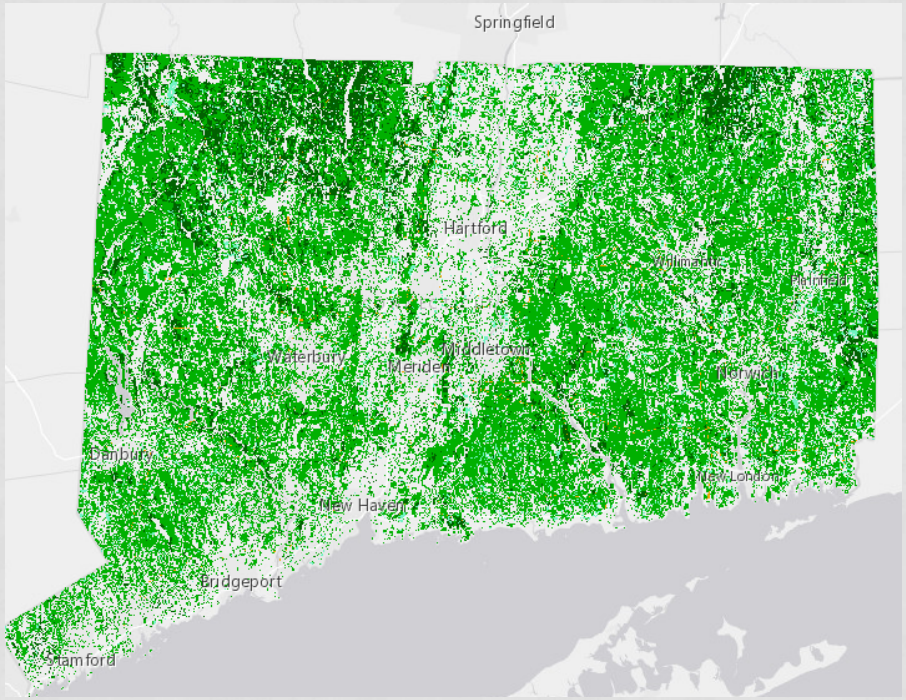
Helen D. Silver, Esq.

Linda Powers Tomasso, ALM, MSFS

October 19, 2015

OVERVIEW

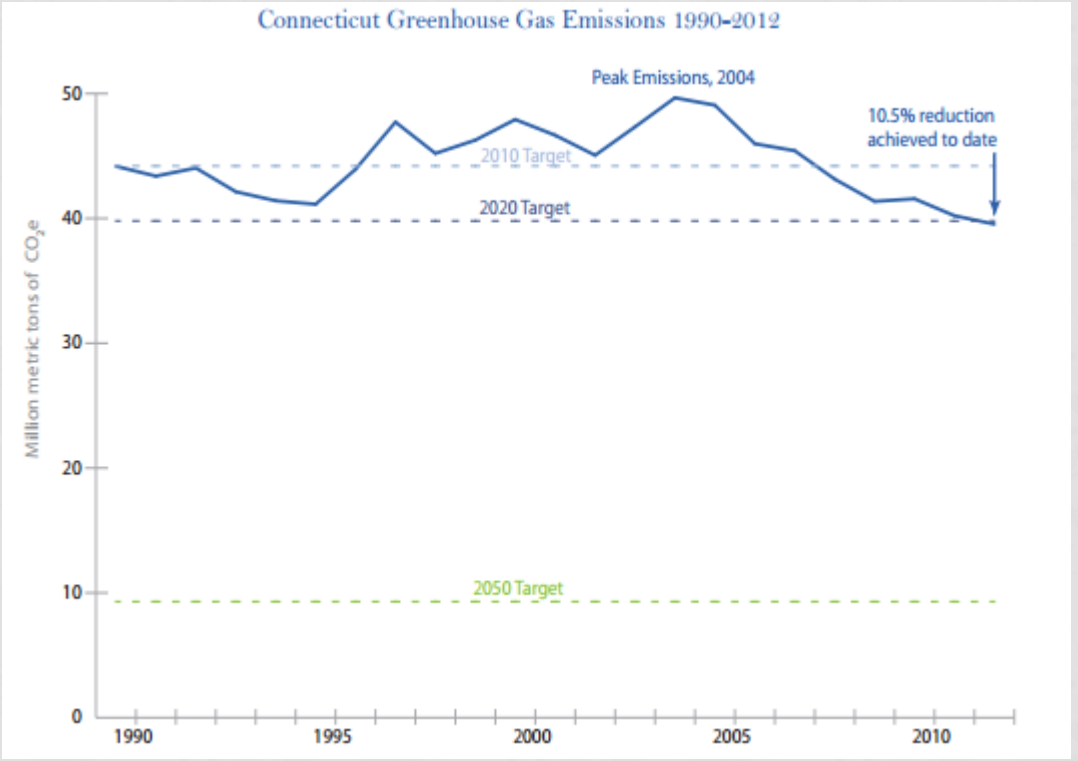
- **Background**
  - Chronology of Work Performed
  - Climate impacts of CT's forests
    - Sequestration and GHG Emissions
  - Forest Ownership Facts
  - Causes /Rates of Land Use Change (LUCF)
- **Presentation highlights the top 5 recommendations for conservation**



State Forest Coverage in 2010. Between 1985 and 2010, Connecticut lost 190 square miles of forest. (CLEAR, 2010)

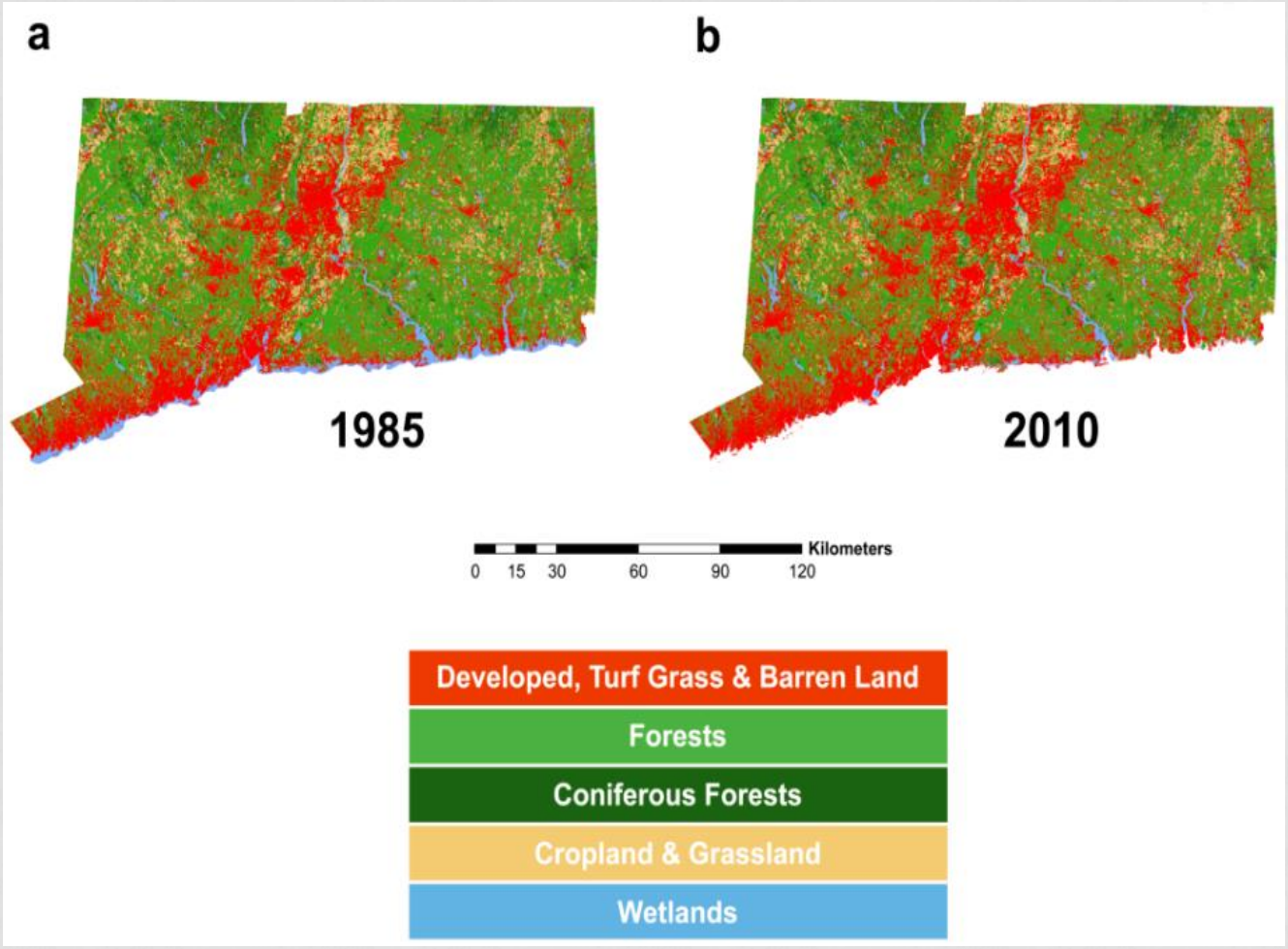
OVERVIEW:
MAIN CONCLUSIONS

- Forests are critical to meeting 2050 CC targets
  - Avoiding GHG emissions and sequestering additional carbon
  - Forest sequestration capacity is expected to increase
- Must be accounted for in GHG Inventory
- Conversion is imminent and significant, but conservation is feasible



Forest conservation will help bridge the gap through sequestration *and* avoided significant emissions (graph: CLEAR)

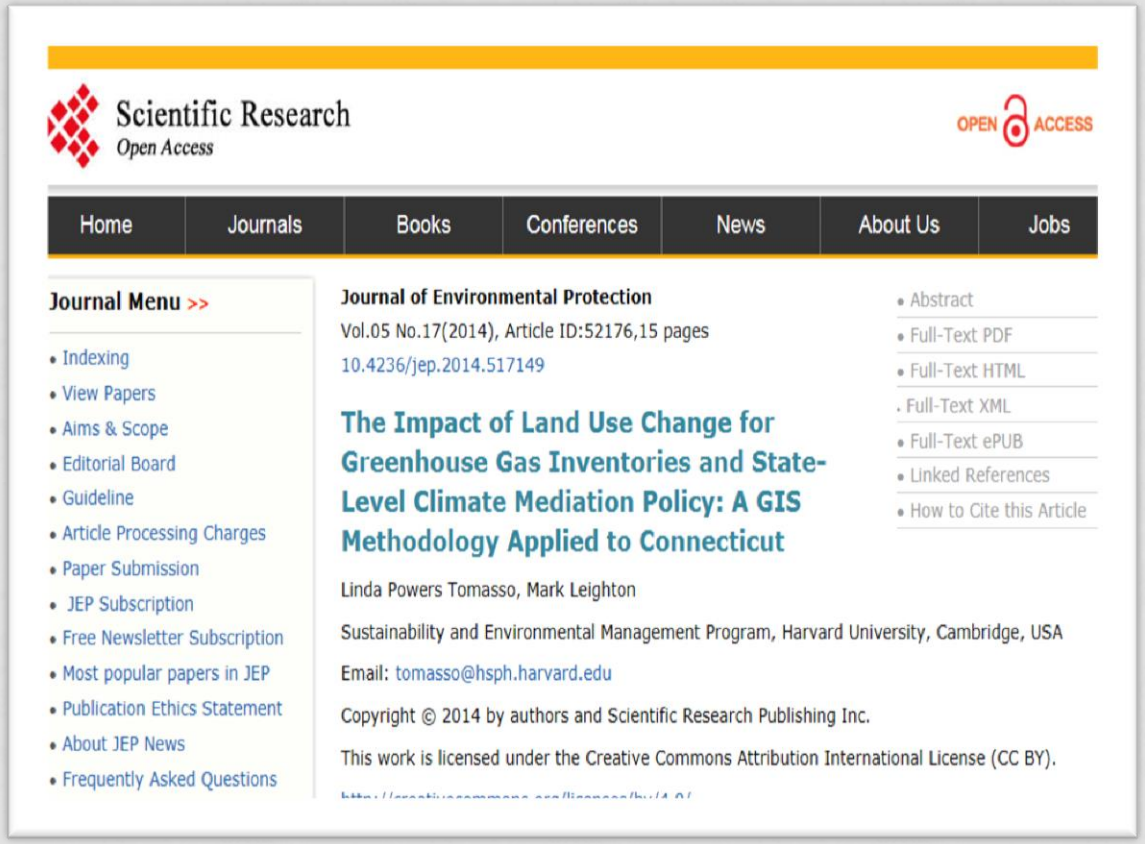
CT LAND USE CHANGE 1985-2010



Source Data: CLEAR land use change. www.CLEAR/uconn.edu Mapping: Tomasso (2014)

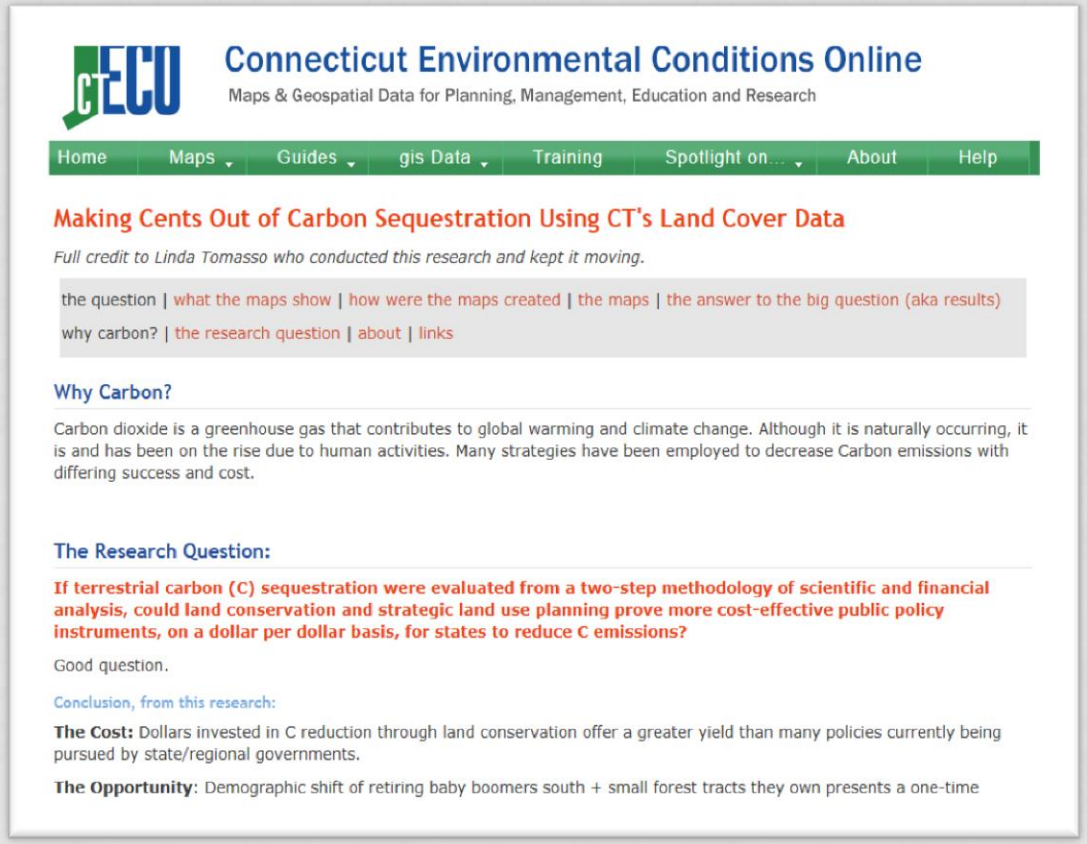
CHRONOLOGY OF WORK PERFORMED

Journal of Environmental Protection publication, Oct 2014



www.scrip.org/journal/paperInformation.aspx?PaperID=52176

CT Eco: "Making Cents out of C Seq-uestration using CT's Land Cover Data"



www.cteco.uconn.edu/energy/carbon/index.htm

CHRONOLOGY OF WORK PERFORMED (CONT'D)

- Summer of 2015: Two research projects completed for CT DEEP
  - **Task 1:** Evaluate GHG Inventory Methodologies to Account for Land Use Change and Forestry & Propose Recommendations
  - **Task 2:** Evaluate Other State Practices & Propose Polices for Forest Conservation and Enhancement of C Sequestration

Increasing the Climate Mitigation Potential of Connecticut's Forests: Policy Recommendations

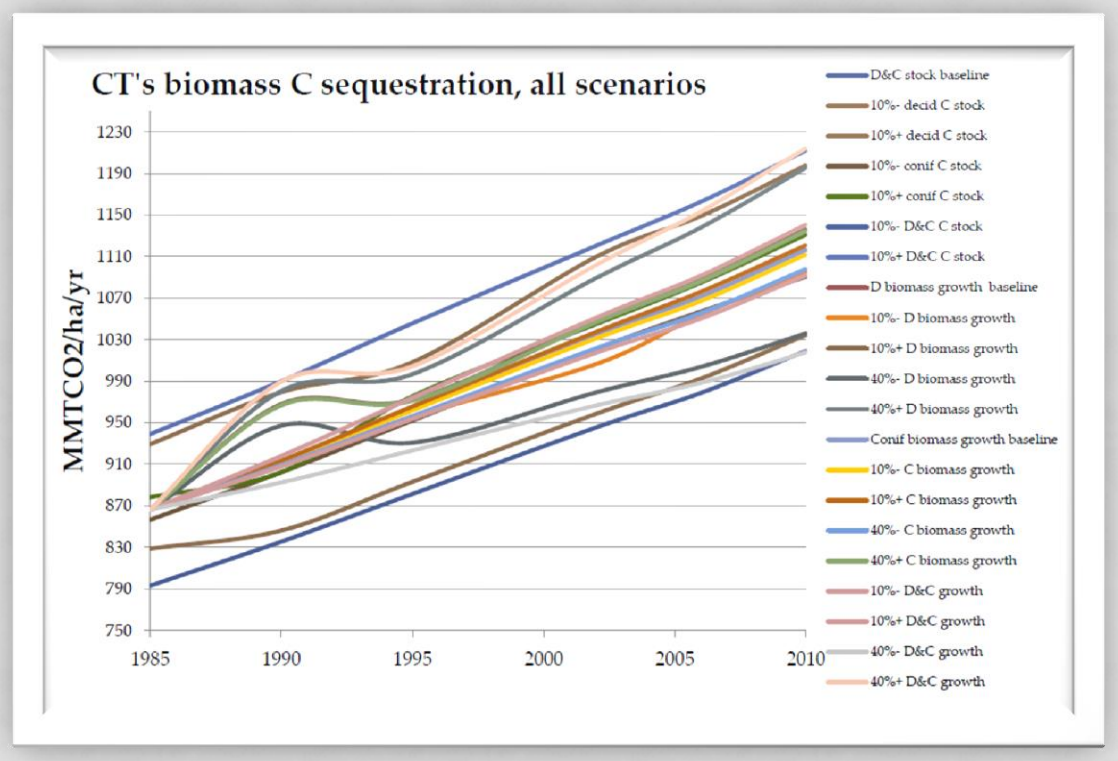
Prepared for Jeff Howard & Keri Enright-Kato

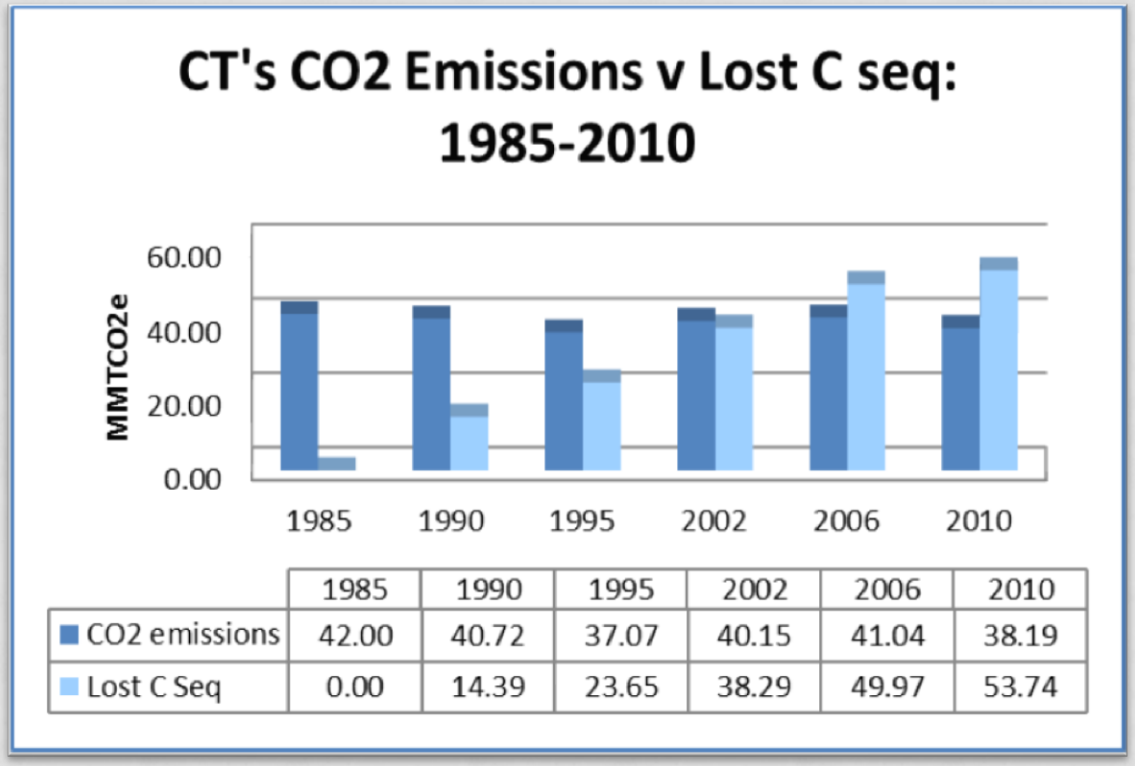
Connecticut Department of Energy & Environmental Protection (Office of Climate Change, Technology, and Research)

August 2015

Helen D. Silver, Esq. (h_d_silver@yahoo.com)

FOREST SEQUESTRATION CAPACITY IS LIKELY TO INCREASE IN COMING YEARS

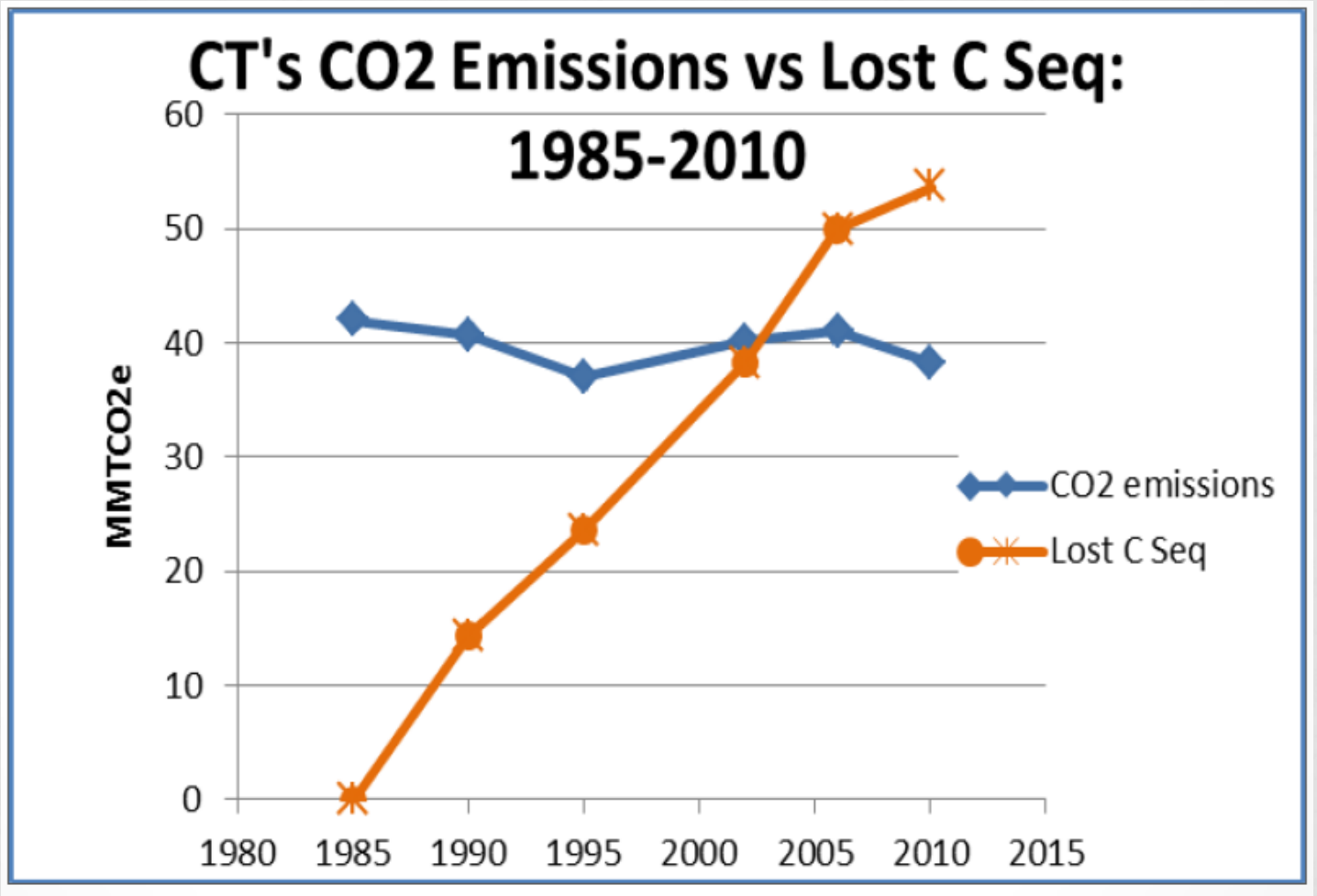




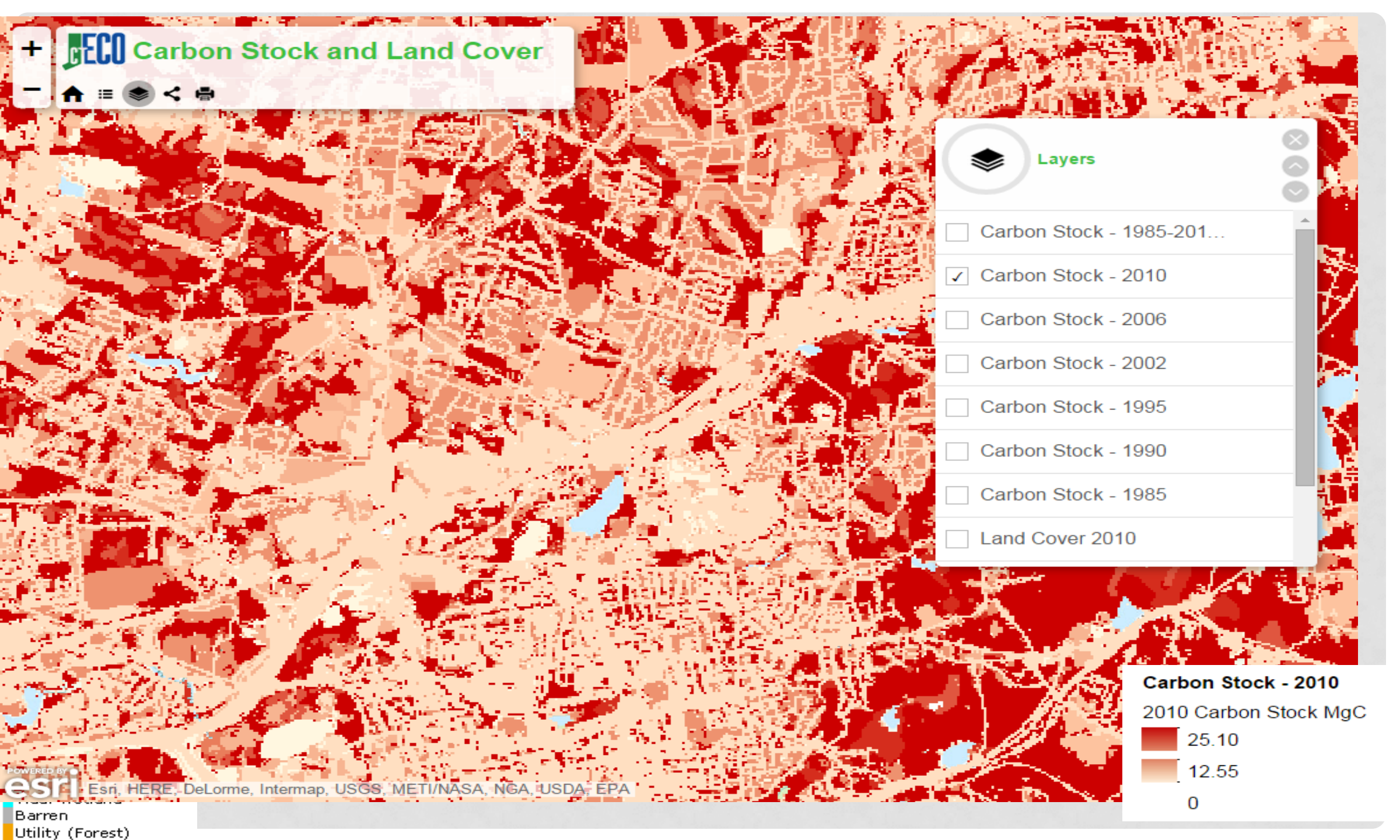
	1985	1990	1995	2002	2006	2010
CO2 emissions	42.00	40.72	37.07	40.15	41.04	38.19
Lost C Seq	0.00	14.39	23.65	38.29	49.97	53.74

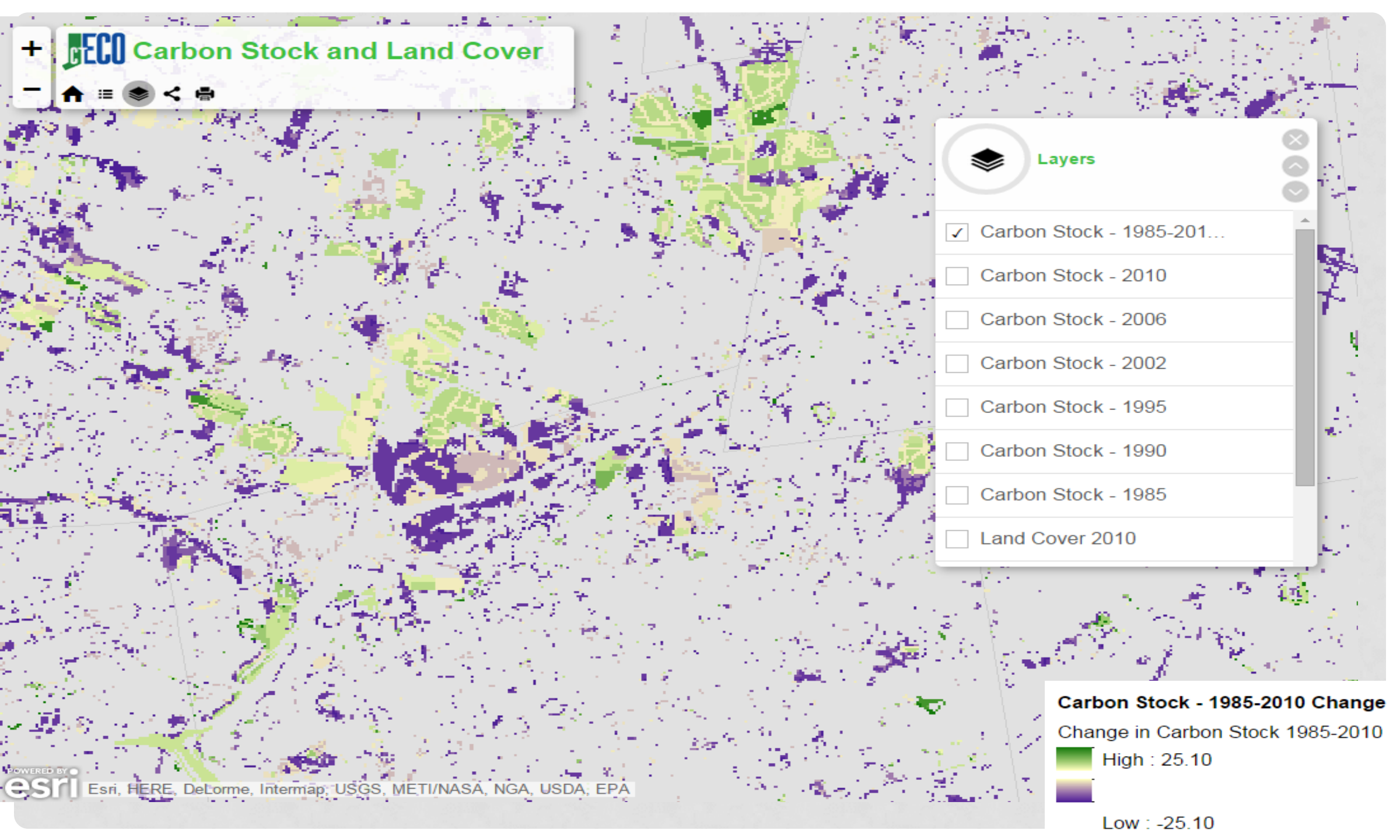
Graphics, Tomasso (2014). www.scrip.org/journal/paperInformation.aspx?PaperID=52176

GROWTH OF LOST C SEQUESTRATION OPPORTUNITY OVER 25 YEARS OF LUCF



Graphics, Tomasso (2014). www.scrip.org/journal/paperInformation.aspx?PaperID=52176


Carbon Stock and Land Cover
Layers
Carbon Stock - 1985-201...
Carbon Stock - 2010
Carbon Stock - 2006
Carbon Stock - 2002
Carbon Stock - 1995
Carbon Stock - 1990
Carbon Stock - 1985
Land Cover 2010
Carbon Stock - 2010
2010 Carbon Stock MgC
25.10
12.55
0
Esri, HERE, DeLorme, Intermap, USGS, METI/NASA, NGA, USDA, EPA
Barren
Utility (Forest)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Carbon Stock - 1990
Carbon Stock - 1985
Land Cover 2010
Carbon Stock - 1985-2010 Change
Change in Carbon Stock 1985-2010
High : 25.10
Low : -25.10
Esri, HERE, DeLorme, Intermap, USGS, METI/NASA, NGA, USDA, EPA

Ag Field or Other Grass to Turf and grass

Lose forest, lose potential

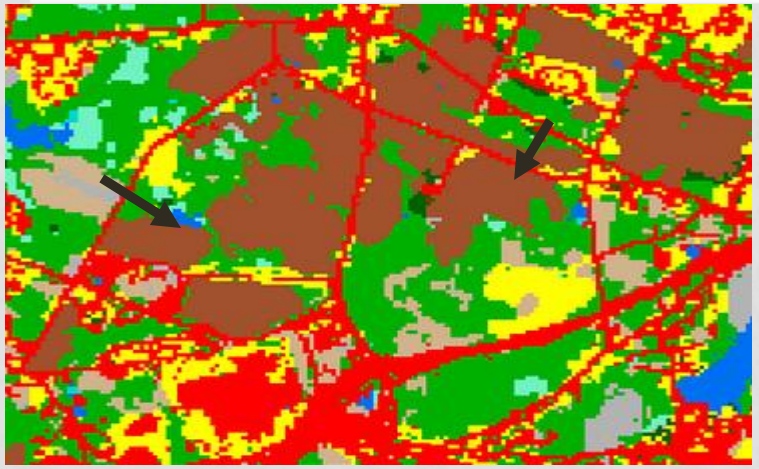
FROM \ TO	Developed	Turf & Grass	Other Grass	Ag. Field	Deciduous Forest	Coniferous Forest	Water	Non-forested Wetland	Forested Wetland	Tidal Wetland	Barren	Utility (forest)
Developed		86.2	48.2	34.0	236.4	189.2	-33.8	110.5	148.3	209.5	-33.1	172.6
Turf &Grass	-86.2		-38.1	-52.2	150.2	103.0	-120.0	24.3	62.1	123.3	-119.4	86.4
Other Grass	-48.2	38.1		-14.2	188.3	141.1	-81.9	62.4	100.1	161.4	-81.3	124.5
Ag. Field	-34.0	52.2	14.2		202.4	155.2	-67.8	76.5	114.3	175.5	-67.1	138.6
Deciduous Forest	-236.4	-150.2	-188.3	-202.4		-47.2	-270.2	-125.9	-88.1	-26.9	-269.5	-63.8
Coniferous Forest	-189.2	-103.0	-141.1	-155.2	47.2		-223.0	-78.7	-40.9	20.3	-222.3	-16.6
Water	33.8	120.0	81.9	67.8	270.2	223.0		144.3	182.1	243.3	0.7	206.4
Non-forested Wetland	-110.5	-24.3	-62.4	-76.5	125.9	78.7	-144.3		37.7	99.0	-143.7	62.1
Forested Wetland	-148.3	-62.1	-100.1	-114.3	88.1	40.9	-182.1	-37.7		61.2	-181.4	24.3
Tidal Wetland	-209.5	-123.3	-161.4	-175.5	26.9	-20.3	-243.3	-99.0	-61.2		-242.6	-36.9
Barren	33.1	119.4	81.3	67.1	269.5	222.3	-0.7	143.7	181.4	242.6		205.7
Utility (forest)	-172.6	-86.4	-124.5	-138.6	63.8	16.6	-206.4	-62.1	-24.3	36.9	-205.7	

More developed, lose sequestration

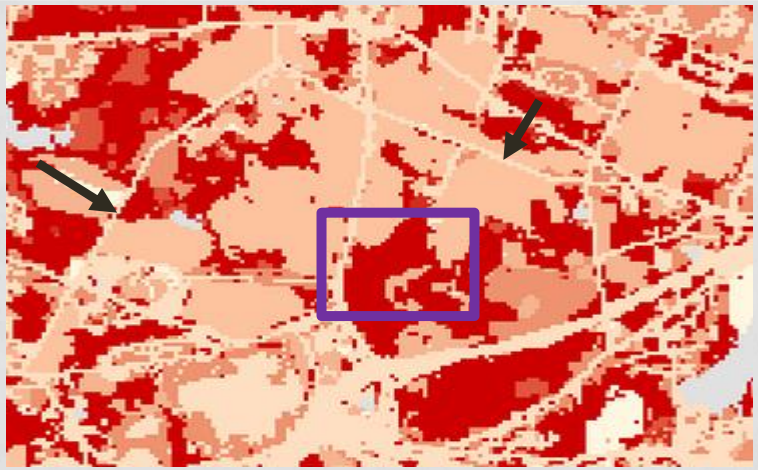
Gain forest, gain sequestration (light green)

Sample Carbon Mapping: Manchester/ South Windsor line Buckland Mall and Evergreen Walk area

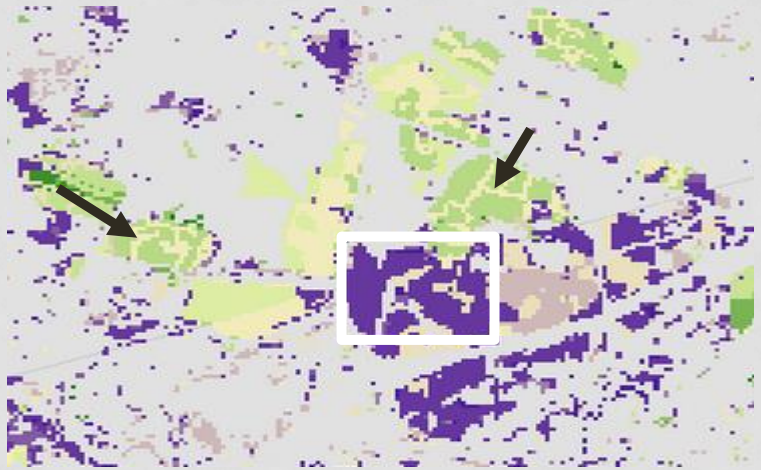
1985 Land Cover



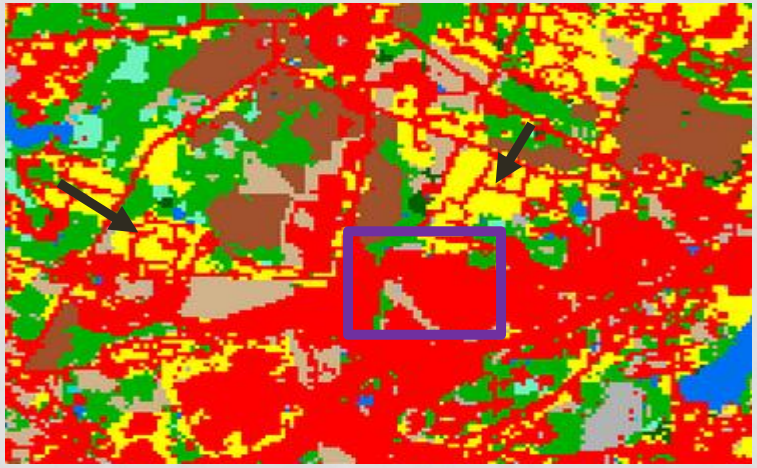
1985 Carbon Stock



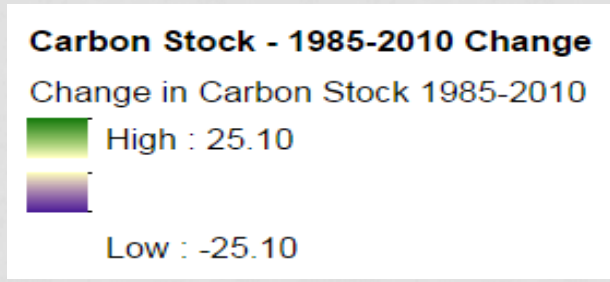
1985-2010 Change in Carbon Stock



2010 Land Cover



2010 Carbon Stock



CONNECTICUT LEADS IN:

- **Forested area:** Though one of the most densely populated states, ~59% is forested
- **Longevity of land use mapping data** (1985-2010)
- **Leading academic institutions**
- **Private forest land-holding** (73%; 54% owned by families in parcels of 10 acres or more)
- **Conservation and legacy values of forest landowners**
- **Awareness of "legacy tools," e.g., conservation easements**
- **Demographic data on forest landholders**

CONNECTICUT LAGS IN:

- Positioning of forests as essential mitigation tools in key policy documents
- Policies and programs dis-incentivizing land use change
- Adequate Funding for DEEP Division of Forestry
- High average age of forest landholders
- Low percentage of younger residents in state

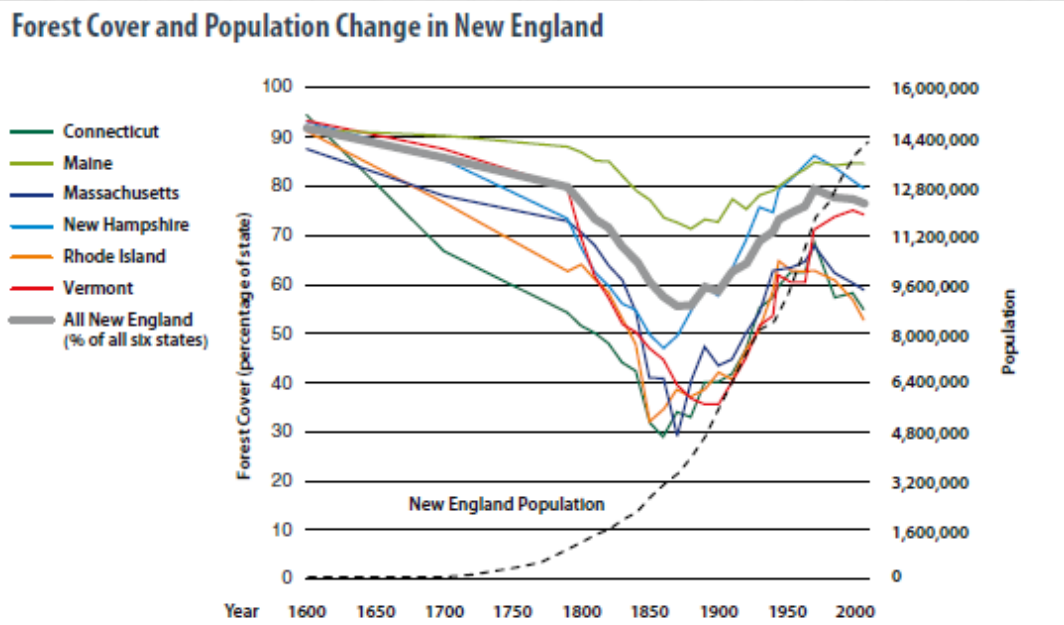


FIGURE 1: *Long-term trends in forest cover and human population in the six New England states shows that even as the population grew, forest cover increased between 1850 and the early 2000s. In recent years, forest cover has again declined due to conversion of forests to developed land.*

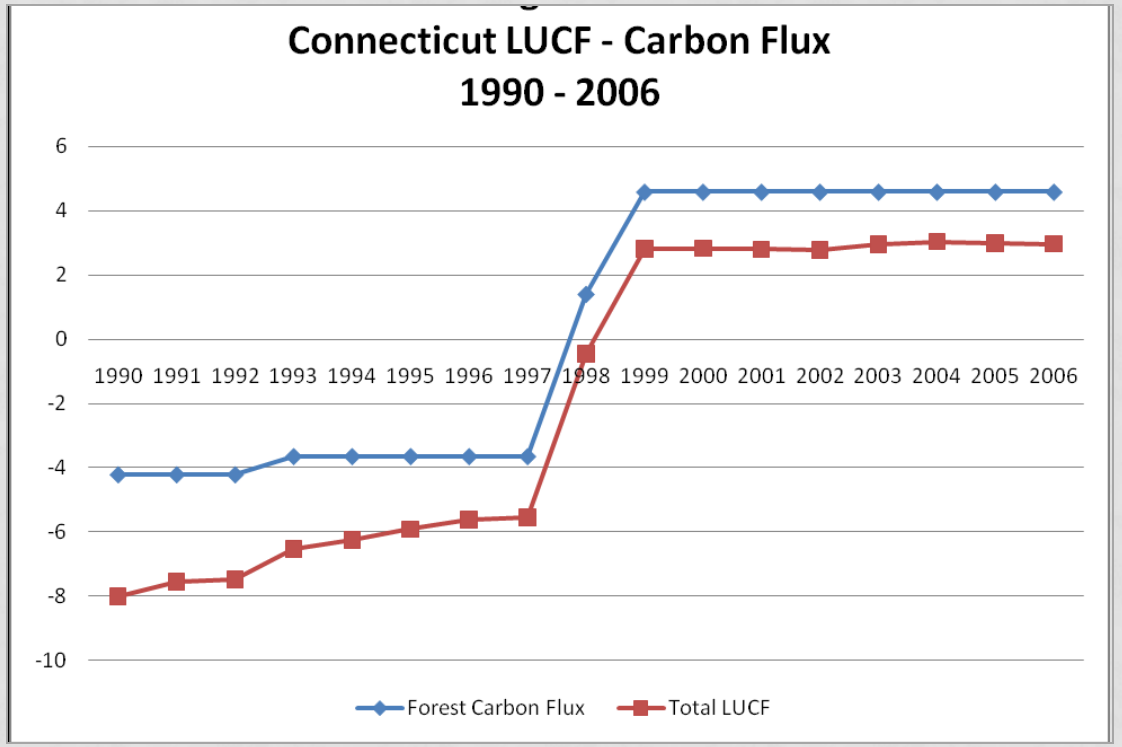
Source: Metropatterns CT, 2003

UNIQUE OPPORTUNITY TO CATCH UP

- Current situation is a once in lifetime chance to permanently capture forest conversion due to demographics
- Meaningful C sequestration impact relative to GHG goal:
  - 2.6MMT/yr average (recent yr vs total graph): 9.25 MMT 2050 target
- Meaningful risk of increased GHG emissions from conversion relative to 2050 target
- Because C quantified thru bottom-up methodology, chance to use knowledge to incorporate into long-term GHG profile
- Recommendations and strategies applicable to other High-C lands of value (agricultural lands and wetlands)

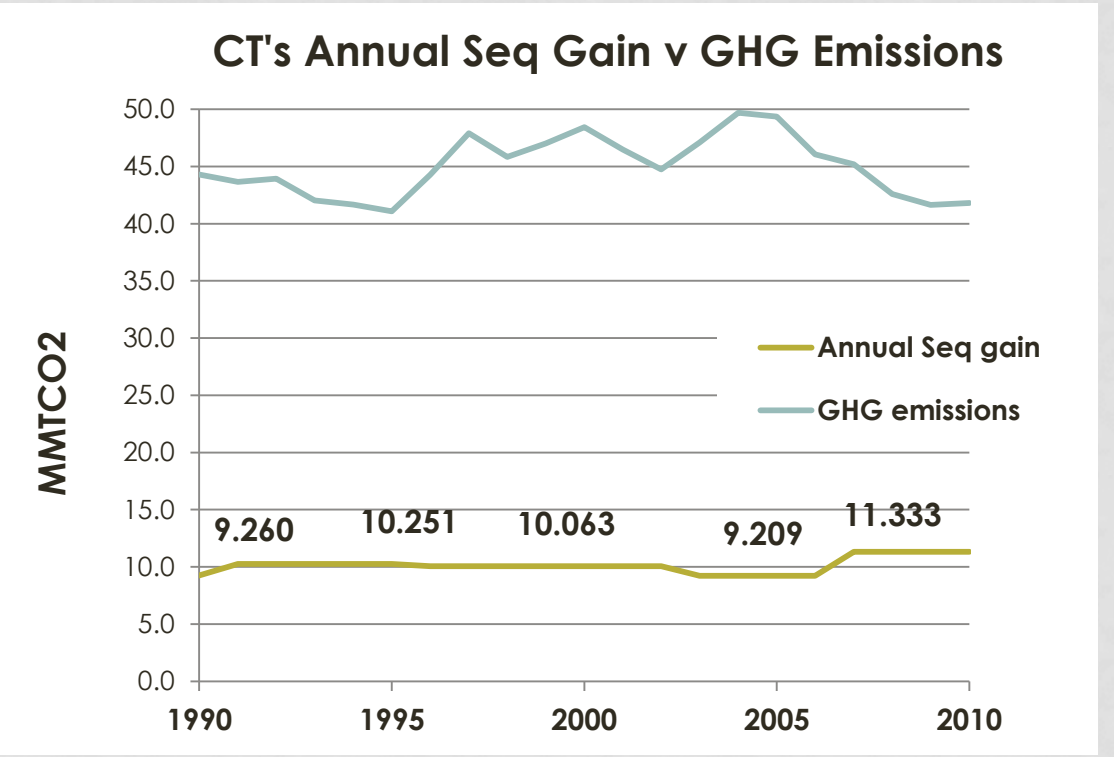
NEED FOR ACCURATE LAND USE ACCOUNTING

EPA State Inventory C Accounting



CT Climate Change Progress Report, 2009

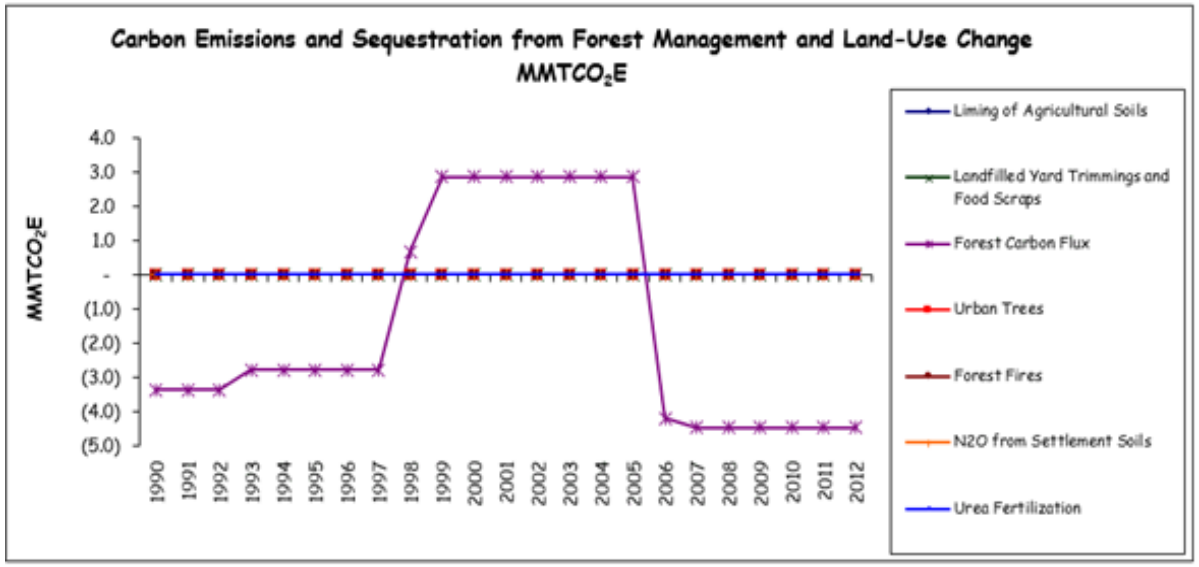
Tomasso InVEST C Accounting



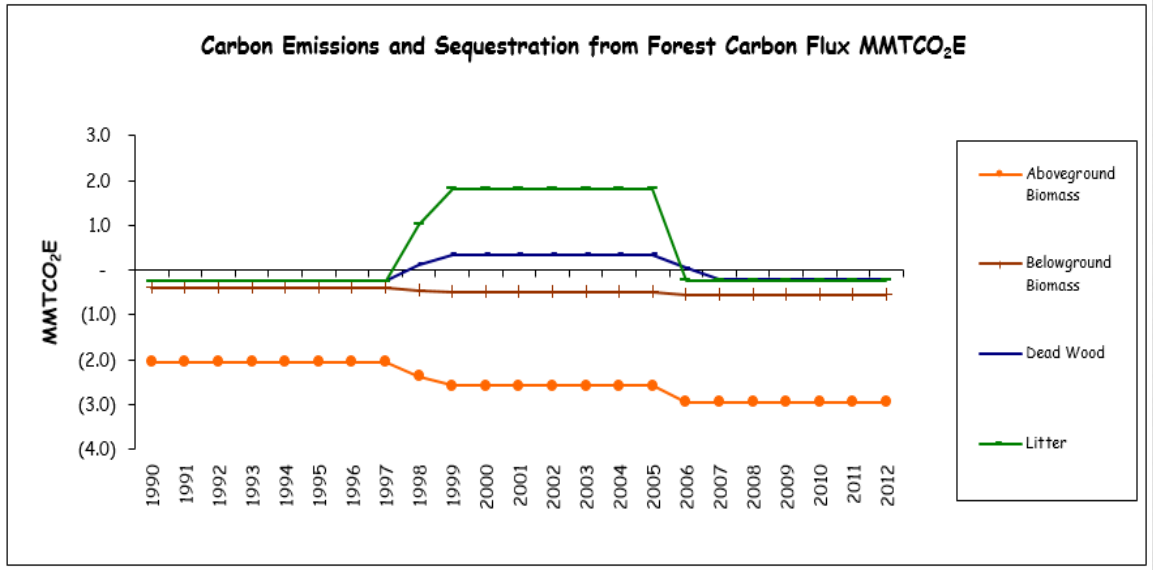
Tomasso modeling of CLEAR data, 2015

EXISTING TOP-DOWN METHODOLOGIES FOR LUCF ACCOUNTING

SIT Module Results, June 2015

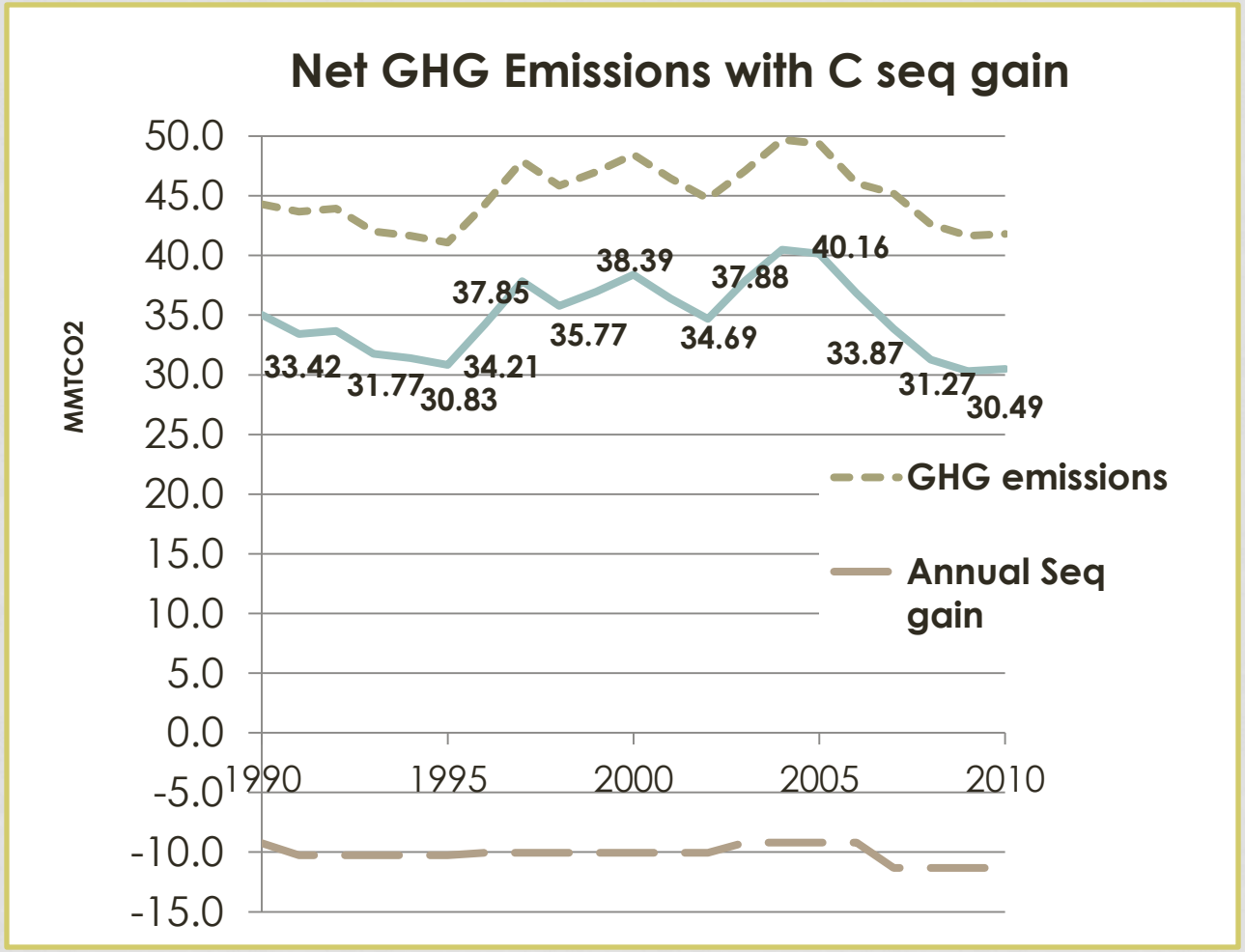


SIT Module Results, C Differentiated



Helen Silver modeling, June 26, 2015.

IMPACT OF C FOREST ACCOUNTING ON GHG TOTALS



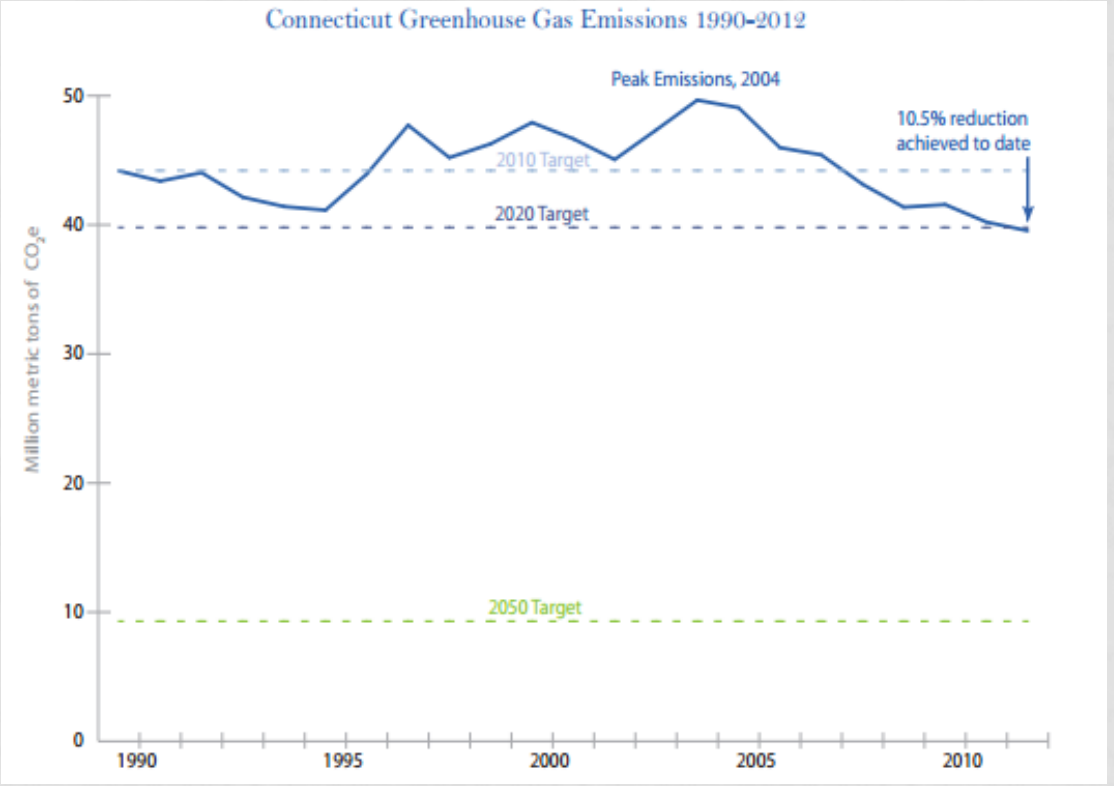
Tomasso modeling of CLEAR data, 2015

FOREST CONSERVATION IS A COST-EFFECTIVE MITIGATION ALTERNATIVE

Estimated costs of implementation per ton of CO2 reduced

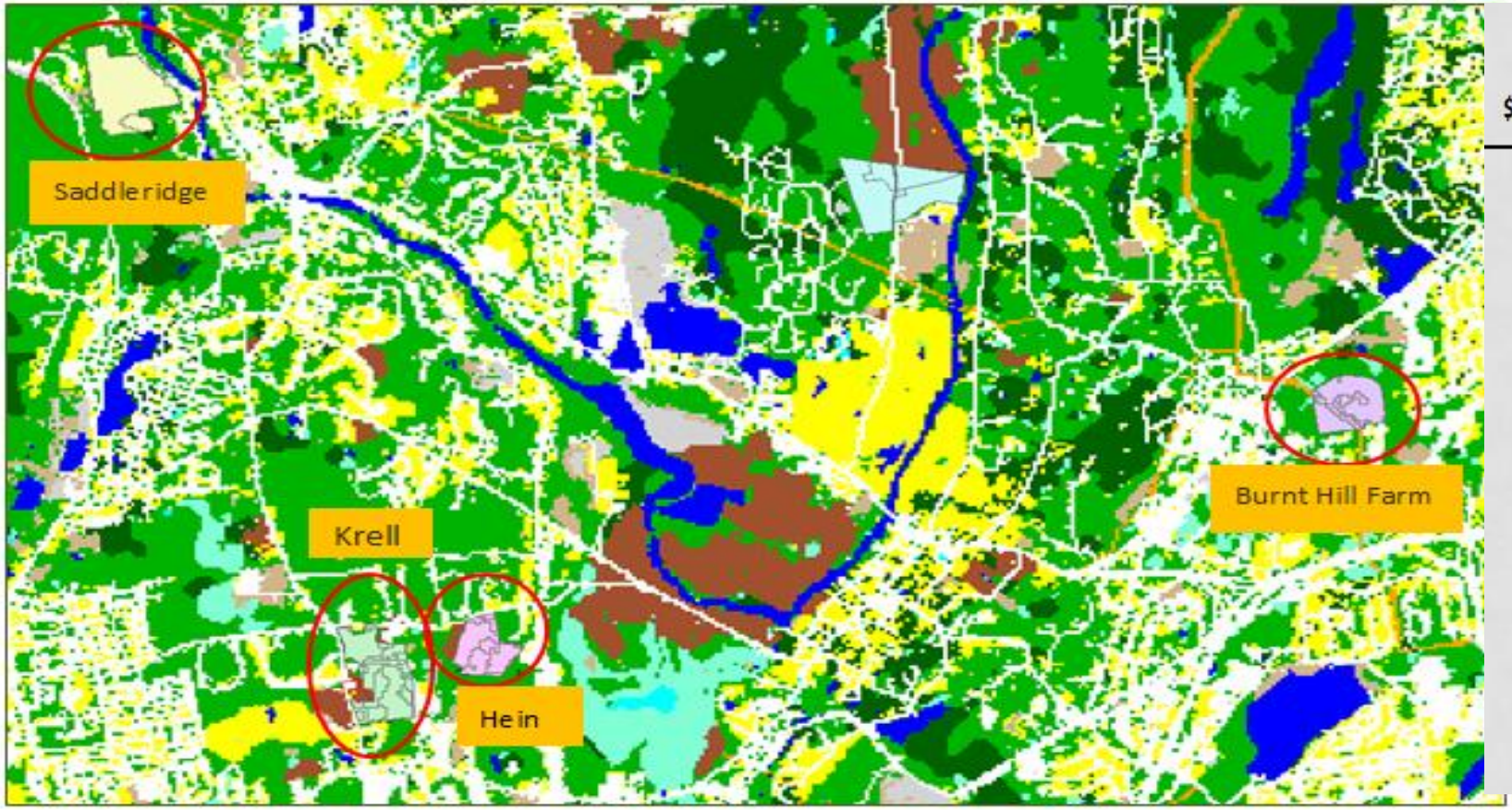
Transit modification strategies (Reason Foundation)	$ 4,257/tCO$_2$
(Moore, Staley & Poole)	$ 833/tCO$_2$
(Victoria Policy Institute)	$ 1,000/tCO$_2$
Bus rapid transit systems	
Los Angeles	$ 117/tCO$_2$
Vancouver (Millard-Ball)	$ 3,238/tCO$_2$
Major road improvements	$ 3,995/tCO$_2$
(Reason Foundation)	$ 52/tCO$_2$
Concentrated solar in select sun-rich locations	
(CT State DEEP)	$ 27/tCO$_2$
Current nuclear competitive with coal/NG (MIT)	$ 4/tCO$_2$
RGGI auction 23 clearing price	$47-137/tCO$_2$
Forest preservation	

Tomasso Harvard thesis, 2014.



CT Climate Change Progress Report, 2014

RESEARCH APPLIED TO PRESERVED PARCELS IN FARMINGTON, CT



$/MgC	$/MTonsC	$/MTCO2	$/MMTCO2
244.90	244.90	66.84	66,840,652
182.24	182.24	49.74	49,737,286
501.13	501.13	136.77	136,772,110
379.79	379.79	103.65	103,654,695
326.56	326.56	89.13	89,125,898
233.33	233.33	63.68	63,682,880
240.84	240.84	65.73	65,732,428
172.45	172.45	47.07	47,066,579

Map Source: Esri 10.1 ArcGIS; Data Source: Farmington, CT Office of Town Planning

AT ANY LEVEL, FOREST C SEQUESTRATION COULD BE CLOSING THE GAP BTW 2020 & 2050 GHG REDUCTION TARGETS

Table 1: Connecticut Gross Annual Emissions of Select Years and GHG Reduction Targets

	1990	2001	2007	2010	2020	2050
Total Emissions (MMT CO_2)	43.75	46.25	45.06	41.38		
2010 Target (Attain 1990 Level)				✓		
2020 Target (10% Below 1990 Level)					39.38	
2050 Target (80% Below 2001 Level)						9.25

Source: DEEP analysis using EPA's SIT.

BACKGROUND TO CT PRIVATE FOREST OWNERSHIP

Parcel Size (acres)	Owners	% of all 10+ acre Owners	Acres	% of land in 10+ acre class	% of CT Forest	Average parcel size	# Survey Respondents
10-24	9,700	58%	140,500	24%	8%	14 acres	53
25-99	6,000	36%	267,800	47%	15%	45 acres	101
100+	1,000	6%	167,100	29%	10%	162 acres	63

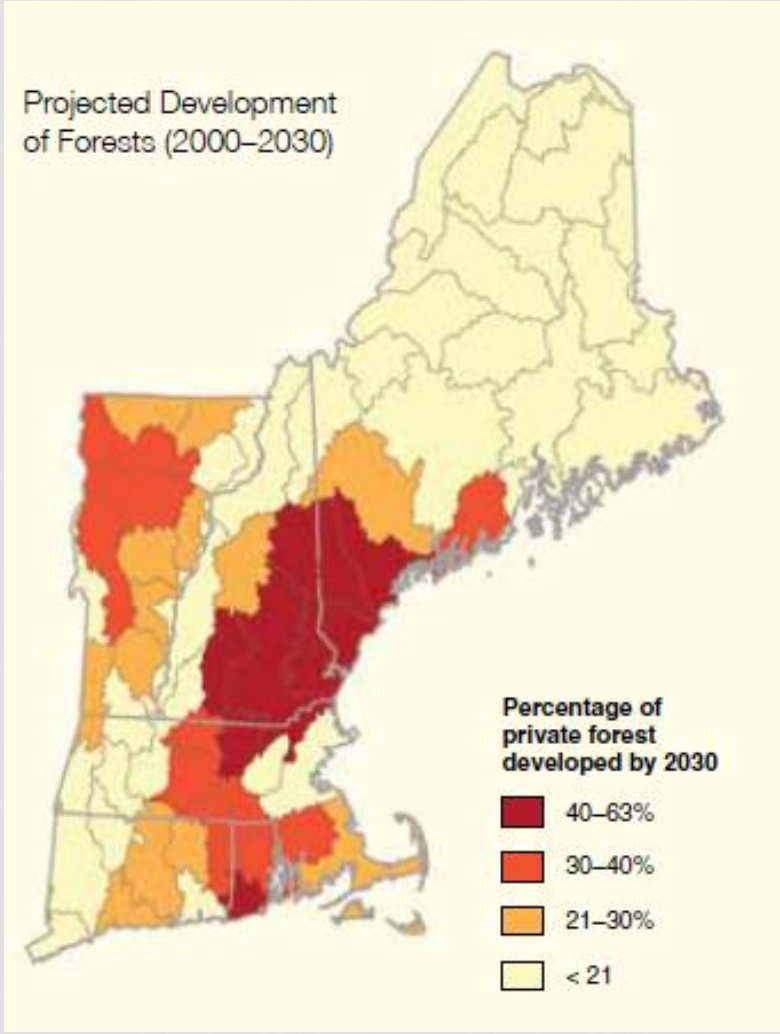
Table 8. Connecticut 10+ acre family woodland owners by size class.

- 85% of Connecticut Forest Owners are above the age of 50
- 40% are retired
- Aging is a major concern for property maintenance and transfer

OPPORTUNITY COSTS ASSOCIATED WITH CONSERVATION ARE HIGH

Connecticut's forests are at risk of imminent conversion

- 1/3 of landowners would sell if offered a "reasonable price" (300,000 acres)
- 17% say that land transfer is likely **within the next five years** (200,000 acres)
- CT property **taxes** are **6th highest** in nation
- **High property taxes** are the most often cited concern for landowners (80%)



Illustration, Harvard Forest.

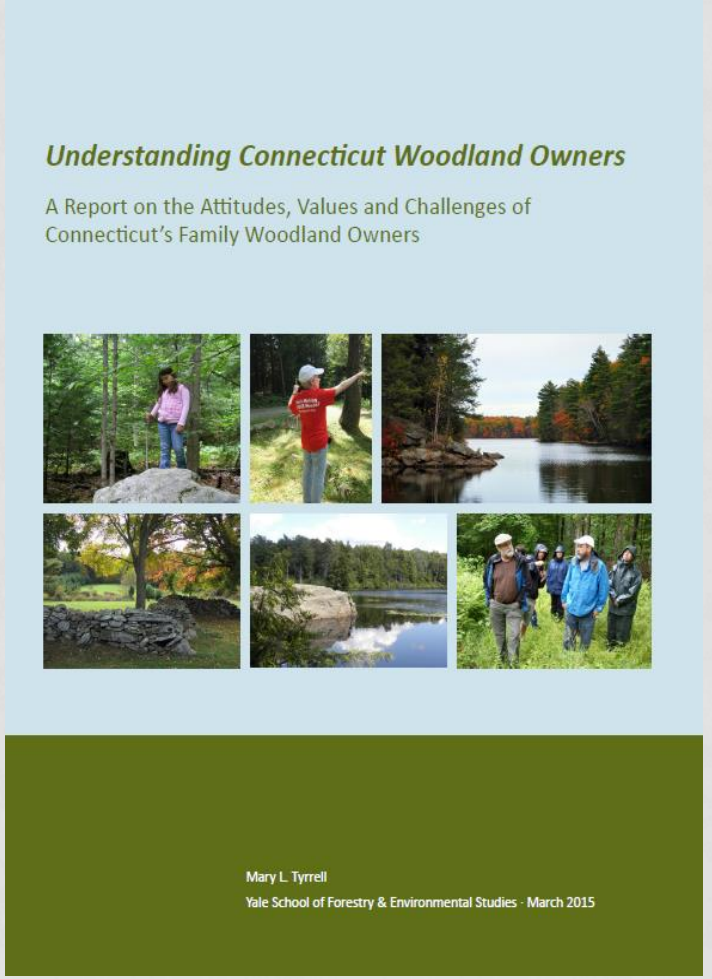
OPPORTUNITIES ASSOCIATED WITH CONSERVATION ARE ALSO HIGH

Connecticut's Forests: Ownership Facts

- Private ownership accounts for 73% of total forested land
- Family/individual owned forestland is 34% of total (600,000 acres) (10/+ acre parcels)
- 85% of forest owners > 50 age: Concern of future ownership and ability to care for land

Conservation awareness primed for protection

- 80% want their land to remain forested
- Owner awareness of easements is 46% v 15% nationally, but only 6% (v 3%) under easements
- Awareness of other protective mechanisms low



POLICIES THAT WOULD BE SUPPORTED BY CONNECTICUT FOREST OWNERS

More favorable tax policies	68%
Advice on caring for your property	52%
Advice on invasive plants	51%
Advice on insects and diseases	49%
Advice on woodland management	47%
Advice on how to transfer land to the next generation	42%
Advice on wildlife management	42%
Cost sharing for woodland management	33%
Payments for ecosystem services	32%
Stronger timber markets	19%
Advice on selling or giving away development rights	19%

Source: Yale Forest Report (2015)

10 RECOMMENDATIONS FOR FOREST C SEQUESTRATION

- ***Recommendation #1.*** *Adopt Overarching Land Use Priorities and Forest Sector Goals.*
- ***Recommendation #2****. Strengthen Tax Incentives & Cost Sharing Programs for Privately Owned Lands.*
- ***Recommendation #3****. Manage and Acquire State Forestlands (including easements) for Mitigation and Adaptation Purposes.*
- ***Recommendation #4****. Increase Educational & Technical Assistance for Privately Owned and Municipal Forestlands.*
- ***Recommendation #5****. Guarantee annual funding for on-going land mapping by UCONN's Center for Land Use Education and Research (CLEAR).*

10 RECOMMENDATIONS CONT'D

- ***Recommendation #6***. *Include GHG Impacts and Land Conversion Status in State Environmental Review.*
- ***Recommendation #7***. *Align Connecticut's Transportation Planning with Climate Change and Smart Growth Goals.*
- ***Recommendation #8***. *Increase Land Use Planning at the Regional & Municipal Levels.*
- ***Recommendation #9.*** *Facilitate Additional Revenue Streams for Privately Owned Lands.*
- ***Recommendation #10***. *Increase Stringency of Eligible Biomass Standards under the Renewable Portfolio Standard (RPS).*

RECOMMENDATIONS FOR FOREST CONSERVATION OVERVIEW & RESEARCH METHODOLOGY

Ten Overarching Recommendations

- Overlapping and mutually reinforcing
- Target various sectors
- Roughly weighted according to impact, feasibility, and urgency
- Consideration of budgetary constraints/legislative approval

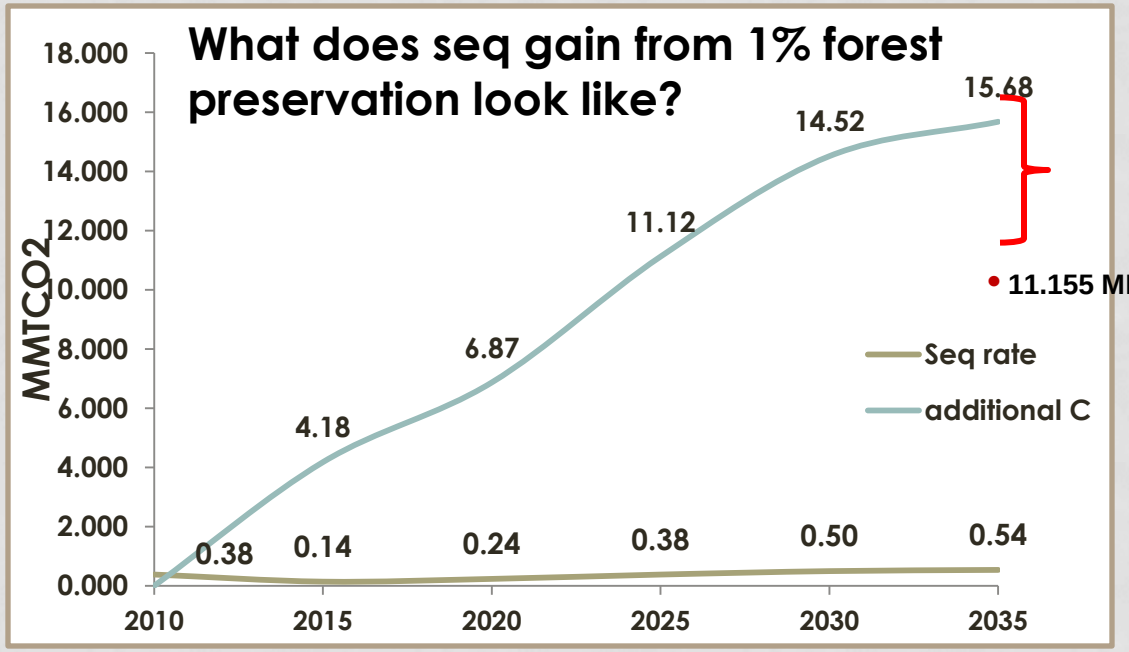
Research Prioritized State Policies Based on:

- Leadership in Climate Change Policies
- Results of GHG Inventory Research
- RGGI membership
- Forest/Natural Resource Conservation Ethic

States of Focus: MA, VT, NY, CA, WA; Federal programs largely excluded

RECOMMENDATION #1:
ADOPT LAND USE PRIORITIES AND FOREST SECTOR GOALS

- **Recommendation 1A: Legislative Revision of 21% Conservation Goal to a no-net loss or net forest gain**



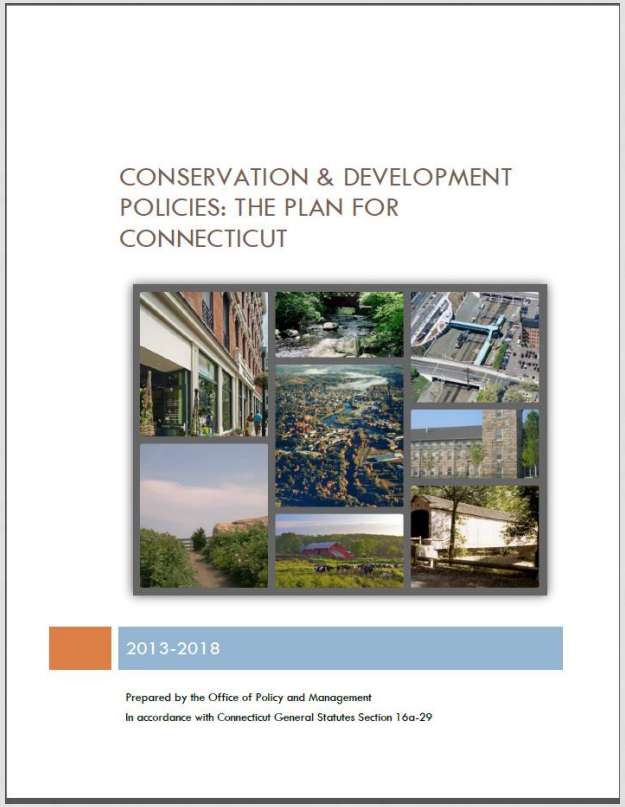
- If the remaining 175,111 acres of CT's total open space mandate were devoted to forest, **8%** of preserved forests would yield an added **36.2 MMTCO2** over 25 yrs.

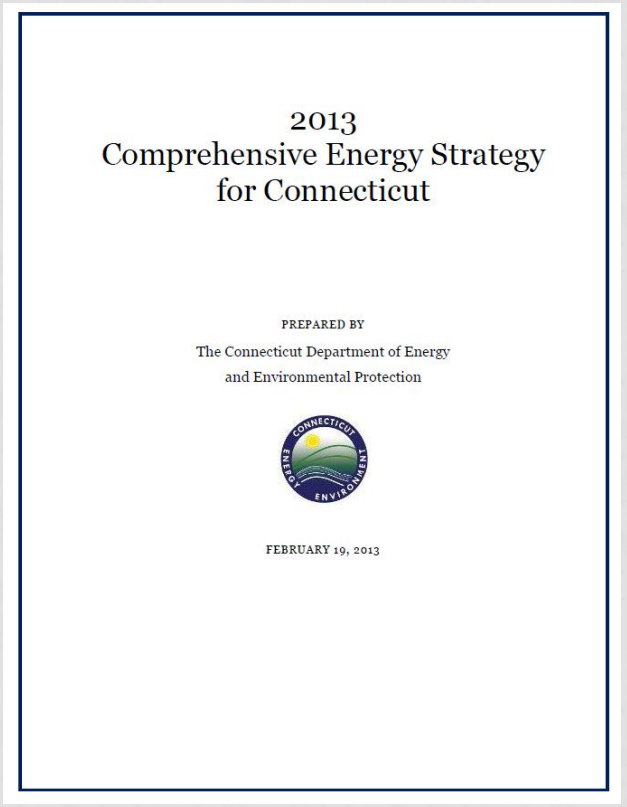
RECOMMENDATION #1:
ADOPT LAND USE PRIORITIES AND FOREST SECTOR GOALS

- **Recommendation 1B: Amend State Conservation and Development Plan and other key documents to include:**
  - Quantified targets (e.g., net sequestration and conservation goals)
  - Targets should address private, municipal, and state-owned lands
  - Use existing authority to set internal agency policies (e.g, state-owned lands)
  - Seek Legislative Action where necessary

RECOMMENDATION #1 (CONT'D)

- Current Plan C&D mentions Carbon 1x and Forests 0x
- C&D Plan needs:
  - Explicit recognition of forests as C sinks and mitigation tools
  - Strengthened Growth Management Principles (particularly GMP #4 & 5)
- Amendment would require legislative approval





RECOMMENDATION #2:
STRENGTHEN TAX INCENTIVES & COST SHARING PROGRAMS FOR PRIVATELY OWNED LANDS

- **Recommendation 2A: Lower eligibility acreage of PA490 from 25 to 9 acres**
  - High likelihood of efficacy
  - 68% support more favorable tax policies
  - Would capture at least 140,000 acres or ~ 8-10% more of privately owned forestland
  - Leverages conservation and legacy ethic
  - Reduces risks of otherwise imminent sale due to opportunity costs/aging
  - Creative ways to counteract budgetary constraints

RECOMMENDATION #2 (CONT'D)
COMPARISON OF OTHER STATE POLICIES

- **Massachusetts:**
  - Over ¼ of total land area legally protected
  - Current Use Laws: capture 10≥ acres
- **Vermont:**
  - 1/3 of total land area enrolled in Current Use Programs
  - No maximum tax credit value
  - Innovative response to budgetary cap: Increased early withdrawal penalties
- **Washington State:**
  - No minimum acreage for Open Space Tax Credit
  - Minimum acreage for timberland = 5 acres

RECOMMENDATION #2 (CONT'D)

- **Recommendation 2B: Establish a Permanent Tax Deduction for Donations**
- **Used in Several Other States**
- **Massachusetts Conservation Incentives Act:**
  - Heralded as a landmark success for conservation
  - Provides 50% tax credit for permanent donations of easements and fee interests ($75,000 maximum)
  - Funded up to $2 million per year

Connecticut Forest & Park Association

Middlesex Land Trust
Conservation in the heart of Connecticut

Audubon Connecticut

RECOMMENDATION #2 (CONT'D): COST-SHARING & GRANT PROGRAMS

- **Recommendation 2B: Increase Cost-Sharing & Grant Programs**
- Wide variety of options available
- To increase area of protected forests, cement programs for Land Acquisition by non-profits, municipalities for conservation
- To increase existing C sequestration capacity, provide financial assistance to:
  - Develop & implement sustainable management plans
  - Ease burden of most costly property maintenance expenses

RECOMMENDATION # 3:
ACQUIRE AND MANAGE STATE LAND FOR CARBON SEQUESTRATION PURPOSES

Incorporate C sequestration into land acquisition and management criteria

Land Acquisition:

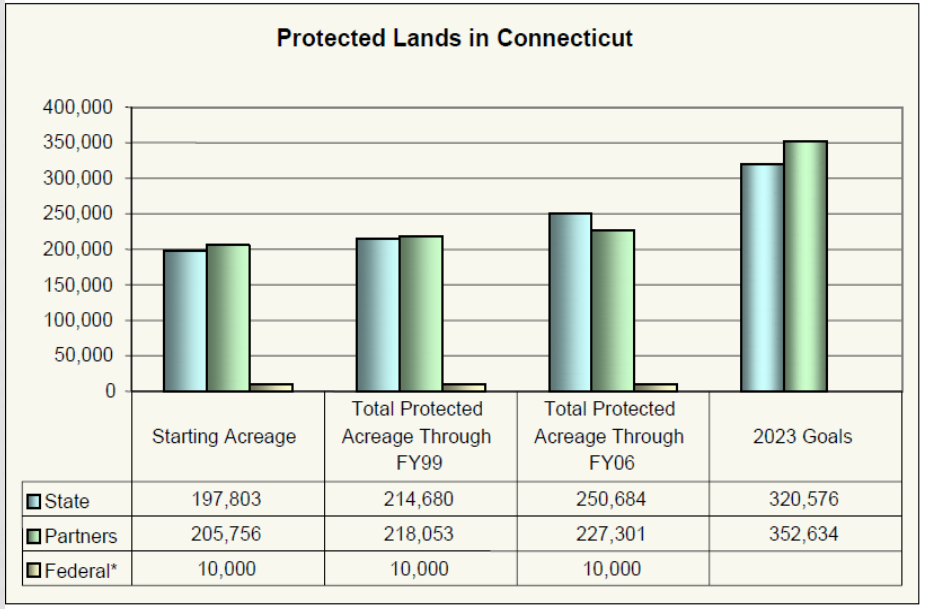
- Through Recreational and Natural Heritage Program, Open Space Program, and The Green Plan
- Expand current focus on traditional public use value to C capture services
- Legislative reform likely necessary

Forest Management:

- Timber harvesting plans should consider enhanced C sequestration as a criteria
- Consider Expansion of Forest Reserves (areas w/out harvesting)

The Green Plan: Guiding Land Acquisition and Protection in CT: 2007-2012

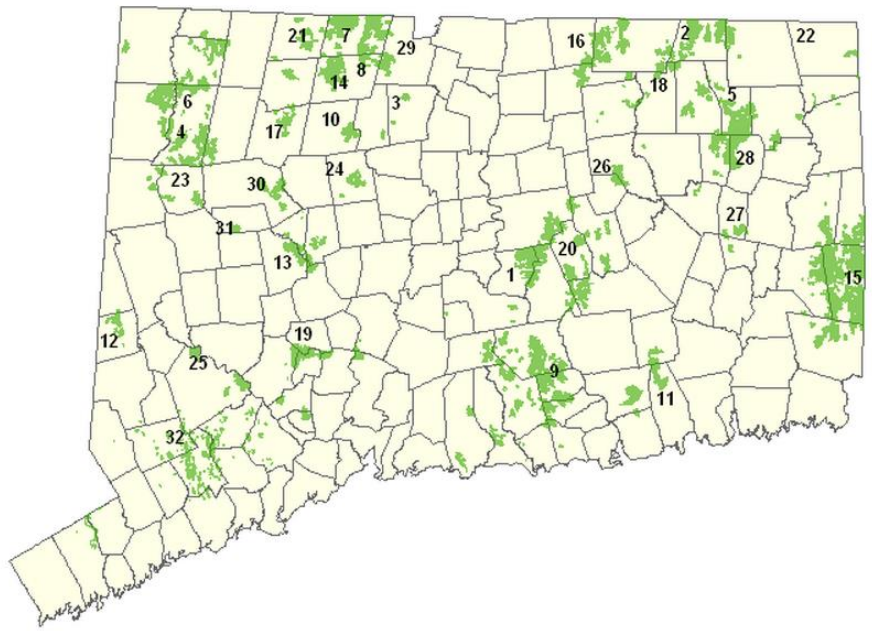
Carbon mentioned 1x in body of report, 2x overall



	Starting Acreage	Total Protected Acreage Through FY99	Total Protected Acreage Through FY06	2023 Goals
State	197,803	214,680	250,684	320,576
Partners	205,756	218,053	227,301	352,634
Federal*	10,000	10,000	10,000	

RECOMMENDATION #3 (CONT'D)

- **Recommendation 3B: Ensure that all State-owned lands have sustainable forest management plans *and* adequate implementation**
  - Significant, but surmountable management deficits
  - As of 2010, only 23 of 32 State Forests managed by a DOF Forester
  - About ½ of all state owned forest land is unmanaged due to personnel deficits
  - **Budgetary assistance from legislature**



Sustainable management of Connecticut's State Forests is essential for ecosystem services, recreational opportunities, and provide timber revenues

RECOMMENDATION #4:
INCREASE EDUCATIONAL & TECHNICAL ASSISTANCE FOR LANDOWNERS

- **Recommendation 4a: Redesign DEEP website to contain user-friendly repository of resources**

College of Agriculture and Natural Resources
Center for Land Use Education and Research
CLEAR

- **Recommendation 4b: Partner with academic and nonprofit institutions to provide learning opportunities and increase awareness of resources**
  - Eg., written materials, webinars, presentations, open-source website
  - Only 2 state foresters devoted to private landowners
  - Evidence suggests that opportunity would be welcomed by both landowners and institutions

Yale School of Forestry & Environmental Studies

THE CONNECTICUT Audubon SOCIETY

RECOMMENDATION #4
RESPONDING TO LANDOWNERS' CONCERNS

Landowners voicing requests for forestry "stewardship" assistance:

What are my options for management and transfer?

More favorable tax policies	68%
Advice on caring for your property	52%
Advice on invasive plants	51%
Advice on insects and diseases	49%
Advice on woodland management	47%
Advice on how to transfer land to the next generation	42%
Advice on wildlife management	42%
Cost sharing for woodland management	33%
Payments for ecosystem services	32%
Stronger timber markets	19%
Advice on selling or giving away development rights	19%

RECOMMENDATION #4
LANDOWNER AWARENESS OF AVAILABLE ASSISTANCE

- Significant gains can be made in Landowner Assistance programs
- Only ~60% are aware of significant tax deductions available through PA490
- ~20% or below are aware of other state and federal programs

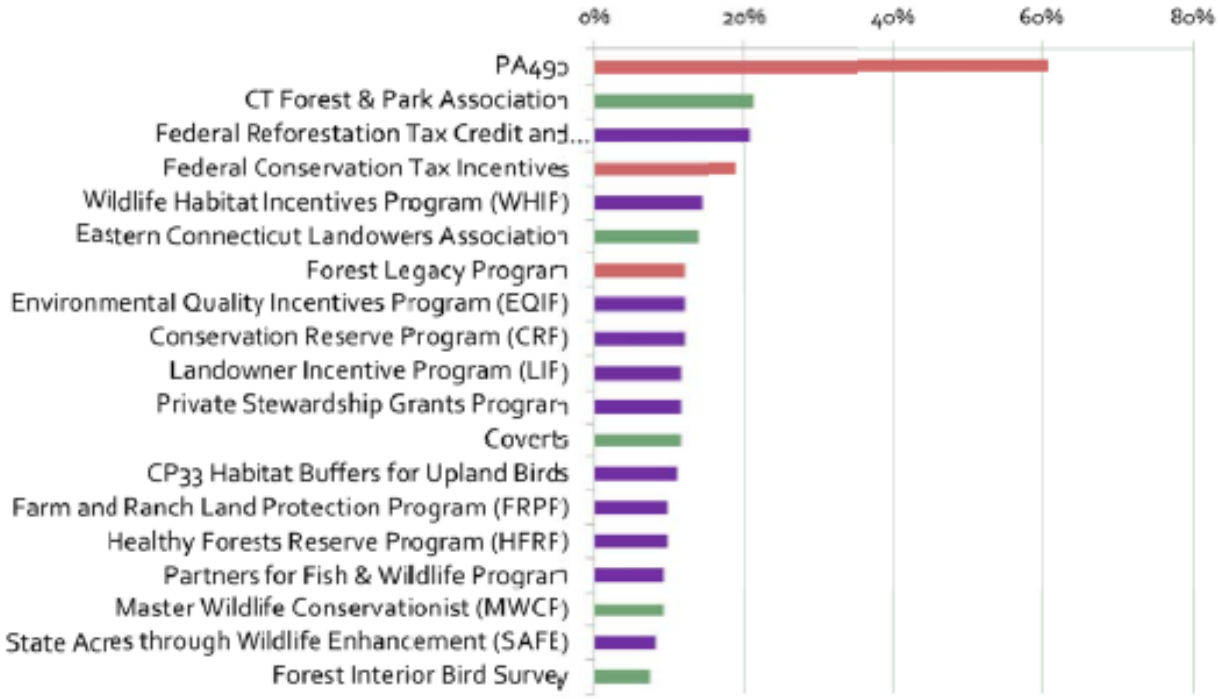


Figure 5. Landowner assistance programs, support organizations, and volunteer programs for Connecticut woodland owners. Percent of woodland owners who have heard of each program. Red are financial programs that effectively reduce taxes; green are organizations or programs that increase landowner involvement; purple are government financial assistance programs for land management.

RECOMMENDATION #5:

PROVIDE **CLEAR** WITH CONSISTENT FUNDING FOR LUCF DATA GATHERING AND ANALYSIS

College of Agriculture and Natural Resources
Center for Land Use Education and Research

CLEAR

- CLEAR generates longest-running data set on land use change in US
- Yale forest analysis utilized CLEAR data
- NOAA partners with CLEAR, currently on Blue Carbon
- Without funding (190K/yr), Connecticut will lose a consistent baseline data set on land cover

CONCLUSION

- Without improved policies, deforestation is likely *and* imminent
- Seizing this opportunity is imperative: *Predicted deforestation would serious compromise CT's ability to meet the 2050 GHG target*
- Compared to other mitigation alternatives, forest conservation is cost effective

CONCLUSION (CONT'D)

- Policies could expanded to protect other carbon intensive lands
  - Between 1985 and 2010, Connecticut lost 22% of its good agricultural soils to other uses
- Conservation of forests and other lands is essential to protecting other values for Connecticut's citizens

SUPPLEMENTARY MATERIALS

10 overarching recommendations

Table 1 From August 2015 Memorandum:

with Specific Action Items, Comments, and Examples of Other State Programs

10 RECOMMENDATIONS FOR FOREST C SEQUESTRATION

- ***Recommendation #1. Adopt Overarching Land Use Priorities and Forest Sector Goals***: Connecticut should establish an overarching goals for its forest sector, such as a no-net-loss goal, as well as near-, mid-, and long-term sequestration goals (e.g., percentage capture of parcels most ripe for land conversion due to owner demographics, parcel size and location). While Connecticut's Conservation & Development Plan (C&D Plan) provides a robust foundation for land preservation, the State must explicitly prioritize forest conservation for carbon sequestration in the C&D Plan and other key documents.

- ***Recommendation #2. Strengthen Tax Incentives & Cost Sharing Programs for Privately Owned Lands:*** One of the primary causes of deforested land conversion is that opportunity costs associated with conservation are high, and land sale for development is ultimately more profitable. Thus, making conservation more financially attractive by increasing available tax deductions will counteract an underlying root cause of deforestation.

- ***Recommendation #3. Manage and Acquire State Forestlands (including easements) for Mitigation and Adaptation Purposes:*** Both forest management plans and state acquisition criteria should include a goal of enhancing carbon sequestration through forest acquisition. Moreover, Connecticut DEEP should seek additional funding to ensure that all state and town-owned forests are managed appropriately.

- ***Recommendation #4. Increase Educational & Technical Assistance for Privately Owned and Municipal Forestlands:*** Managing lands for C sequestration and other values is technically complex, and Connecticut can facilitate assistance to private and municipal forest owners through strategic partnerships and knowledge dissemination, beginning with DEEP website redesign to access "boots-on-the-ground" outreach and e-outreach.

- ***Recommendation #5. Guarantee annual funding for on-going land mapping by UCONN's Center for Land Use Education and Research (CLEAR),*** the fundamental data base on Connecticut's forestlands.

10 RECOMMENDATIONS (CONT'D)

- ***Recommendation #6. Include GHG Impacts and Land Conversion Status in State Environmental Review:*** Connecticut should revise either its statutes or regulation so that GHG emissions from both land conversion and bioenergy and effects on forest C sequestration potential are considered under the Connecticut Environmental Policy Act.

- ***Recommendation #7. Align Connecticut's Transportation Planning with Climate Change and Smart Growth goals:*** Reducing sub/urban sprawl through Connecticut DOT programs will reduce not only VMT but forest incursion by development as well as habitat fragmentation.

- ***Recommendation #8. Increase Land Use Planning at the Regional & Municipal Levels:*** Several opportunities exist to facilitate regional land use planning, co-housing opportunities and clustered development, including through the State Conservation & Development Plan, coordinating with the state's regional planning organizations, and providing financial incentives to municipalities.

- ***Recommendation #9. Facilitate Additional Revenue Streams for Privately Owned Lands:*** Increasing landowner income by expanding eligible C offset projects, recreational leases, and payments for ecosystem services will discourage property sales.

- ***Recommendation #10. Increase Stringency of Eligible Biomass Standards under the Renewable Portfolio Standard (RPS):*** To ensure that the RPS does not increase near-term GHG emissions, Connecticut should amend its definition of "sustainable biomass" to include more stringent sourcing requirements and, possibly, a GHG reduction requirement.

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
#1. Adopt Overarching Land Use Priorities and Forest Sector Goals		Though direct GHG emissions reduction attributable to these types of programs may be difficult to determine, they are essential for coordinating and prioritizing state action	
Strengthen existing Growth Management Principles to incorporate forest conservation and climate mitigation potential	Legislative revision and/or Revision to the 2013 State Conservation & Development Plan		
Adopt guiding principles to organize state and municipal policies	Either agency level (informal policies/regulation) or legislative action	Time and costs depends up on process	Massachusetts Sustainable Development Principles (http://www.mass.gov/envir/smart_growth_toolkit/pdf/patrick-principles.pdf)
Establish a goal of C negative (net C sequestration) for the land use sector	Either agency level (informal policies/regulation) or legislative action		
Amend the current conservation goal of 21% forest by: - Increasing percentage - Including a no net loss goal	Legislative action		Recommendations by MA Secretary of Energy and Environmental Affairs (http://www.mass.gov/eea/docs/eea/energy/cca/eea-climate-adaptation-report.pdf) Recommendations by California Air Resources Board for Forest Planning and Actions

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
- Establishing a C sequestration goal with quantified near-, mid-, and long-term targets			(http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm (overview))
Fully engage the private sector in both policy development and implementation			The New York Climate Action Council has adopted such a vision as a primary guide in policy development (Full report available here: http://www.dec.ny.gov/energy/80930.html; *see Overview and Chapter 9)*
Fully engage the Transportation and Land Use Sector at all governmental levels with a vision that Connecticut will live in smart growth communities by 2050			The New York Climate Action Council has adopted such a vision as a primary guide in policy development (Full report available here: http://www.dec.ny.gov/energy/80930.html; *see Overview and Chapter 7)*
Consider the establishment of an interagency Forest Carbon Working Group to further develop and explore cross-sector climate mitigation strategies and available funding	Legislative or Executive action	High administrative costs, but benefits could be enormous through the identification of administrative, regulatory, and funding opportunities and streamlining	California Planned Forest Carbon Work Group (http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm (Overview))
Include in economic analysis of policies all environmental, social, and health benefits			
Consider an appropriate discount rate for net present value of future benefits			
#2. Strengthen Tax Incentives, Cost Sharing, and Grant			

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
Programs for Privately Owned Forests			
Tax Incentives[1]			
Lower the required acreage under PA 490 from 25 to 9 acres Defines tax on open space as current use vs highest/best use	Legislative action	Tax negative	Massachusetts Current Use Tax (http://www.mass.gov/eea/agencies/dcr/conservation/forestry-and-fire-control/ma-current-use-forest-tax-program.html) Washington State Current Use/Open Space Tax Law (http://dor.wa.gov/docs/pubs/prop_tax/openspace.pdf)
Revise PA490 to include existing C sequestration and increased sequestration	Legislative action	Tax negative	
Identify tax exempt purposes for other types of ecosystem services/environmental values		Tax negative	Vermont Dep't of Forest, Parks & Recreation climate policy recommendation (May 2015) (http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/The_Forest_Ecosystem/Library/Climate%20change%20report_final_v6-18-15a.pdf)
Establish "Keep forests as forests taxes" by providing tax deductions for most costly landowner expenses (e.g., roads, trails, fences, insurance, etc.)	Research Legislative action or amendment to implementing regulations	Time and cost depend upon procedure; much work has been done	
Provide a permanent tax deduction for the gift of either a fee interest or easement for conservation purposes	Legislative action	Tax negative	Massachusetts Conservation Land Tax Credit (http://www.mass.gov/eea/state-parks-beaches/land-use-and-management/land-conservation/massachusetts-conservation-tax-credit-program.html)
Increase tax incentives or provide cost-sharing programs for the adoption of sustainable forestry practices	Promulgate regulations pursuant to the	Tax negative C sequestration not currently included	Massachusetts Forest Stewardship & Green Certification Program (http://www.mass.gov/eea/agencies/dcr/conservation/forestry-and-fire-control/forest-stewardship-program.html)

[1] Several of the proposed tax incentives/deductions could be formulated under cost-sharing or grant programs. The main difference would be in the economic impact (e.g., direct expenditure by the state vs. loss of tax revenue)

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
	Forestry Practices Act		
Cost Sharing & Grants			
Provide financial assistance in the form of cost-share programs to nonprofits, municipalities, and individuals for acquiring conservation land	Funding requirement	Tax negative or direct expense	Massachusetts Conservation Partnership Grant http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/dcs/grant-programs/conservation-partnership-grant.html) Washington State (various Habitat Conservation and Restoration Grants; http://www.rco.wa.gov/grants/habitat_grants.shtml)
#3. Manage & Acquire State Forest Lands (including easements) for Climate Mitigation purposes			
Expand Forest Legacy Program pursuant to comprehensive state-wide plan accounting for climate change values	Work with USFS, potentially budgetary approvals, plan design		
Ensure that lands have management plans & appropriate personnel	Seek budget assistance		
Harvesting: Consider enhancing C sequestration as a requirement in CT forest harvesting plans	Amend state forest management plans	May result in an increase in harvesting costs or reduction in timber revenues Amendment of plans may require stakeholder engagement	

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
Consider establishment and expansion of Forest Reserves where no harvesting can occur	Amend state forest management plans	Low cost as management is generally for natural baseline But may result in a decrease in timber revenues Amendment of plans may require stakeholder engagement	Massachusetts Forest Reserve Program expansion enjoys broad public support (http://www.mass.gov/eea/state-parks-beaches/sustainable-forest-management/forestry-reserves/what-are-forest-reserves.html)
Consider C sequestration & stored C in land acquisition programs, focusing on large unfragmented blocks	Likely regulatory/policy reform	Low cost if no legislative amendments	Massachusetts' Clean Energy and Climate Action Plan for 2020 adopted this as a specific recommendation (http://www.mass.gov/eea/docs/eea/energy/2020-clean-energy-plan.pdf)
Amend Open Space Plan and other programs to specifically include climate change mitigation (C sequestration in acquisition criteria)	Legislative action		Connecticut plan currently under revision (draft makes no meaningful mention of C sequestration or climate change) (http://www.ct.gov/deep/cwp/view.asp?a=2706&q=511558&deepNav_GID=1641)
#4. Increase Educational & Technical Assistance for Privately Owned and Municipal Forest Lands			
Redesign DEEP website to contain user-friendly repository of landowner financial assistance resources (nonprofit, federal, and municipal)	Website redesign	Low cost	Nonprofit and university websites provide the best models (UMass Amherst: http://masswoods.net/landowner-programs; Landscope (Washington): http://www.landscope.org/washington/programs/wa_programs/)
Partner with institutions (CLEAR, academic & nonprofit)		Website would contain scientific	

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
to provide peer-to-peer learning opportunities via webinars, land trust presentations, and an open-source website		and technical information and contacts regarding sustainable harvesting techniques, environmental management plans, etc.	
Increase technical assistance and educational programs for municipalities and landowners	Funding requirement		Massachusetts Forest Stewardship Program (http://www.mass.gov/eea/agencies/dcr/conservation/forestry-and-fire-control/forest-stewardship-program.html)
Consider the establishment of Conservation Districts within Connecticut's Regional Planning Organizations	Potential funding requirement	Potentially high initial costs for establishment	Washington State Conservation Commission (http://scc.wa.gov/)
#5. Guarantee annual funding for on-going land mapping by Center for Land Use Education and Research (CLEAR).	Annual line-item funding of $190K	Essential to maintain this fundamental longitudinal data base on CT's forestlands and changing land use	Center for Land Use Education and Research (http://clear.uconn.edu/) Symbiotic state-state partner for disseminating technical and financial assistance to land owners and non-profits.
#6. Include GHG Impacts and Land Conversion in State Environmental Review			
Prioritize GHG and climate impacts in CEPA review	Adoption of regulations or policy by CEQ to incorporate quantification and consideration of	Alternatives analysis and mitigation measures should include smart growth principles	Massachusetts Environmental Policy Act (http://www.mass.gov/eea/agencies/mepa/greenhouse-gas-emissions-policy-and-protocol-generic.html) Washington State Environmental Policy Act (http://www.ecy.wa.gov/programs/sea/sepa/climatechange/index.ht

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
	GHG impacts from projects, including emissions from land conversion	Land conversion mitigation could include purchase of conservation land	m; http://www.ecy.wa.gov/climatechange/docs/sepa/20110603_SEPA_GHGinternalguidance.pdf) California Environmental Quality Act (http://resources.ca.gov/ceqa/docs/Adopted_and_Transmitted_Text_of_SB97_CEQA_Guidelines_Amendments.pdf)
#7. Align Connecticut's Transportation Planning with Climate Change and Smart Growth goals:		Reducing sub/urban sprawl through Connecticut DOT programs will reduce not only VMT but forest incursion by development as well as habitat fragmentation.	
Incorporate sustainability into DOT's programs, including a self-certification program			New York GreenLITES program (https://www.dot.ny.gov/programs/greenlites)
Enter into an interagency agreement between DEEP and DOT to coordinate review of transportation decisions to avoid habitat fragmentation & conversion	Facility with GIS map overlays of development, transportation, ecological state priorities		Massachusetts DOT & DEP agreement (agreement not publicly available; MA SWAP June 2015 draft (Chap. 2, p. 17): http://www.mass.gov/eea/docs/dfg/dfw/habitat/ma-swap-public-draft-26june2015-chapter2.pdf) Maine's Sustainability Solutions Initiative: http://www.unh.edu/nressphd/docs/HartDavidUNHseminar5.pdf
Add climate change tools to existing CT Rides Website			Create a toolkit that contains a personalized GHG calculator where commuters can track GHG reductions, in addition to $/mileage saved

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
#8. Increase Land Use Planning at the Regional & Municipal Levels	Several opportunities exist to facilitate regional land use planning, co-housing opportunities and clustered development, including through the State Conservation & Development Plan, coordinating with the state's regional planning organizations, and providing financial incentives to municipalities.	In general, land use planning and smart growth policies can be more expensive than direct conservation efforts (Tomasso, 2014), but long-term impacts from reduced vehicle miles traveled can be substantial.	
Activate/Revive the Interagency Transit-Oriented Development Panel			Established in 2012, by Governor Malloy it does not appear that this panel is active.
Amend CT General Statutes Title 8, Ch. 126, §§ 8-23 & 8-35a. to require mandatory smart growth plans	Legislative revision	Political opposition from municipalities and private landowners	Washington State Growth Management Act (Rev'd WA Code, Title 36, Ch. 36.70A: http://apps.leg.wa.gov/rcw/default.aspx?cite=36.70A) Massachusetts Proposed Land Use Partnership Act (http://www.mass.gov/hed/economic/eohed/pro/zoning-reform/land-use-partnership-act.html)
Increase Coordination with Connecticut's 9 Regional Planning Organizations			

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
Develop an educational tool for municipalities regarding smart growth including model bylaws and case studies	Stakeholder engagement with municipalities and nonprofits to develop model bylaws; other research to develop educational materials including case studies	Much would be low cost, with the exception of developing model bylaws	Massachusetts Green DOT: Smart Growth/Smart Energy Toolkit http://www.mass.gov/envir/smart_growth_toolkit/; http://www.mass.gov/envir/smart_growth_toolkit/pages/SG-bylaws.html)
Encourage the adoption of market-based mechanisms such as transfer of development rights on a regional and local basis	Several ways to accomplish (e.g., increased funding, enactment of a Growth Management Act, technical assistance, and state spending)	Allows development of policies based on local needs; market-based mechanism	King County, Washington (http://www.kingcounty.gov/environment/stewardship/sustainable-building/transfer-development-rights.aspx) Falmouth, Massachusetts (http://www.mass.gov/envir/smart_growth_toolkit/pages/CS-tdr-falmouth.html) Other case studies (http://www.njfuture.org/wp-content/uploads/2011/07/Case-Studies-in-Transfer-of-Development-Rights-8-10-Intern-report.pdf)
Encourage adoption of a Green DOT program with focus on developing long-term transportation and land use planning	Announce as an initiative DOT or joint initiative with DEEP	Depends on amenability of DOT, but long-term action and impacts	Massachusetts Green DOT Policy Directive (http://www.massdot.state.ma.us/portals/0/docs/P-10-002.pdf) Massachusetts Green DOT Implementation Plan (https://www.massdot.state.ma.us/GreenDOT/GreenDOTReport/GreenDOTImplementationPlan.aspx)
Provide direct financial incentives to municipalities for the adoption of smart growth policies	Funding requirement	Direct expense	Massachusetts Smart Growth Zoning Overlay District Act (http://www.mass.gov/hed/community/planning/chapter-40-r.html)

Recommendations	*Action Item*	*Pros/Cons & Comments*	*Other State Programs*
#9. Facilitate Additional Revenue Streams for Privately Landowners			
Expand projects eligible for offsets to include projects for improved forest management and avoided conversion	Adopt RGGI Offset Forest Protocol (U.S. Forest Projects) Amend RGGI implementing regulations to include additional offset projects	Tax positive	RGGI Offset Protocol: U.S. Forest Projects (http://www.rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Forest_Protocol_FINAL.pdf); *See* especially Sec 3.1.2.3: Avoided Conversion Programs California Compliance Offset Protocol: US Forest Projects (http://www.arb.ca.gov/regact/2014/capandtrade14/ctusforestprojectsprotocol.pdf)
Aggregate current forested lands to reach threshold eligibility criteria for GHG offset projects	Requires coordinating office for offset application	Tax Positive	RGGI Offset Protocol: U.S. Forest Projects (http://www.rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Forest_Protocol_FINAL.pdf)
Encourage private landowners to participate in other offset markets (e.g., other RGGI states, California)		Tax Positive	California is actively purchasing offset projects in other states (Ex. http://bangordailynews.com/2013/11/24/news/down-east/washington-county-land-trust-gets-1-million-in-california-C-offset-funds/)
Develop private and public programs for ecosystem service payments including C sequestration	Funding requirement; potential legislative action	Tax Positive	Vermont Dep't of Forest, Parks & Recreation Climate policy recommendation (May 2015) (http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/The_Forest_Ecosystem/Library/Climate%20change%20report_final_v6-18-15a.pdf)
Explore the facilitation of leases on private land for hunting and other sport	Review legal requirements for liability insurance; explore legislative exemptions	Tax positive	California SHARE (Shared Habitat Alliance for Recreational Enhancement; https://www.wildlife.ca.gov/hunting/share)
#10. Increase Stringency of RPS Biomass Requirements			

Recommendations	***Action Item***	***Pros/Cons & Comments***	***Other State Programs***
Incorporate Sourcing and GHG reduction standards	Legislative action	Politically sensitive issue; large potential for opposition at local and national level:	Massachusetts is the national leader (http://www.mass.gov/eea/docs/doer/renewables/biomass/225-cmr-14-00-final-reg-doer-081712-clean-copy.pdf) Massachusetts regulations contain a lifecycle GHG reduction requirement, sourcing requirements, and prohibitions on land conversion, but adoption may face significant political opposition. Rhode Island provides a protective model, but no GHG reduction requirement: http://www.ripuc.org/utilityinfo/res.html Adopting similar policies may be more politically feasible in Connecticut. New York contains *the least* restrictive standards that should be adopted (NY Biomass Power Guide, available at http://www.ripuc.org/utilityinfo/res.html)

REFERENCES

- Holchholzer, H. Connecticut Forest Planner, (2010). *Connecticut's Forest Resource Assessment and Strategy*. Retrieved from website: http://www.ct.gov/deep/lib/deep/forestry/assessment_and_strategy/assessment__strategy.pdf

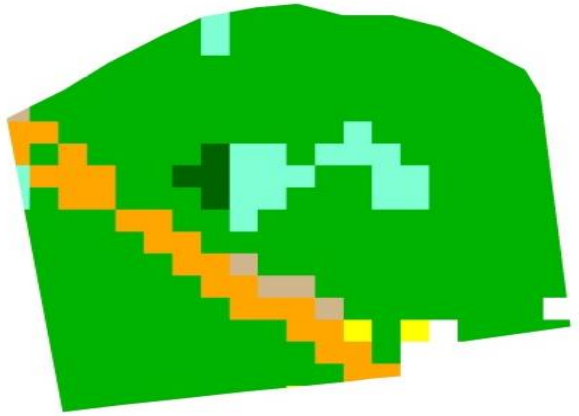
- Tomasso, L. P. (2014). The Impact of Land Use Change for Greenhouse Gas Inventories and State-Level Mediation Policy: A GIS Methodology Applied to Connecticut. *Journal of Environmental Protection*, *5*, 1572-1587. doi: 10.4236/jep.2014.517149; http://www.scirp.org/journal/PaperInformation.aspx?PaperID=52176

- Tyrell, M. (2015). *Understanding Connecticut Woodland Owners*. Retrieved from Yale School of Forestry & Environmental Studies website: http://environment.yale.edu/gisf/files/CT%20Woodland%20Owners%20Report%20March%202015-2.pdf

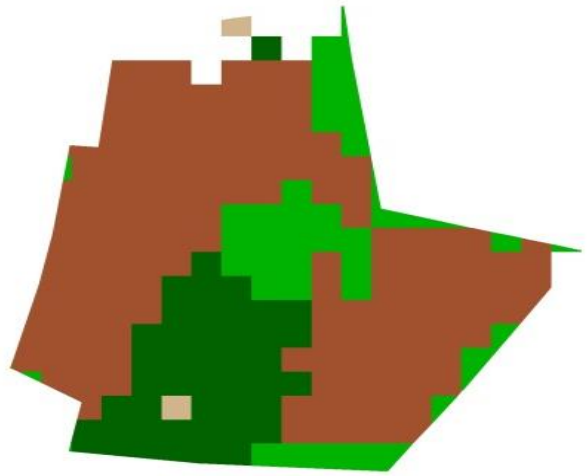
- UCONN CLEAR. http://clear.uconn.edu/ (source of various data points)

ARCGIS LAND COVER MAPS OF OPEN SPACE PARCELS

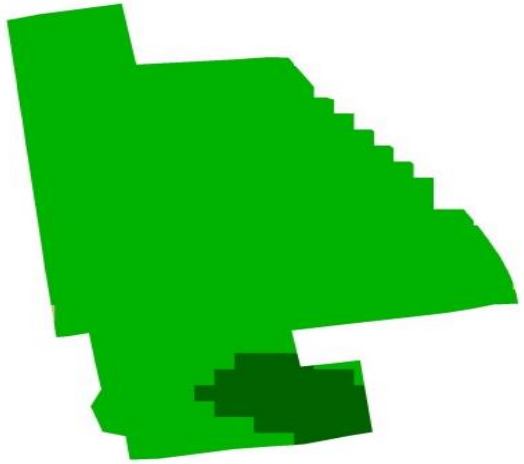
Burnt Hill Farm



Hein Farm



Krell Farm



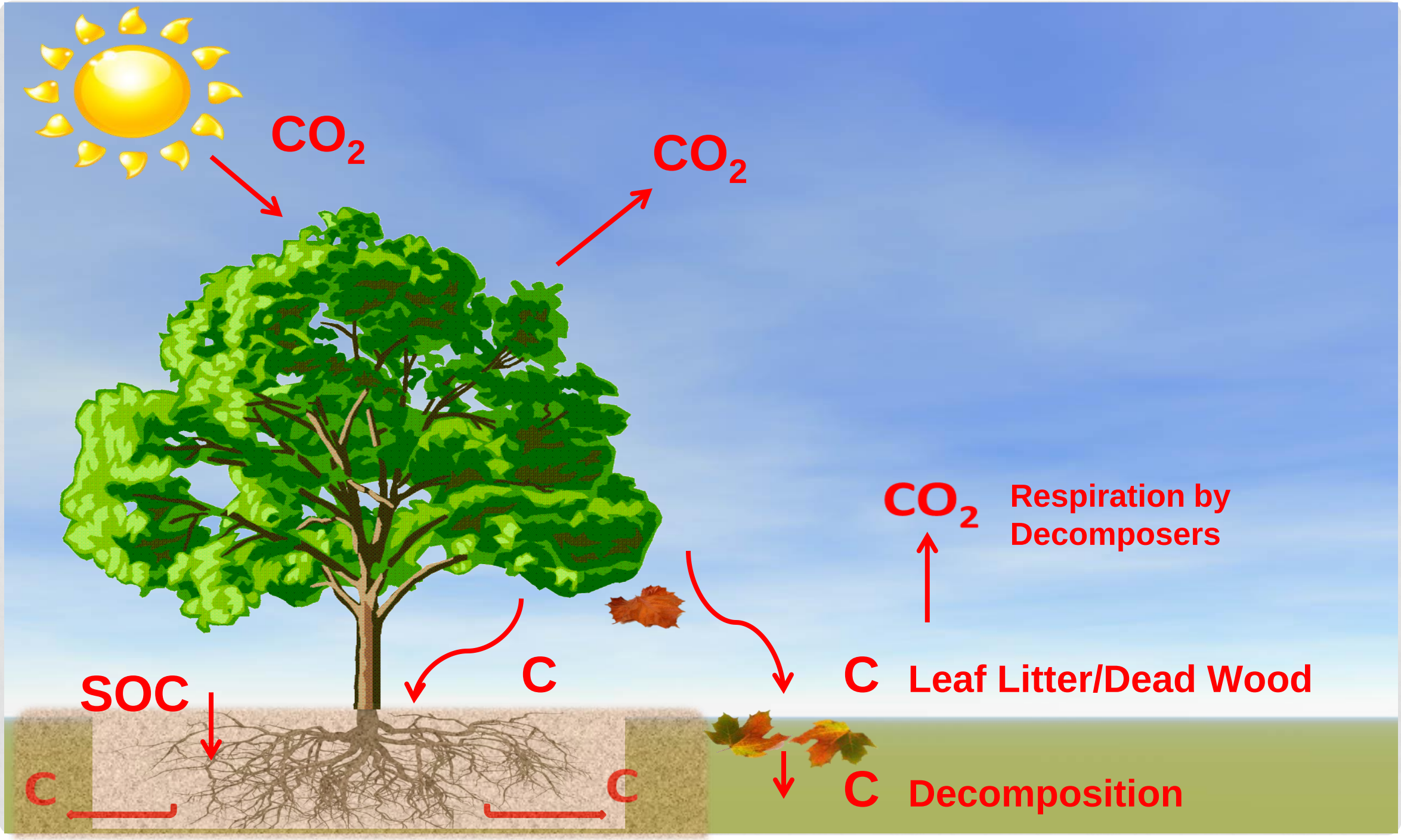
Saddleridge Farm

RESULTS: PRICE DIFFERENTIALS IN $/TCO$_2$ ARE A FUNCTION OF C DENSITIES

Farm		acres	ha	Total MgC	MgC/ha sequestered	MgC>MgCO2 sequestered	MgCO2 > MtCO2	$/acre	$/ha	$/MgC	$/MTonsC	$/MTCO2	$/MMTCO2
Burnt Hill													
	1985	64.9	26.264	6,625.02	252.25	924.23	924.23	25,000.00	61,776.35	244.90	244.90	66.84	66,840,652
	2010	64.9	26.264	8,903.19	338.99	1,242.05	1,242.05	25,000.00	61,776.35	182.24	182.24	49.74	49,737,286
Hein													
	1985	53.5	21.651	2,668.99	123.27	451.67	451.67	25,000.00	61,776.35	501.13	501.13	136.77	136,772,110
	2010	53.5	21.651	3,521.73	162.66	595.98	595.98	25,000.00	61,776.35	379.79	379.79	103.65	103,654,695
Krell													
	1985	90	36.422	6,890.12	189.17	693.14	693.14	25,000.00	61,776.35	326.56	326.56	89.13	89,125,898
	2010	90	36.422	9,642.90	264.75	970.06	970.06	25,000.00	61,776.35	233.33	233.33	63.68	63,682,880
Saddleridge													
	1985	103.5	41.885	10,743.50	256.50	939.82	939.82	25,000.00	61,776.35	240.84	240.84	65.73	65,732,428
	2010	103.5	41.885	15,004.19	358.22	1,312.53	1,312.53	25,000.00	61,776.35	172.45	172.45	47.07	47,066,579

1 acre = 0.404685642 ha

1 ha = 2.471054 acre


CO_2
CO_2
CO_2
Respiration by Decomposers
C
Leaf Litter/Dead Wood
C
Decomposition
C
SOC
C
C