

Vermont Forest Carbon Sequestration Working Group

Final Report

January 4, 2020

Working Group Membership

Commissioner Michael Snyder, Chair – Commissioner, VT Department of Forest, Parks, and Recreation

Representative John L. Bartholomew – Windsor-1

Jack Byrne – Director of Sustainability Integration, Middlebury College, *House appointee*

Cecilia Danks, PhD – Associate Professor & Gund Fellow, Environmental Program & Forestry, Rubenstein School of Environment & Natural Resources, University of Vermont, *House appointee*

Senator Ruth Hardy – Addison District

Representative Mark Higley – Orleans-Lamoille

Senator Corey Parent – Franklin District

Jim Shallow – Director of Strategic Conservation Initiatives, The Nature Conservancy-Vermont Chapter, *Senate appointee*

Robert Turner – Independent forestry consultant, *Senate appointee*

Stephen Webster – Private forest landowner, *Governor appointee*

Executive Summary

This report of the Vermont Forest Carbon Sequestration Working Group (Working Group) makes seven policy recommendations following a four-month investigation into the viability of enrolling Vermont forests into carbon offset markets. The report offers an explanation of the forest carbon sequestration and storage process to provide a scientific context for the discussion of forest carbon markets and projects. The report offers an overview of the current status of carbon offset markets and feasibility analyses for Vermont and New England projects, and examples of programs in other states. The report then provides an economic and environmental rationale for forest carbon offset projects in Vermont. The report also addresses avenues for marketing carbon offset credits in Vermont and how projects on state and municipal lands could be beneficial in a number of ways.

Further, there is an in-depth analysis of factors to consider for entering forestland in Vermont into carbon markets, including program rules and protocols and interactions with Vermont's Use Value Appraisal (UVA)/Current Use program. The report ends with an analysis of the potential for a statewide program and an example of potential estimated revenue from carbon offset projects. The Working Group found merit in continuing the work and analysis that would move Vermont closer to realizing the potential benefits of entering Vermont forestland into carbon offset markets. Overall, keeping forests as forests and promoting forestry practices that best sequester and store carbon are crucial to Vermont's efforts to mitigate climate change and protect important state natural resources.

Introduction

In 2019, the Vermont General Assembly passed Act 83 that established the Vermont Forest Carbon Sequestration Working Group *to study how to create a statewide program to facilitate the enrollment of Vermont forestlands in carbon sequestration markets*. The Working Group met six times from September through December 2019 to study the areas outlined in Act 83; the full text of Section 9 of Act 83 can be found in Appendix A. This report details the findings and recommendations of the Study Committee, which were approved unanimously at its final meeting on December 18, 2019. Additional information about Working Group deliberations and testimony can be found on the General Assembly website, [Working Group webpage](#).

The Vermont General Assembly, through this Working Group, is interested in evaluating the opportunities for public and private landowners to create forest carbon sequestration offset projects with their forestland and enroll such projects in carbon offset markets, including ways in which the State could play a role in facilitating landowner participation. Ideally, landowners, including private landowners and state or local governments, would receive financial payments for a newly quantified forest product (carbon), while the State could support policies that maintain or increase the levels of carbon sequestration and storage in Vermont forests, thus promoting climate stabilization.

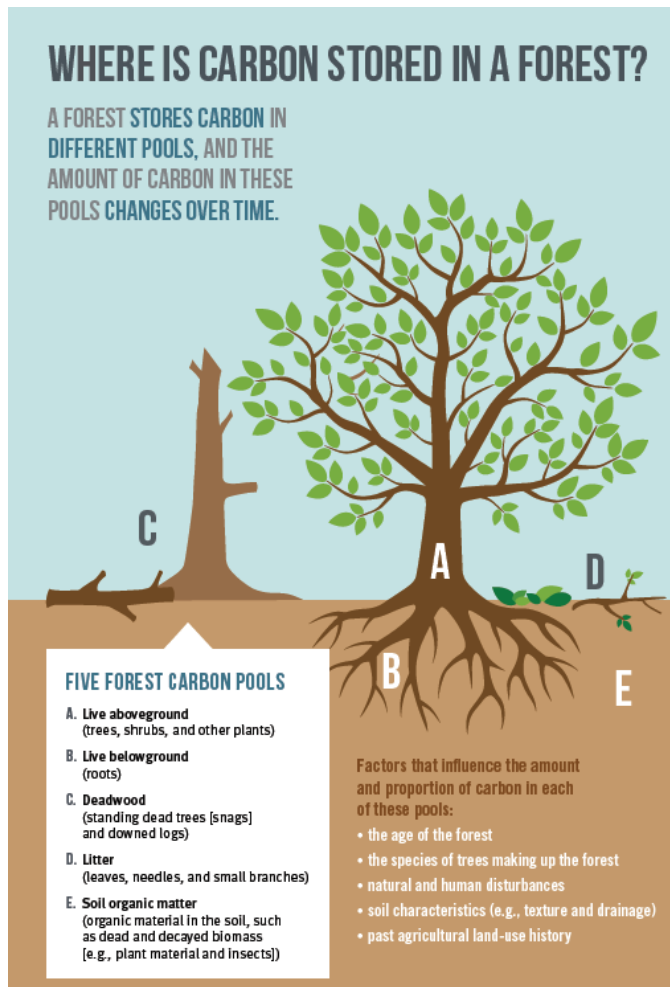
Recommendations

- 1) The Department of Forests, Parks, and Recreation (DFPR) develop public information materials, including online and print materials, regarding the components of forest carbon offset protocols and markets, appropriate silvicultural practices, project development, and additional resources available for assistance and information. These materials should be designed for use by the general public, forest landowners, municipalities, and private organizations and businesses. Such materials should outline the compatibility of forest carbon offset projects with the Vermont Use Value Appraisal (UVA)/Current Use Program and other state and federal programs related to forestland management and carbon cycling and accounting.
- 2) By July 1, 2022, the Agency of Natural Resources (ANR) analyze the feasibility of developing a forest carbon offset project for at least one parcel of state land. The purpose of this project would be to: a) build staff expertise that could be used to assist municipalities and private land owners with enrollment in carbon markets; b) provide a public model of exemplary pro-carbon, climate-resilient forestry; c) serve as a potential anchor, if feasible, around which an aggregation project could be developed; and d) generate revenue that could be appropriated to fund land management stewardship, recreational improvements, greenhouse gas (GHG) emissions reduction projects, and additional land conservation or carbon offset efforts. Such an analysis may include engaging the services of an expert forest carbon project developer.
- 3) Department of Forests, Parks, and Recreation work with municipalities to explore opportunities to develop a pilot carbon offset project that includes town forests and/or urban forestry activities. FPR should use insights gained from the pilot effort to create a framework for providing assistance to Vermont municipalities in developing forest carbon offset projects. This pilot would also help determine viable options for aggregation and provide local examples of climate resilient forestry for municipalities, forest landowners, and community members.
- 4) The Agency of Natural Resources explore partnerships, through a formal contract or memorandum of understanding, with private sector organizations that have experience in carbon offset projects in order to create statewide public-private partnerships that could work to minimize the costs and maximize the benefits of enrolling public and private lands in carbon offset market programs.
- 5) If the State of Vermont were to create a state carbon accounting system or protocols as a component of a greenhouse gas emissions reduction program or climate initiative, the State should develop and adopt rules that prevent double counting of carbon. For example, if Vermont forest carbon offsets were sold to account for GHG emissions in California, they should not also be counted as offsets for Vermont GHG emissions.
- 6) If changes were to be considered in the UVA program, the State should avoid program requirements that may constrain carbon offset project viability for lands enrolled in UVA.
- 7) Given the need to expand ANR and FPR capacity, funding options should be explored to provide additional staffing and resources to complete the work recommended above.

Note: None of these recommendations should be interpreted to force private landowners to participate in forest carbon offset projects.

An Explanation of Forest Carbon Sequestration and Storage

Carbon sequestration is the removal of carbon dioxide (CO₂) from the atmosphere for use in photosynthesis, resulting in the maintenance and growth of plants and trees. Carbon storage is the amount of carbon that is retained in a forest carbon pool, including standing trees, soil, roots, deadwood, and litter. See the image below. In the aggregate, forests in the United States sequester approximately 15% ([Oswalt and Smith, 2014](#)) of total carbon dioxide emissions. In New England, this estimate is closer to 35% of total carbon dioxide emissions, and in *Vermont, approximately 50% of the state's annual CO₂ emissions are sequestered by the state's trees* ([VT Climate Action Commission, 2018](#)).



In recent years, the value of this “ecosystem service” has received greater recognition: intact forests globally store a huge amount of atmospheric carbon in woody biomass and soils. They also absorb carbon dioxide through growth, essentially providing negative emissions. Partly in recognition of the important role of forests in climate regulation, mechanisms have developed that encourage and reward good forest stewardship.

One such mechanism is a *forest carbon offset* which is a financial instrument that represents the equivalent of one metric ton of sequestered carbon dioxide (tCO₂e). These instruments can be sold and retired to “offset” emissions elsewhere in the economy, and also traded like a stock certificate. Forest landowners may enroll in various programs that support the accounting, validation, listing, and tracking of credits, and once

verified to be in compliance with program rules, landowners can sell these credits.

Image Source: Catanzaro, Paul and Anthony D’Amato, 2019.

Forests cover roughly 78% of Vermont’s land area. Most forestland is privately owned and in relatively small parcels. While the acreage of forested land has been relatively stable over the past 20 years, the most recent data from the United States Forest Service (USFS) shows an average of 20,000 acres per year was lost from the forest land base in Vermont between 2012 and 2017 ([Morin, 2018](#)). While the causes of these changes are not entirely clear, the conversion of forest to development and agriculture

is widely implicated. Other threats to forest integrity and health compound these concerns — invasive insect pests, plants, and pathogens; changing landowner demographics; unpredictable and globally complicated forest products markets; increasing ownership costs — all add stress to a resource that many Vermonters may reasonably take for granted.

Vermont has a strong interest in protecting and enhancing forests and the many values and benefits they provide. Mitigating climate change, enhancing efforts toward clean air and water, maintaining healthy soil and flood control, supporting the forest economy, promoting recreation and tourism, and preserving Vermont's identity as the Green Mountain State all depend on conserving healthy and productive forests. Forest carbon offset programs may offer one potential tool to help preserve Vermont forests by providing additional revenues to landowners and creating a financial incentive for the goal of keeping forestlands forested and ensuring the benefits we all receive from them continue.

Summary of Findings

This section provides an overview of the findings of the Working Group. Each of the topics discussed are revisited in greater detail later in the report.

Nationwide, there have been a growing number of forest carbon offset projects in recent years that provide revenue to landowners to implement practices that sequester and store carbon beyond regional baseline forest practices. Such practices may include timber harvesting, recreational use and wildcrafting, among others. While “forever wild” designations are possible with carbon offset projects, forest carbon protocols do not require strict off-limits preservation. There are two major categories of carbon offset markets: *Compliance markets* are established by governmental entities as part of comprehensive, mandatory plans to reduce greenhouse gas (GHG) emissions from specified sectors of the economy. *Voluntary markets* are created when private entities, such as businesses, organizations, or individuals, choose to purchase offsets to help achieve some of the reductions in GHG needed to meet their own climate goals. Several globally-recognized carbon market protocols and registries currently operate and sell high-quality carbon offsets, including the [American Carbon Registry](#) (ACR), [Climate Action Reserve](#) (CAR) and [Verra, formerly Verified Carbon Standard](#) (VCS).

Currently, the relevant U.S. compliance market for forest carbon offsets is the California Compliance Market. Of the 144 million offsets developed for compliance trading, forest carbon offsets make up 83% of them. The compliance markets require that carbon represented by sold credits be maintained in place for 100 years or more, therefore enrollment periods for forestland mirror this commitment. Prices in compliance markets tend to be stable and higher than voluntary markets; in 2019 the price in the CA compliance market was approximately \$14 per metric ton of carbon. California compliance offsets are capped at 8% of targeted emissions reductions, a cap which will drop in 2020. Half of these compliance offsets must show direct environmental benefits to California, which is most feasible for adjacent states (CARB, 2019).

Given the specific protocols of the CA compliance market, it is not likely to be a good fit for most Vermont carbon offset projects. Establishing a free-standing Vermont market would not be fiscally or programmatically viable for such a small state. Further, research on past efforts by other states suggests that creating a stand-alone offset program with less rigorous protocols and no clear connection to a

market has not been successful ([Danks, 2019 and forthcoming](#)). Should New York State develop a compliance market, it may be a viable option for Vermont forest carbon offset projects. However, voluntary market options are still likely to make carbon offset projects in Vermont more viable because the protocols related to carbon baseline calculations, parcel aggregation, and pricing individualization are more suitable for Vermont's situation than compliance markets.

Trading in voluntary markets has tripled since 2017, with growing public interest in offsetting personal or organizational GHG emissions attributed to travel or special events, such as conferences and weddings. Voluntary market protocols require a minimum project commitment of 40 years, making these projects potentially more viable for Vermont landowners, but prices vary greatly from \$0.10 to over \$12 per metric ton of carbon equivalent. The variation in prices can reflect an "affinity" buyers may have with a project. In general, projects that have desirable benefits in addition to carbon – such as special wildlife, scenic value, ecological connectivity, watershed functions, relevant location or other values of special interest to the buyers – will earn higher prices. In addition, forest carbon projects are most likely to be financially viable if there are high levels of diverse standing timber already on site; no conservation easements or other legal requirements that put significant restrictions on land management; and a project area large enough to cover the substantial fixed costs of developing a carbon project. At current prices, a project in the northeast region must generally be several thousand acres in size to be financially viable.

Because the information and processes required by carbon markets are complex and vary by protocol, commercial private-sector carbon project developers typically provide a wide-range of services needed to create offset projects. These services include estimating viability, arranging for intensive carbon inventories, modeling management alternatives, shepherding paperwork through reviewers and registries, preparing for verification and monitoring visits, and in some cases, marketing the resulting credits. In addition to their specialized knowledge, project developers may cover the upfront costs of project development, which can be substantial, retaining 20-40% of credits as payment for their services. From the perspective of forestland owners, project developers reduce two of the main barriers to entering the carbon market – specialized expertise and start-up development costs. Even large, high-capacity industrial and non-profit forest owners engage project developers because of the specialized knowledge and skills needed to comply with carbon offset protocols. There may be opportunities for the public and non-profit sectors to provide some of these services in a manner that allows more income to be retained by landowners.

For a variety of reasons, there are very few forest carbon offset projects to date in Vermont. Vermont forestland owners generally hold parcels too small to enter into carbon markets without significant aggregation of parcels. The average size of forest holdings for family forest ownerships in Vermont with 10 or more acres is 63 acres (Butler, 2014) and the average forestland parcel enrolled in the UVA program is 151 acres, as of October 2019. According to data analyzed by the Working Group, the average size of a carbon offset project in the northeast region is 39,675 acres and the median size is 11,625 acres. (Turner, 2019) Developing mechanisms for easily aggregating small forest landowners is time-intensive and site specific, although the "Cold Hollow to Canada" project discussed later in the report could provide a model for such necessary aggregation. The long commitment periods required for carbon market entrance — 40 to 100 years or more — may not be viable or appealing for many Vermont forest owners.

Vermont forestland owners also may not be aware of carbon market opportunities, may hold misconceptions about carbon projects, may prefer other alternatives for preserving and managing their forestland, and/or may feel uncertain about navigating the complex process of developing carbon offset projects. Currently, there is just one forest carbon offset project in Vermont that has been issued carbon offsets – the Middlebury Bread Loaf Project discussed later in this report. In addition, The Nature Conservancy (TNC) is pursuing a project on Burnt Mountain in Franklin and Lamoille counties, which is also discussed later in the report. All the current Vermont projects are being developed for the voluntary carbon market using American Carbon Registry (ACR) Improved Forest Management (IFM) protocols.

A public-private collaborative approach that leverages expertise in both sectors could be effective in helping Vermont forest owners participate successfully in all stages of the voluntary carbon markets – appropriate management practices, project development, and selling carbon offsets at a premium price. ANR and DFPR have strong programs for outreach to landowners that could be expanded to include basic information about how to engage with carbon market opportunities. There are several individuals and organizations in Vermont that have experience in developing forest carbon projects nationally and globally. Entrepreneurial opportunities for public, private, and non-profit partners in the tourism, recreation, and business development sectors could help market carbon offsets to secure the highest prices for Vermont-branded offsets.

The UVA program is compatible with forest carbon protocols, and therefore changes would not be necessary for the program to facilitate Vermont participation in carbon markets. Because UVA is a voluntary program that does not place permanent restrictions on enrolled land, VT forest owners whose land is enrolled in UVA are permitted to participate in carbon markets. While carbon management is not in and of itself an eligible primary forest management objective under any UVA enrollment category, it is a compatible management objective under all categories when program requirements are met. If future changes were made to UVA rules to require management for forest carbon, it is advisable to consult the forest carbon market protocols to determine how proposed rules could affect that ability of forests enrolled in UVA to generate carbon credits.

Carbon offset projects are also voluntary and, as a condition of the program rules, no landowner can be compelled to participate in one. Projects must demonstrate that the carbon being sequestered and stored is above what would have occurred under current management practices, including any legally required practices. Therefore, carbon offset projects in both the compliance and voluntary markets must demonstrate that the landowner is voluntarily implementing the actions needed to sequester and store the additional carbon. Landowners must show that the project is not a result of any law, administrative rule, or legal settlement. Thus, laws or rules requiring participation in such projects would be counter-productive, rendering carbon offset projects non-viable for private landowners.

Public lands owned by the State and municipalities could participate in forest carbon markets in ways that provide multiple public benefits. As noted above, timber and wildlife management and recreation could continue on public lands enrolled in carbon offset programs. State lands may have the acreage, stocking, and forest management practices that are necessary for viable carbon projects. Some public

lands may have easements or other legal constraints which could impact baseline calculations and eligibility to participate in carbon projects and would need to be evaluated on case-by-case basis. However, developing a carbon project on state-owned forestland could have multiple benefits. Such a project could further develop in-state capacity to understand carbon markets and technical assistance capacity for Vermont landowners. Adding carbon sequestration and storage to the suite of values for which ANR lands are owned and managed would complement ANR's goal of keeping forests as forests and sustaining the many benefits and values accruing from them. The larger size and higher stocking levels of state land enhance the feasibility in both voluntary and compliance markets. Although no such projects currently exist, the enrollment of state lands in carbon markets could potentially advance the enrollment of private lands in carbon markets by serving as an anchor around which an aggregation project is developed. A state lands project could generate revenue from the sale of carbon offsets which could fund state land stewardship, recreational improvements, greenhouse gas emissions reduction projects, and additional land conservation or carbon offset efforts. Finally, such a project could provide a public demonstration of exemplary carbon sequestration and storage practices and climate resilient forestry.

Similarly, developing carbon projects with aggregated municipal forests could have some specific public values. Town forests may provide carbon offset models on a scale (parcel size) that is similar to forest land owned by private individuals. Towns could generate revenue from growing carbon in their forests, which could fund land management costs, recreational improvements, and additional climate resiliency and conservation efforts. Municipal forest management involves local public input and budgets, enabling a transparency that allows the public to see the costs and benefits of participating in carbon markets. The field work and public discussions that accompany the development of a carbon offset project on town forests could provide opportunities to educate landowners about pro-carbon, climate resilient forestry appropriate for their local area. DFPR's county foresters, who often help manage municipal forests, could help aggregate municipal forests if needed to develop viable offset projects.

When implementing carbon offset projects, it is important to avoid double counting carbon – if a credit is used once to offset an emission, it must be retired and never used again. The various offset registries bear the responsibility to track individual credit certificates, both their ownership and status. Double counting is also a concern if carbon sequestration is counted towards a statewide or community emissions reduction goal. If a Vermont landowner sells credits to offset emissions in California, that credit should no longer be counted as satisfying any part of Vermont's accounting for its own emission reduction (ER) goals. At this point, Vermont's accounting does not count carbon sequestration and storage as contributing to statutory ER obligations, but that could change. Any future legislation or regulations accounting for carbon storage or sequestration need to recognize and avoid the risk of double counting forest-based "negative emissions" from projects.

Based on these findings and recommendations, it is clear that ANR and DFPR would need additional staff capacity and resources to carry out the work required. Providing additional positions and state funding, and/or exploring alternative funding sources such as grant funds, federal dollars, or private investments would be necessary to make most partnerships or initiatives successful.

Overall, while financial benefits are possible and the environmental case for maintaining intact forests is clear, forest carbon offset projects are only a small part of many actions, initiatives, and changes that are required to significantly reduce GHG emissions and address climate change. As the research and

report of this Working Group demonstrate, keeping forests as forests is imperative to these efforts. If discussions and information about carbon offset projects lead to practices, policies, and public determination to better protect forests in Vermont, this could be the greatest benefit of this Working Group's endeavor.

Current Status of Carbon Offset Markets

According to the California Compliance Offset Program, “a forest offset project is a planned set of activities that increases carbon storage in trees or prevents the loss of carbon stored in trees, compared to what would have occurred in the forest absent project activities” ([U.S. Forests Offset Projects, California Air Resources Board presentation, May 30, 2019](#)). The markets for forest carbon offsets in the U.S. have been created by the public and private sector over the past 15 years as part of comprehensive approaches to addressing climate change. *These markets can be divided into two categories: 1) compliance, or regulatory, markets, in which offsets are a component of government initiatives to mandate reductions in GHG emissions, and 2) voluntary markets, in which businesses, individuals and other entities choose to reduce their GHG emissions over time.* Both compliance programs and voluntary climate initiatives place primary focus on reducing direct emissions from specified sectors or activities first, then reducing indirect emissions from supply chain or other sectors, and finally only allowing offsets for a small fraction of emissions that may be especially hard to reduce. Offsets are often considered a transition strategy until non-fossil fuel alternatives are viable.

Compliance market overview. The largest demand for forests carbon offsets in the United States currently results from the California's Cap-and-Trade program, which went into effect in 2013 as part of the California Global Warming Solutions Act of 2006 ([A.B. 32, 2006](#)). Under this law, emissions of carbon and other GHGs in many sectors of the California economy are capped, and those caps are reduced over time. The entities in covered sectors must secure “allowances” equal to their emissions each year. Industries are permitted to trade these allowances, since some may have excess allowances while others need to purchase additional credits to meet the level of their emissions. Carbon credits derived from offsets can also be used to fulfill a small portion of this regulatory obligation – currently only 8% of emissions. California's Air Resources Board (ARB) manages the compliance program and approves protocols for offset projects. The California legislature renewed its commitment to its cap-and-trade program in 2017, extending it for another ten years with some minor modifications. From 2021 through 2025, carbon offsets may be used to satisfy only 4% of their emissions “of which no more than one-half may be sourced from projects that do not provide direct environmental benefits in state” ([A.B. 398, 2017](#)). That cap will rise again to 6% in 2026 due to anticipated demand as more sectors become subject to emissions caps, and all caps are again reduced over time.

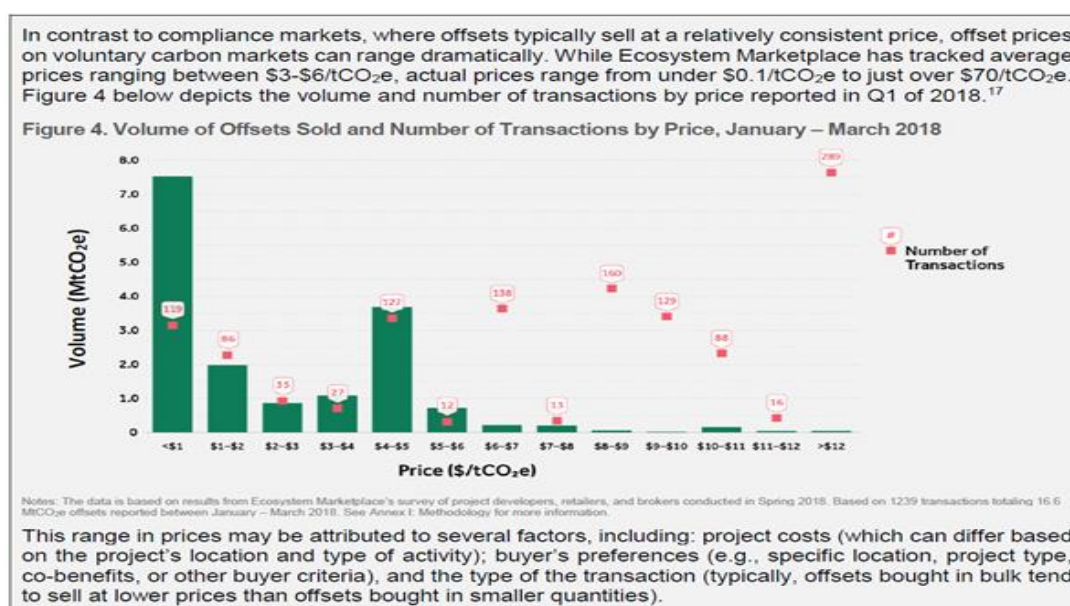
As of 2019, the California cap-and-trade program accepts the following types of carbon offset projects throughout the United States, all of which must follow strict protocols established by the ARB: forestry, urban forestry, dairy digesters, destruction of ozone-depleting substances, mine methane capture, and rice cultivation. Forest carbon offsets represent approximately 84% of the over 144 million compliance offset credits generated to date ([CARB, 2019](#)). One offset — one metric ton of carbon equivalent (1 tCO₂e) — is currently worth approximately \$14 on the compliance market. Because the California

economy is large and its cap-and-trade program covers many sectors, demand for forest carbon offsets that meet its rigorous standards has been strong and steady.

Voluntary market overview. There is an upward trend in demand for voluntary carbon offset credits. Buyers are typically companies, organizations, or groups that have undertaken a voluntary program to reduce their emissions. Similar to compliance programs, offsets typically represent a relatively small portion of the emissions targeted for reduction under any organization’s program. The prices of voluntary offset credits vary greatly but tend to be lower than California’s compliance market. Since the majority of voluntary trades are over-the-counter, negotiated transactions, there is no public record of prices paid. The best estimates come from an annual survey ([Hamrick & Gallant, 2018](#)) which suggests an average of \$3-6 per tCO₂e in 2018, but notes prices vary widely from \$0.10 to \$70 per tCO₂e.

Table 1 below charts the variety of prices carbon offsets in voluntary markets internationally. Part of this price variability may be attributed to a project’s “provenance”— where a project is located and how the story of its conservation is relevant to a buyer or could be woven into environmental messaging for a purchasing company. The prices shown below reflect carbon offsets from many different sources— including forest offsets; forest offsets tend to trade at the higher end of the range. Some voluntary purchasers even provide funding up front to an organization or project that is of special interest, which can defray some of the initial costs of developing a carbon project. Interest in the provenance of a project provides an opportunity for marketing and branding carbon offsets to appeal to specific types of buyers. The voluntary market has matured considerably over the past decade – there are now several globally recognized registries and standards; the most relevant for US forest projects are the [American Carbon Registry](#) (ACR), [Climate Action Reserve](#) (CAR) and [Verra Verified Carbon Standard](#) (VCS).

Table 1: Price Variability in the Voluntary Carbon Offset Market



Source: Hamrick and Gallant, 2018. Voluntary Carbon Markets Insights: 2018 Outlook and First Quarter Trends. Ecosystem Marketplace.

Program Requirements Relevant to Vermont Participation

Compliance and voluntary market project requirements share several basic features, but their protocols vary in a few important ways that may affect the ability of most Vermont landowners to participate in them. Both have rigorous protocols for forestry which address four important elements of a high-quality carbon offset: 1) baseline and additionality, 2) leakage, 3) permanence, and 4) verification.

Assessments of the *baseline* indicate the starting point for any project, or the amount of stored carbon (CO₂e) that can be considered “business as usual.” For a forestry project to meet *additionality* criteria, it must show that the proposed forestry activities will sequester carbon above and beyond the baseline over time. It could appear that a landowner would receive payment for practices that may have happened regardless of a carbon offset project. However, “real” and “additional” are assessed in relation to the rules of individual carbon offset programs which are designed around a more global application. Behavior that may not appear additional on a single project has distinct benefits if the behavior is manifest across a broader landscape or region. Similarly, carbon offset programs credit not just future, but *past* good forest management in order to avoid a perverse incentive for significant harvesting *before* enrolling in a carbon market. Carbon offset projects therefore value both existing stock and new growth – underscoring the value of both carbon storage in existing trees and sequestration with new growth.

Leakage means the displacement of activities that may release carbon from the offset project site to another area. In other words, offset projects must prove that the project won’t result in another forested area being developed instead of the forestland that conserved for the project. Because fossil fuels release below ground carbon into the atmosphere more or less permanently, carbon offsets are expected to sequester carbon for a very long time. Verifiers examine not only the upfront calculations of carbon to be sequestered, but also conduct site visits over time to make sure that the reductions are real. *Permanence* in the context of carbon markets, means 40 or 100 years — the length of time project owners would be required to maintain the carbon they have sold. The longer monitoring timeline of 100 years for the compliance market adds value to the integrity of the credit, but its relevance to climate change is likely most important in the next 25-50 years. The voluntary carbon market policy which trades 60 years of monitoring and reporting for a decrease in credit price and thereby leverages more acres for carbon sequestration and storage is likely a net environmental gain.

Finally, the amount of carbon sequestered and stored must be *verifiable* or measurable, as opposed to estimated. Verification by an independent third party adds to the integrity of carbon offsets. Forests carbon offsets are comparatively reliable to measure – for example, not as direct as measuring methane captured from a capped landfill, but more reliable than estimating soil carbon flux in agricultural systems. Similarly, any measurements taken to estimate sequestration and storage must be repeatable and independently verifiable. Compared to early offset programs targeted at reducing deforestation in developing nations, current programs in the United States are rigorous, both in their protocols for measurement and the extent of verifier review.

Each protocol varies in how these key criteria are specifically addressed. The baseline is not set by the intentions or past history of the current owner, as both ownership and intentions could easily change. Rather, the baseline is set by a combination of legal requirements and regional trends in harvesting, conversion and carbon stocking levels. Compared to other regions of the country, the California ARB offset protocols have set fairly high baseline stocking levels of trees per acre for much of Vermont, making it more difficult for Vermont projects to show additionality.

Certain legal requirements may affect the baseline, including conservation easements and state laws or regulations restricting harvesting or stocking levels. Land conservation easements are legal restrictions which can affect baseline and thus the number of credits generated. For example, if an easement restricts timber harvesting or places some parts of the parcel off limits for harvesting, the baseline is raised, thus reducing the number of credits possible. A conservation easement that protects a forest from conversion to non-forest land could make a parcel ineligible for credits based on the already avoided conversion of forestland.

However, a conservation easement can also help a project meet permanence requirements. The California ARB permanence requirements are quite rigorous. Monitoring must be continued at the owner's expense for 100 years after the last credit is issued. In comparison, some voluntary protocols require only a 40-year commitment from the landowner. Harvesting of forest products is compatible with carbon offset rules. In fact, the California offset program encourages harvesting of forest products, because it can reduce leakage resulting from more intensive harvesting elsewhere to meet demand for forests products. Some of the carbon stored in durable forests products, such as furniture or building materials, could be counted toward the carbon sequestered and be eligible for carbon credits.

Because the rules and protocols are complex and upfront costs are high, project development – the process of turning carbon sequestering activities into a marketable carbon credit – is generally managed by project developers who are specialized consultants who provide not only expertise but often upfront funding for carbon projects. Most forest landowners who have committed to offset programs have had relatively large holdings or have particularly high levels of carbon stored in their forests.

Feasibility Analyses for Vermont and New England

There are several published studies and ongoing projects that examine the feasibility of enrolling Vermont forest lands in carbon offset projects. The most relevant study is [Vermont Forest Carbon: A Market Opportunity for Forestland Owners \(Keeton, et al, 2018\)](#). The report provides a comprehensive overview of compliance and voluntary forest carbon markets, examines the compatibility between carbon offset projects and other forests stewardship programs in Vermont, and suggests a “Vermont Path” which identifies the best opportunities for Vermont forest landowners. The study concludes that the voluntary market is more suited to Vermont forestlands largely due to the market's mechanism for aggregation of smaller parcels and the opportunity to use the “Vermont Story” to add value to the price of the offset credits.

Another useful analysis is a report entitled, [“Can Rehabilitative Forestry and Carbon Markets Benefit Degraded Forestland? A Case Study from Northeastern Vermont” \(Saligman, et al, 2013\)](#), which presents the results of a Natural Resource Conservation Service Innovation Grant project. This report examines the carbon market options for a 1,000-acre parcel of heavily logged forest. It compares viability of carbon projects for both the CAR and ACR protocols under 13 different management scenarios by calculating both annual cash flow and net present value over the life of the project. This report also looks at the “stackability” of payments for ecosystem services and describes how other conservation and stewardship tools and funding, such as cost-share programs, conservation easements, and the UVA program, interact with carbon market participation. They found that several management scenarios were viable options for carbon offsets in the voluntary market, but that the number of credits generated varied significantly between the two protocols assessed.

In 2012, the Manomet Center for Conservation Sciences updated its user-friendly publication [Selling Forest Carbon : A Practical Guide to Developing Forest Carbon Offsets for Northeast Forest Owners \(Beane 2012\)](#). It explains the steps involved in creating a forest carbon offset project as well as a basic introduction to the four major standards at the time: ACR, CAR, VCS and the then emerging California ARB standards. While the market and protocols have since evolved, the report remains a useful primer for landowners. Particularly helpful is the viability assessment of potential forest carbon projects in red-yellow-green light categories based on the size of project in acres, volume of standing timber, and restrictions that might be included in conservation easements. These guidelines were updated in 2014 ([Beane & Whitman, 2014](#)) including the addition of the length of time a landowner must commit to a carbon contract and real case examples.

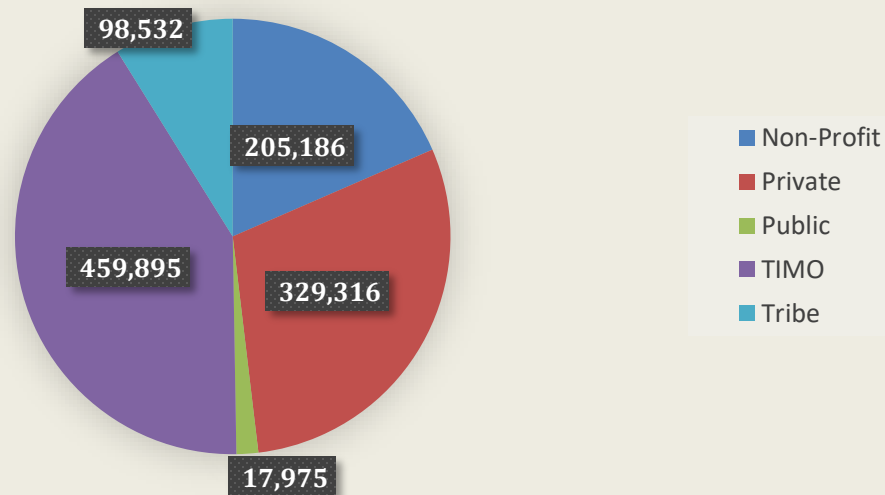
While each report examines specific conditions and protocols in detail, in general these analyses conclude that the financial viability of carbon projects in the northeast region depend on the factors outlined below in Table 2.

Table 2: Factors Affecting Financial Viability of Carbon Projects in the Northeast

- 1) The size of the project
 - More than 1,000 acres is generally needed for compliance market, often more than 5,000 acres depending on stocking levels, to cover fixed costs
 - Fewer than 1,000 acres may be viable for voluntary market, especially if aggregation is facilitated
- 2) The initial stocking level of timber
 - Above regional averages are generally needed for a viable project
- 3) The specific provisions and timing of any conservation easements
 - Pre-existing easements could limit potential for generating credits if they restrict harvest levels
 - New easements created as part of the carbon project could help satisfy protocol requirements
- 4) The availability of aggregation options in offset protocols
 - Currently no option in compliance market
 - Options do exist in voluntary standards
- 5) The willingness of landowners to commit to long-term contracts
 - More than 100 years for compliance market
 - 40 years for most voluntary markets
- 6) The price of carbon
 - The financial viability of a forest carbon project is very sensitive to the price of carbon
 - Should the commodity price of compliance carbon rise, as is expected, or a relatively high price is obtained in the voluntary market, then projects on smaller parcels or less well-stocked forests may become viable

According to a recent analysis of projects registered on the major carbon offset markets, shown in Table 3 and with further information in Appendix B, over 1.1 million acres of forestland in the region (MA, ME, NH, NY, VT) are already part of a carbon offset project enrolled in either a compliance or voluntary market (Turner, 2019). There are several projects in Vermont or the northeast region that could provide helpful information regarding the challenges, opportunities, and overall feasibility for participating in forest carbon markets.

**Table 3: Forest Carbon Projects (measured in acres)
NY, VT, NH, MA, ME**



Burnt Mountain Carbon Project

The Nature Conservancy's (TNC) Vermont chapter is developing a carbon project at its 5,400 acre Burnt Mountain Natural Area located mostly in the town of Montgomery. TNC acquired the property in 2018 and placed a forever wild easement held by the Northeast Wilderness Trust on the parcel in 2019. The carbon being stored as a result of this shift in management will be sold as voluntary carbon offsets. The project is being developed by Blue Source a commercial carbon project developer. Blue Source is developing the project in exchange for a privately negotiated percentage of the carbon credits generated. Currently, the project is undergoing third-party verification and credits should be available for sale in mid-2020. Initially, TNC and Blue Source believed there was sufficient carbon stored on the property to qualify for the California compliance market. However, after the full carbon inventory showed less carbon on the property compared to the regional baseline, developers had to shift the project into the voluntary market. The Burnt Mountain project will be registered in the American Carbon Registry and will be the largest carbon project in Vermont to date. Revenue generated from the project will be used to steward the property and complete additional forest protection projects in the state.

Cold Hollow to Canada Carbon Aggregation Project

The Vermont Land Trust (VLT) is working with TNC and a private carbon offset project developer, Spatial Informatic Group, to develop an aggregated carbon project in northern Vermont's Cold Hollow mountains. The Cold Hollow Carbon project is aggregating the carbon from 14 parcels totaling 7,978 acres. Participating landowners have contracted with a private corporation to develop and list the credits on the American Carbon Registry as voluntary offsets. Individual landowners will agree to implement carbon enhancing improved forest management for a term of 40 years and will receive payments based on the proportion of the project's total carbon stored in their forestland.

Middlebury College Bread Loaf Forest Conservation & Carbon Credit Project

To date, the Middlebury College Bread Loaf Project is the only forest project in Vermont that has been developed sufficiently to sell credits on a carbon market. In 2014, Middlebury College placed a conservation easement on 2,400 acres of forestland at its Bread Loaf Campus in Ripton. The easement, held by the Vermont Land Trust, included a provision which enabled the College to create a carbon offset project on the forestland. The provision was motivated in part by the College's efforts to achieve carbon neutrality by 2016 and in anticipation of the potential need for carbon credit offsets to meet this goal. In 2015, the College entered an agreement with Blue Source to develop and market a carbon offset project based on the conserved forestland. Although 2,400 acres is a small project compared to what Blue Source typically develops, they felt that the College's reputation as an environmental leader in higher education, as well as Bread Loaf's storied history, could appeal to prospective carbon credit purchasers. Under the agreement, the College also reserved an "up to" number of credits it could buy itself to satisfy its carbon neutrality goal going forward.

The project took about 20 months to complete from planning to putting verified credits on the ACR up for sale. The project is listed as an Improved Forest Management project following ACR's protocol for non-federal U.S. forestlands. As with similar projects, Blue Source shouldered the project development costs, about \$85,000, up front and was reimbursed with proceeds from the first sale of carbon credits. The process consisted of identifying the boundaries and ownership of the lands involved, setting up a sampling plan and conducting on the ground sampling and measuring of 100 forest subplots to calculate carbon storage and sequestration, independent verification of the results of the field sampling, application to the ACR, and marketing of the resulting credits issued by the registry. The agreement with Blue Source includes a negotiated split of proceeds from credits sold on the carbon market.

Based on the College's past and future management practices, Table 4 shows projected credits for the first seven years of the project and their value based on an assumed price of \$10 per credit. The table also shows the anticipated volume of credits retained for purchase by Middlebury College to meet its carbon neutrality commitment. It is expected that in Year 8 the volume of credits will drop to a range of 5,000 to 8,000 per year which will represent the annual net growth of the forest. The higher volume of credits in the first eight years is attributable to the relatively low harvesting done in prior years compared to what is a typical baseline for similar forests in the region.

Table 4: Middlebury College Bread Loaf Carbon Offset Project Finances

Reporting Period	Total Volume	Volume Sold	Volume Retained	Price	Gross Value	Total Expense	Net Value
2016	30,069	16,453	13,616	\$10.00	\$300,690	\$85,103	\$215,587
2017	23,654	10,932	12,722	\$10.00	\$236,540	\$12,925	\$223,615
2018	23,481	10,781	12,700	\$10.00	\$234,810	\$12,873	\$221,937
2019	23,481	10,781	12,700	\$10.00	\$234,810	\$12,873	\$221,937
2020	23,481	10,781	12,700	\$10.00	\$234,810	\$12,873	\$221,937
2021	21,522	11,522	10,000	\$10.00	\$215,220	\$55,963	\$159,257
2022	21,522	11,522	10,000	\$10.00	\$215,220	\$12,513	\$202,707
TOTAL	167,210	80,772	86,438	\$10.00	\$1,672,100	\$205,123	\$1,466,977

Middlebury College had sold 11,100 credits as of November 2019. Average annual costs for maintaining the project and meeting ACR requirements for eligibility are anticipated to be approximately \$20,000. A more complete analysis of costs and benefits will be done after the first major field remeasurement and calibration is completed in 2021. In addition to financial benefits, the project has provided educational benefits to students and faculty who have used the project for their coursework and research.

Programs in Other States for Private Landowners

The Forest, Climate and Community Research Group led by Working Group member, Dr. Cecilia Danks, examined state initiatives to facilitate family forest and community forest participation in carbon markets from 2008 to 2017. In a 2008 nationwide phone survey, seven states (CA, GA, IL, MI, OK, OR, and TX) asserted that they had programs through which small-scale landowners could obtain assistance with accessing forest carbon markets. In addition, 2008 interviewees noted that early discussions and explorations about forest carbon markets were being conducted in agencies in almost every state, with thirteen states indicating that forest carbon market programs were under development. By 2012, however, forest carbon programs existed in only five (CA, GA, MI, OK, OR) of the original seven states and no additional states had developed programs. Case studies were then conducted of four of those programs (GA, MI, OK, and OR). California was excluded because it was significantly different in scale and scope and has been described in other published studies.

In 2008, the Chicago Climate Exchange was at its zenith, the Kyoto protocol had been in effect since 2005, California had passed its cap-and-trade legislation in 2006, and federal climate legislation was expected soon. State forestry agencies were eager to find ways to help family forest owners access the growing carbon offset markets to encourage climate friendly forestry and help defray the costs of forest ownership that could lead to forest conversion and fragmentation. Each of the four states studied took a different approach, which together provide lessons still relevant to today's markets.

In 1993, Oregon established a trust fund to which GHG emitters, like utilities, or revenue generators like the state lottery, could contribute. Family forests owners could borrow from that fund to establish plantations on suitable sites and would not be required to repay the loan until or if trees were harvested. Owners signed a 200-year contract that gave ownership of the carbon to the state, which could be ended early if the loan was repaid. The concept of a revolving loan fund was a good way to cover the upfront costs of afforestation and landowners with as few as ten acres could participate. However, the trust was underfunded and relatively few acres were planted. Given the long time to maturity, loans were not paid back quickly enough to make funds available to more landowners. By 2015, 40 landowners representing only 1,159 acres had participated in the program. While still on the books, this program is now inactive.

Michigan's Department of Natural Resources provided start-up funds and staff time to the non-profit Delta Institute to develop a carbon offset program for family forest owners. Delta worked closely with the Chicago Climate Exchange (CCX) to create the first protocol for sustainably managed forests. This was the most successful of the state-led initiatives because it linked directly to an active trading platform, the CCX, and it required only a 15-year commitment. By 2010, a total of 125,370 acres were enrolled, with parcels ranging in size from 20 to 33,000 acres. Unfortunately, the program ended when the CCX closed in 2010. The Michigan DNR then used remaining funds to provide information about carbon sequestration as part of stewardship plans created for some family forest owners. A survey of forest owners who received such plans revealed that this information had little or no impact on their management.

In 2007, Georgia set up its own state-run carbon registry and simplified carbon protocols to facilitate access to the voluntary market for Georgia forest landowners, both public and private of all sizes. However, this registry was not tied to a marketing platform and the protocols were not as rigorous as most voluntary market purchasers expected. In 2015, only three projects enrolled in the program: one private landowner, one state forest, and one federal army base. No credits were sold.

Oklahoma sought to regularize, if not regulate, the emerging voluntary market by providing verification services for offsets, state approval of aggregators, and state-approved carbon offset certificates. Their program was open to owners of any land in the state, both forest and agricultural. The only participants in the forest program were the five forestland owners recruited for a pilot project in 2011-2013 to develop protocols, who together had 2,101 acres enrolled. Again, because this project was not tied to robust, well-recognized markets or standards, there was no little incentive to participate.

Even as these state programs were being developed and implemented, the global voluntary market was growing, and consensus was being reached on how to create offsets that were real, additional, measurable, and verifiable. The voluntary standards mentioned thus far (CAR, ACR and VCS) grew in credibility and the institutional infrastructure to support all stages of project development and financing, verification, registration and trade grew in strength and complexity. Private sector project developers now play essential roles in turning forest management activities that sequester carbon into marketable carbon offsets. These roles include recruiting participants, estimating profitability, financing upfront

costs, arranging for intensive forest inventories, modeling management alternatives, shepherding paperwork through reviewers and registries, and preparing for verification and monitoring visits. Developing carbon offset projects has not typically been in the skillset of typical consulting foresters or land managers. Even large, sophisticated land ownership management organizations like The Nature Conservancy depend on carbon project developers to participate in carbon offset markets. The challenge states now face is not how to create or recreate key elements of the carbon market chain, but rather how to help landowners understand and navigate the existing opportunities.

Given the growth in California's compliance market and the continued demand in the voluntary market, some states are again looking at how to help forest landowners in their states participate in these markets. American Forests compiled a list of recent state initiatives regarding forest carbon policies. These initiatives fall roughly into two categories: 1) facilitating landowner participation in forest carbon markets and 2) directly incentivizing management practices that result in long-term carbon sequestration and storage. While most of these state programs are still under development, some of them risk sharing the fate of the earlier state initiatives when they attempt to create their own state offset programs that are not connected to voluntary or compliance markets.

In spring 2019, the Virginia legislature authorized "industrial development authorities" to facilitate the aggregation of landowners "to reach a size that attracts the investment of private capital" as a way to facilitate their participation in carbon markets. Because this approach appears to target existing voluntary markets, it could avoid the challenges experienced by Oklahoma when it attempted to set up its own system of aggregation. New York State's 2019 climate legislation calls for ambitious reductions in emissions which can be met in part with offsets, including forests offsets. How New York's offset program is developed remains to be seen, but it could be an important new compliance market for Vermont if out-of-state projects are permitted. Like Vermont, Washington established a forest carbon project working group to investigate ways to facilitate landowner participation in carbon offset programs; their report is due December 2020.

Other states, including California, New Jersey, Connecticut and Massachusetts, have allocated funding to incentivize carbon sequestration directly on forest lands without the focus on carbon market participation. A great deal of effort and funds in carbon offset projects goes to meeting the requirements of the protocols leaving less to invest in on-the-ground practices. While market-based initiatives can mobilize private capital, states that sell cap-and-trade allowances or collect carbon taxes as part of a larger emissions reduction policy can generate substantial funds to invest in the full range of practices that enhance carbon sequestration and storage on public and private lands.

The [California Forest Carbon Plan](#), (Forest Climate Action Team, 2018) developed with public input, is a model of a comprehensive, science-based plan to tackle the diverse factors that affect forest health and resilience from fragmentation and wildfires to harvesting and restoration practices. A substantial portion of the hundreds of millions of dollars generated by the sale of allowances is channeled through the [California Climate Investments](#) Fund to forest stewardship practices, as well as conservation easements and urban and community forestry. On a much smaller scale, New Jersey and Connecticut

have allocated a portion of their Regional Greenhouse Gas Initiative (RGGI) funds to forest, wetland, and urban forestry projects. Massachusetts has developed partnerships and allocated resources to incentivize forest resilience and carbon sequestration and storage. They are considering modifying their current use program to include “forest resilience” goals and creating a public-private, state-managed payment-for-ecosystem-services program.

An example of a private program is The Nature Conservancy’s Working Woodlands program which works with forest landowners to manage their forests sustainably in return for conservation and management assistance with improving the value and the health of their land. Working Woodlands projects exist in Tennessee, Kentucky, Pennsylvania, Michigan and New York, with expansion planned to other states. TNC works with landowners to analyze a property’s potential as wildlife habitat and climate change mitigator. In return, participating landowners receive: 1) an assessment of the forests, wildlife, and carbon on their property; 2) a customized 10-year forest management plan; and 3) certification by the Forest Stewardship Council. Revenue generated by FSC-certified products from these enrolled properties goes directly to the landowner. Private landowners who enroll their property can sell credits to businesses seeking to reduce their carbon footprint. The majority of carbon revenues also stay with the landowner, except for a portion dedicated to help pay program expenses. To date most of the carbon credits created by the Working Woodlands program have been sold as voluntary carbon offsets. In addition to developing “traditional carbon offsets,” TNC’s Working Woodlands program is piloting an effort to develop payments for family forest landowners who implement forest practices that increase the amount of carbon stored in the forest (TNC, 2019).

The Case for Offset Projects in Vermont

Over the last five years, numerous reports have cited the economic benefits provided by Vermont forests and the various types of businesses that use forest resources, including the [Economic Impact of Vermont’s Forest-based Economy 2013 and Vermont Forest Sector Systems Analysis Report](#). Economic pressures on forest landowners and the overall threats to forest health and integrity from a variety of sources are similarly documented in [2015 Vermont Forest Fragmentation Report](#), [Informing Land Use Planning and Forestland Conservation Through Subdivision and Parcelization Trend Information](#), and the [Vermont Forest Indicators Dashboard](#). The economic case for encouraging payments to landowners for carbon sequestration and storage is simply stated: any additional revenue source improves the viability of maintaining these lands as forests. A program that uses private capital to pay landowners for some of the non-market environmental services forests provide not only sustains those services, but eases pressure on other mechanisms that currently support forest stewardship.

This section examines an important conservation tool the state of Vermont uses to keep forests intact – the Vermont Use Value Appraisal (UVA)/Current Use Program. This section also reviews the expected landowner returns from carbon offset programs and comments on conditions and trends that may influence those returns. Lastly, the environmental case highlights the role of temperate forests as a global carbon sink, Vermont forest’s role in balancing our own emissions footprint, and the importance of intact forests in the face of climate change.

Economic rationale

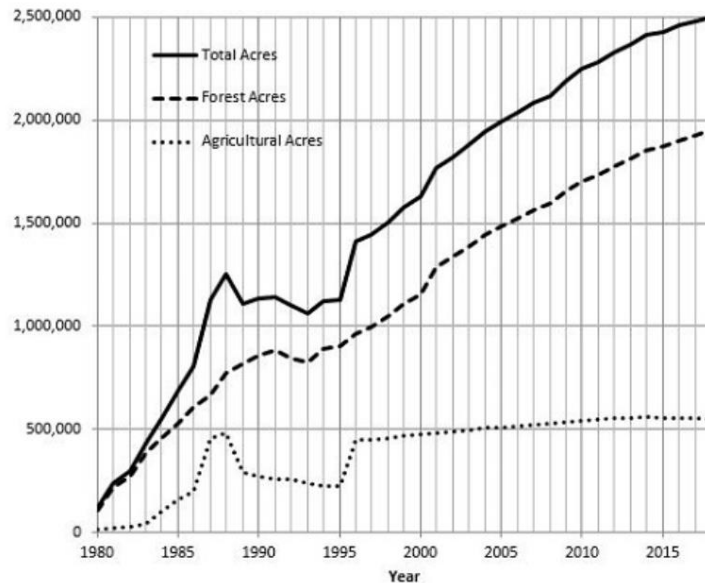
Each year, the Current Use Advisory Board calculates the “use value” of Vermont forestland – an estimate of that land’s capacity to generate income to the landowner through active forestry – as the basis for per-acre valuation for property taxes due from landowners enrolled in the UVA program. Among the items included in that calculation is the estimated value of stumpage payments, or the price paid to a landowner for standing timber to be harvested, and the non-residential effective tax rate. Table 5 illustrates these two components of the UVA rate-setting formula over the last six years to calculate a “coverage ratio” — the number of times the average stumpage covers the average taxes, both on a per acre basis. The coverage ratio captures the tax obligation of ownership. If taxes rise, but stumpage also rises, the theoretical obligation on landowners is mitigated. However, if taxes rise and stumpage declines, the obligation is compounded.

Table 5: Coverage Ratio of Current Use Program

Year	Statewide			Per acre		Coverage Ratio
	Forested Acres	Stumpage	Effective Tax rate	Average stumpage	Taxes (UVA basis)	
2014	4,588,386	\$26,913,956	\$ 1.99	\$ 5.87	\$ 2.35	2.50
2015	4,514,170	\$31,539,752	\$ 2.03	\$ 6.99	\$ 2.66	2.63
2016	4,514,170	\$32,776,374	\$ 2.10	\$ 7.26	\$ 3.02	2.40
2017	4,514,170	\$29,447,597	\$ 2.14	\$ 6.52	\$ 2.89	2.26
2018	4,514,170	\$25,441,571	\$ 2.10	\$ 5.64	\$ 2.86	1.97
2019	4,494,125	\$27,391,925	\$ 2.14	\$ 6.10	\$ 3.10	1.96

Source: Annual Report, Division of Property Valuation & Review, 2019

The data above suggest the tax obligation for landowners is increasing — stumpage is declining as property taxes increase. A less direct indicator of the effect of economic forces on landowners can be seen in UVA enrollment trends shown in Table 6. Forestland enrollment in the UVA program continues to increase at a steep rate, despite the fact that nearly 50% of eligible forestland in the state is already enrolled. Hold harmless payments to towns for UVA- enrolled parcels grew at a 3% annual rate,

Table 6: Annual Current Use Enrollment 1980-2018

Source: Annual Report, Division of Property Valuation & Review, 2019

(*carbon storage*) and increasing the uptake of CO₂ from the atmosphere (*carbon sequestration*). Current estimates suggest Vermont forests take up nearly one-half of our state's annual emissions, compared to 15% nationwide, but store over 200 years' worth of emissions (VCAC, 2018). From a regional context, the temperate forests of the eastern United States are a significant global carbon sink. Northeastern forests tend not to grow as quickly as in other regions, but are more diverse, have high carbon "density," and live longer, and therefore store more carbon.

In addition to the value of removing carbon dioxide and storing it, northeastern forests offer an array of co-benefits for wildlife, water quality, flood protection, and recreation (Moomaw, et al, 2019). Research suggests northeastern forests also have the potential to greatly increase biological carbon sequestration and storage (Keeton, 2018). Achieving this potential may require changing some forest management practices, including reducing harvest size and frequency, increasing the average tree size, and generally making the typical forest more "structurally diverse." In the process, these forests could become more resilient to the impacts of climate change (Nunery and Keeton, 2010).

Reaching this potential involves overcoming various obstacles and challenges. Carbon offset programs require that the carbon represented by each offset sold be maintained in place for 40 to 100 years to assure reductions in atmospheric carbon are reasonably "permanent." Harvesting is allowed under the program but is essentially constrained to the level of forest growth. The obligation to maintain the forest's carbon stocks transfers, like a temporary easement, with the ownership of the property. The substantial enrollment costs generally restrict the feasibility of smaller ownerships, though these small tracts dominate the pattern of ownership in the state. Climate change has already forced many landowners to incur higher management costs. Forest carbon offset projects will not be available to all landowners, and even for those that are eligible, the payments received may not seem worth the challenges of monitoring and reporting. Lastly, while the environmental case for maintaining intact

even though the per-acre reimbursement *declined* at roughly the same rate over the same period. From a statewide policy perspective, inducing private capital into the revenue stream for landowners may mitigate the impact of increases in property taxes.

Environmental rationale

The role of forests in mitigating atmospheric carbon dioxide and climate change was elevated by the United Nations Intergovernmental Panel on Climate Change in the [Climate Change 2013 Report](#) (IPCC, 2013). This report highlights how forests can help both by retaining existing carbon

forests is clear, forest carbon offsets are only a small part of many actions, initiatives, and changes that are required to significantly reduce GHG emissions and address climate change.

Marketing Carbon Credits in Vermont

Vermont's well-stocked, well-managed forests along with Vermont's reputation for a strong environmental ethic make Vermont well positioned to market and sell carbon credits through existing carbon registries. The existing voluntary registries would allow public and private landowners in Vermont to use existing and recognized carbon accounting protocols and systems as the most efficient path to established markets. By using the existing registries, Vermont would avoid the costs associated with developing the carbon accounting and tracking necessary to have marketable credits. Experience by other states has shown that state specific registries and market exchanges have not been successful.

Voluntary carbon offset markets would likely be the best opportunity for both public and private landowners in Vermont to sell carbon credits. There are several existing carbon offset registries where credible carbon offsets can be verified using established protocols and credits. Using the Improved Forest Management (IFM) protocols, Vermont forest carbon credits could be registered. As discussed earlier, despite offering higher prices, the compliance markets would not likely be an option for most private landowners given the relatively small parcel sizes and stocking levels on private lands.

Developing voluntary carbon projects still has significant up-front costs and on-going monitoring expenses. The Nature Conservancy's Working Woodlands program has found that a minimum of 1,500 acres is required for a viable carbon project (TNC, 2019). A recent Vermont Land Trust study found that aggregation of the carbon on multiple parcels is a viable way to allow Vermont landowners to sell the carbon being stored in their forest (Keeton et al. 2018). The Cold Hollow to Canada pilot is now underway to explore the viability of aggregating smaller parcels into a larger pool of carbon to be marketed together.

Voluntary carbon offset purchases can be made by individuals, institutions, and businesses seeking to address sustainability goals or a specific goal to reduce emissions. Worldwide the majority of voluntary offset purchases by volume are made by multi-national, private, for-profit companies. Market trends indicate that end buyers looking for offsets that emphasize co-benefits like biodiversity preservation, sustainable economic growth or other social benefits are willing to pay higher prices for them (Hamrick & Gallant, 2018). These co-benefits are often in line with other aspects of sustainable development, such as supporting the local economy through forestry, job training and creation, protecting watershed areas that supply clean water, or safeguarding habitat and biodiversity. In many cases, co-benefits are integral to the project and often one of the main reasons that suppliers and many buyers are engaged in voluntary carbon markets (Hamrick & Gallant, 2018).

Vermont carbon projects could be well positioned to market co-benefits. Carbon offset projects could be associated with the permanent protection of the forests involved either through direct public acquisition or conservation easements that enable improved forest management. Preserving core forest, connecting forest parcels, and protecting threatened and endangered species habitat could be

promoted through various projects. Projects that assure public access and sustainable recreation could also help round out the story.

Since aggregating smaller parcels together would be necessary to develop financially viable offset projects, Vermont projects could emphasize how the aggregation limits forest habitat fragmentation and supports the local forest economy. Public lands could play the role of an anchor forest that helps contribute to an aggregated project of nearby private lands. The emerging carbon offset markets could arguably be viewed like other forest products produced from Vermont private and public lands. As Vermont invests in forest conservation to maintain the wide variety of benefits it provides, carbon sequestration can be a by-product of this conservation activity. The state of Vermont could play a role in marketing and technical assistance to landowners.

Carbon Market Projects on Vermont State Lands

Since the first official state forest (L.R. Jones State Forest) was acquired in 1909, the State has acquired over 400,000 acres of land, beginning what has become a long, rich history of land ownership and management. Today, the diverse holdings managed by the Agency of Natural Resources (ANR) include state parks (54,000 acres), state forests (183,000 acres), wildlife management areas (130,000 acres), streambanks (3,500) and a diverse holding of conservation easements (170,000 acres). Vermont's public lands provide Vermonters with myriad opportunities for recreating, enjoying nature, and getting away to somewhere peaceful. Just as importantly, these lands provide ecosystem services for Vermonters such as clean water, forest products, habitat diversity and connectivity, flood resilience, and carbon sequestration.

ANR manages state-owned land for a variety of purposes, ranging from the protection of important natural resources to public uses of land. ANR plans for the management of its state-owned lands through the development of long-range management plans. Planning processes are important for guiding the allocation of resources, such as where and what types of recreation occur; where, when, and how timber is harvested; and the management of wildlife habitats. While every parcel of land cannot accommodate all possible uses, ANR considers the following activities when planning for use and management of state-owned land:

- Sustainable forest management;
- Sustainable recreational activities;
- Wildlife habitat and species management;
- Wildlife-oriented activities (e.g. hunting, birding, trapping, and fishing);
- Restoration and protection of water resources;
- Protection of biodiversity and natural communities; and
- Protection of historical and cultural resources.

While carbon sequestration and storage is one of the multiple values that ANR lands provide, it's important to determine for what purposes the state may consider a carbon offset project on state land. State participation in carbon markets could lead to more forest conservation, development of staff

expertise to help guide projects on private lands, a new source of revenue for the state to invest in land conservation and management and/or, a model and anchor for aggregation of private lands surrounding the public ownership. ANR carries out a broad range of management strategies on public lands to achieve the multitude of environmental and economic benefits of Vermont's forests. Adding carbon sequestration to the suite of values for which ANR lands are owned and managed would be reasonable because it complements ANR's goal of keeping forests as forests and sustaining the many goods, benefits, and values they provide.

Units of state public land are large compared to the average private parcel size in Vermont, and state forestlands generally have higher stocking levels than the regional baseline, which both enhance project feasibility in voluntary and compliance markets. Additionally, classification categories assigned to lands through ANR's long-range management planning provide the ability to limit management when management outcomes would be benefited by less human intervention. Like the choice to limit management through long-range management planning, ANR has chosen and could continue to choose to encumber land with legal constraints to achieve greater additionality. Lastly, considering the role state lands could play in supporting increased enrollment of private lands, ANR lands could serve as an anchor around which an aggregation project is developed. Staff members at ANR could build necessary expertise and expand the data already collected about forestland.

However, some characteristics of state-owned land could be impediments to enrollment in a carbon project. ANR has worked with non-profit, federal, and state partners to acquire land, often resulting in legal constraints typically in the form of a conservation easement. The presence of a legal limitation on the development and management of land could reduce and possibly eliminate any additionality needed to make a project viable. Further, some easements prohibit a landowner's ability to earn revenue except where activities are consistent with the purposes of the easement and with approval from the easement holder. Not all ANR lands are encumbered with a conservation easement, however, and further analysis would be needed to determine whether or not lands most feasible for enrollment in a carbon market are encumbered with an incompatible conservation easement.

Other considerations include the funding sources used to acquire lands. Some state-owned lands acquired or managed with funds like those from the U.S. Fish & Wildlife Service and the Land and Water Conservation Fund may not be compatible depending on how federal agencies treat revenue generated by selling carbon credits or how they view the commitment made by landowners enrolling in a carbon market. In other cases, the Vermont Fish & Wildlife Department acquired lands without timber rights for the purpose of maintaining public access. Until the timber rights are reunited with title, those specific lands owned without timber rights would not be eligible. Lastly, certain policies that result in limitations on management, such as ANR's riparian buffer policy or natural areas designations, may also affect the feasibility of enrolling certain state-owned forestland.

In recent years, both the Department of Forests, Parks and Recreation and the Fish and Wildlife Department have acquired some sizeable parcels in singular transactions such as the 2,085-acre Dowsville addition to Camel's Hump State Park and the 2,880-acre Conservation Fund addition to

Birdseye Wildlife Management Area. Both projects on their own are likely too small to be financially feasible for the compliance market, although, as noted above, similarly sized parcels in Vermont have recently been viable voluntary-market carbon projects.

Parcels of several thousand acres or greater constitute a very small percentage of the landscape in Vermont; as such, the opportunity to marry a carbon project with a new acquisition project will be rare. However, if a large acquisition opportunity arises, adding a carbon offset project into the acquisition development phase could have added benefits. Benefits may include increased project management capacity, both internal and through partnerships, and additional funding sources, which are often available at the onset of an acquisition. Fundraising capacity is often more available during the project development phase. These additional funds could help support the due diligence that would be needed to verify a carbon project. Lastly, if a carbon project is considered at the onset of state ownership during project development, the state could impose legal constraints such as conservation easements supporting additionality thus making the projects more financially feasible.

Developing economies of scale in marketing and selling carbon credits

As explained earlier, as of December 2019, only one carbon offset project in Vermont has developed carbon offset credits that are available for purchase. The small number of projects highlight the challenges of developing projects and taking advantage of economies of scale in marketing and selling credits. As discussed earlier in this report, despite having well-stocked forests, the size of Vermont's landholdings has limited participation in the carbon markets.

At today's carbon prices, a project would need to be in the thousands of acres for a single property or more for an aggregated project to make it financially viable. There are several distinct steps in developing a project and getting the credits to market, including securing a landowner agreement, amending or creating a forest management plan, conducting a carbon inventory, modeling the project baseline, calculating the available carbon, verifying the inventory and project, registering the project, and marketing the carbon credits. In addition, ongoing verification and inventory need to be conducted; Vermont foresters and companies can and do provide these services. There are also companies that are developing technologies that could lower the cost of doing the initial inventory as well as providing the on-going verification. Again, aggregation of parcels would be the best way to help lower participation costs and create the economies of scale needed to open these markets to more landowners.

A pilot project in the mid-Atlantic states is testing the concept of paying for carbon enhancing forest practices. The American Forest Foundation and The Nature Conservancy are developing a methodology through VCS that will allow companies to buy a verified carbon credit, resulting from management practices that enhance carbon across a given landscape. If this project is successful, Vermont could implement a similar strategy, after identifying practices that are appropriate for VT forests. DFPR and its statewide partners have the expertise to help develop the practices that will best enhance carbon storage and sequestration at the lowest cost to the landowner.

Financial Incentives, UVA Program, & Maximizing the Value of Forestland

Forestland value— in the context of its use as managed forest for economic return to the landowner —is represented as the capitalized value of anticipated revenues. Myriad factors and forces impact that flow of income. These conditions, largely unaffected by whether the land is enrolled in a forest carbon offset program—weather, forest product markets, carrying costs—are simply a part of owning forests and also part of the financial calculus of management. Proceeds from the sale of carbon offsets could be seen as both a revenue stream and an added obligation. Most landowners would evaluate the opportunity presented by carbon markets as another option for management, certainly one that will need to align with the long-term goals and objectives of ownership.

Aspects of carbon program rules considered for compatibility

- 1) Restrictions on harvesting. It is clear the intent of carbon offset programs is to preserve carbon already captured from being released and to sequester and store additional carbon. Additionality through improved forest management could be achieved by harvesting less than what might otherwise be harvested in the absence of a carbon project. It is also clear that carbon offset projects do not *preclude* harvesting, and depending on the particulars of the individual forest, management that includes harvesting may optimize the returns from carbon.
- 2) Legal obligations. All carbon offset programs require that landowners commit to the maintenance of the carbon that has been “sold.” This addresses the core principle of permanence: the carbon removed from the atmosphere must remain stored for a long enough period to be of real benefit. Legal documents ensure that landowners agree to this commitment, including the reimbursement for offsets sold that end up being destroyed (unintentionally) or removed (intentionally). These obligations run with the title on the sale of the property.
- 3) Natural forest management criteria. Every carbon program expects management that is performed to meet generally accepted measures of sustainability. The actual mechanisms for meeting these criteria vary across programs, but all programs accept third-party certification. While no evidence exists confirming this, it is likely an approved forest management plan under the Vermont UVA program would satisfy most program requirements under “a state or federally approved management plan.”
- 4) Species diversity requirements. These requirements are designed to encourage land management that sustains regional species composition goals. Most Vermont forests would pass this test easily.
- 5) Maintenance of structural elements. Under some programs, the rules extend to include objectives for standing dead trees, or snags, which are included in the “stocks” that are eligible for credits. This is an explicit recognition that snags convey ecological co-benefits and should be protected and enhanced. Under certain protocols, the target stocking for standing dead trees is specified.
- 6) Conservation easements. Under improved forest management carbon offset projects, conservation easements aren’t required, but under some programs they can reduce buffer pool requirements – the

percentage of the project's offsets that are set aside to cover unavoidable losses associated with natural disasters such as weather events or forest pest outbreaks. If conservation easements existing prior to the project contain provisions that restrict harvesting or prescribe stocking levels, these may be legal restrictions that reduce additionality.

Compatibility with Use Value Appraisal.

The stated purpose of Vermont's UVA program is to preserve the working landscape and the rural character of Vermont. As explained previously, the UVA/Current Use program provides a property tax reduction for qualifying landowners engaged in the practices of forestry and agriculture. To be eligible, forestland must contain at least 25 acres that will be enrolled and managed according to a forest management plan in keeping with standards established and approved by DFPR. While certain qualifying Ecologically Significant Treatment Areas are eligible for enrollment without a requirement for periodic harvesting, a minimum of 20 of the enrolled acres must be managed for forest products. Current enrollment is approximately 15,500 parcels covering 2 million of the state's 4.5 million forestland acres.

While carbon management is not an eligible primary forest management objective under any enrollment category, it is a compatible management objective under all categories when program requirements are met. Because participation in UVA is voluntary and reversible, albeit with a tax penalty, and the tax savings realized by landowners are unrelated to the carbon stored or sequestered, there is no inherent conflict between program requirements and carbon market standards that would preclude UVA-enrolled land from participation in market offsets (Saligman et. al 2013). However, since some forestland enrollment categories in UVA require active management for sawtimber, the potential to maximize carbon offsets on some UVA enrolled land may be less than would be possible if active management were not required.

While there does not appear to be an inherent conflict between UVA standards and the requirements of carbon markets, this could change in the future. Since its inception, the UVA program has evolved to include new enrollment categories, establish new penalties, expand program purposes, and amend use value calculations. It is likely that additional changes will occur during the course of carbon projects that could affect compatibility. While many program changes could affect compatibility with future projects, there are three broad categories worth noting:

- Increased regulation. Changes that increase the legal obligation of landowners to maintain high stocking levels in the forest or increasingly restrict the silvicultural options available to landowners could make it difficult for landowners seeking to develop projects to demonstrate additionality or reduce the buffer pool.
- If the purposes of the UVA program were modified to include carbon sequestration and storage as a stated requirement, this change may be a legal obligation of the program that precludes participation in carbon markets.
- Reduced enrollment options. Changes to management strategies allowed in UVA at the beginning of carbon project development could result in strategies that no longer complement carbon offsets and force landowners to choose between UVA and a carbon offset project.

Natural Resource Conservation Service Incentive Programs. The Natural Resource Conservation Service (NRCS) administers several programs that offer landowners both financial and technical assistance to implement conservation practices. Though the compatibility with carbon markets will depend on the specific practice and the degree to which it supports carbon sequestration and storage, there is no inherent conflict between these incentives and participation in carbon markets.

Certifications. Carbon markets require third-party certification that the forest is managed sustainably. There are three major certification bodies in Vermont: Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), and American Tree Farm System (ATFS). Each requires forest management plans, review cycles, and sustainable forest management but they differ somewhat in the specifics of plan requirements, data collection, and review processes. All are compatible with UVA and there are no inherent conflicts.

Conservation and other goals. Management strategies to sequester and store carbon in forests, and the markets to monetize these services, are compatible with many goals to promote wildlife habitat, timber management, recreation, habitat connectivity, and other landowner and conservation objectives. However, strategies to maximize carbon credits by Vermont forests are not always synonymous with maximizing conservation goals. For example, strategies to assist the migration of tree species through climate-adaptive silviculture, creation of young forest habitat, or restoration of structural diversity in middle-aged forests, may advance critical conservation goals while reducing carbon storage or carbon sequestration by forestland. Therefore, the pursuit of these important goals, though broadly compatible with carbon markets, may not maximize the value generated in the carbon markets. Appropriate strategies to advance conservation and other goals while engaging in carbon markets will vary dramatically from one parcel to the next based on the conservation priorities and landowner objectives.

The current suite of widely used forestland management programs and incentives in Vermont is largely compatible with participation in carbon markets. However, different forest management strategies can affect the carbon sequestration and storage benefits that forests provide and thus affect the value realized in carbon markets. To effectively maximize the potential value of forestland in carbon offset markets while also enhancing conservation and other goals, the many complex variables (carbon markets, program requirements, landowner objectives, and forest management) and how they must work together would need to be considered, evaluated, and navigated. For this reason, it is best to equip landowners and forest managers with information that will allow them to balance their conservation and landowner goals with the potential value generated in carbon markets.

Potential Statewide Program Analysis

The information gathered during this study suggests potential opportunities for Vermont landowners, but accessing forest carbon offset markets can be complicated and expensive. The objective of this Working Group is to sort these issues out and offer suggestions for a path to “facilitate the enrollment” of lands in a carbon offset program.

This charge makes two broad presumptions. First, it presumes that there is actual interest on the part of landowners in enrolling in forest carbon projects. At this point, there is only anecdotal information that confirms some landowners are curious, but detailed knowledge is limited. Given the substantial commitments and the inability to predict returns with certainty, it seems prudent to anticipate that only a small number of landowners would sign up until the benefits could be broadly demonstrated to exceed the risks and obligations. Second, the charge presumes there is a role for some entity to support and facilitate enrollment. There is already a vibrant and robust private sector industry to develop these projects, with adequate capacity to respond to landowner interest. Yet this represents the status quo and the charge envisions ways to facilitate enrollment beyond the status quo.

Considered more broadly, how could Vermont position itself to take maximum advantage of the developing opportunities? The ideas in this section are a logical extension of what we've learned, yet also preliminary, speculative and requiring considerable refinement. Project viability is enhanced by a) reducing the costs of project development, b) increasing the scale of projects through aggregation, and c) marketing the story of Vermont's program to raise the price commanded by the offsets produced.

As outlined in this report, the Vermont Land Trust is developing experience as an aggregator through its Cold Hollow project. Working with landowners on complex land transactions, providing a framework to navigate the legal and financial issues of group "ownership" of both the proceeds and the obligations, having direct access to potential landowners who have already made a conservation commitment through an easement—these skills are substantial and unique. VLT leadership in this area could be instrumental. The Nature Conservancy-Vermont Chapter (TNC) could also bring Vermont project experience to the table, and because of its broader experience in carbon projects and markets, may also bring access to potential purchasers of offsets and sources of green investment capital.

The DFPR could develop and share information about forest carbon offsets with interested landowners. DFPR, particularly through its network of county foresters, would be well positioned to offer clear, unbiased information about the opportunities and the risks of forest carbon enrollment. County foresters, with regular access to landowners, could provide public education, technical assistance, and project feasibility assessment before a landowner formally engages a project developer.

The roles assigned to each entity above could supplant similar services currently being offered by project developers, potentially reducing project development costs while leaving the most specialized technical work still to specialized developers or technical consultants. The Working Group interpreted the use of the term "statewide" to be broader than "state-run." A state-run program that would put DFPR in the position of developer seems premature and unnecessary. There is no precedence from other states and too much uncertainty to warrant such an investment. Alternatively, a *statewide* effort that continues to educate and inform, and leverages the strengths of committed partners could be timely, appropriate, and feasible.

Example of Estimated Potential Revenue

To demonstrate the potential revenue from a forest carbon offset program, the fictional project outlined below can serve as an example. A “real life” example can be found earlier in the report for the Middlebury College Bread Loaf Project. Projecting revenues for forestland enrolled in a carbon offset program requires several simplifying assumptions. We assume:

- A project size of 3,000 acres.
- Average level of carbon stocking;
- Projected carbon “yields” in metric tons are averaged over the first 5 years of the project.
- A price per credit of \$10. This was used in the article and table cited below.
- Landowners would net roughly 50% of the annual credit yield. The remaining 50% would cover development costs (32%) and required contributions to a “buffer pool” (18%) to cover possible unanticipated losses.

Depending on the offset program, some allow the claiming of a substantial difference between baseline and project stocks in the first year. Others spread this out over a number of years, typically fewer than ten years. After this point credit yields are simply the net change in stocks, essentially growth less harvest. The first five years are averaged to make the comparison across programs simpler. As the table suggests, credit yields based on growth alone are much lower than initial yields. Table 7 below ([ACF journal 2018](#)) offers some average returns under similar assumptions. Assuming the low point of the first-year value (\$100) and the low end of annual returns (\$5), the total per-acre over five years is roughly \$24 per acre, per year (\$120/5 years). This 3,000-acre project would generate roughly \$360,000 over that 5-year period (\$72,000/year). Under the assumption that 50% would net to the landowner after expenses, the landowner will receive \$36,000 per year or about \$12 per acre.

Region	Project Revenue (\$/Acre)	
	1st Year	Annual
California/PNW	\$800-1200	\$20-40
Coastal Alaska	\$300-1000	\$10-20
InlandWest	\$200-1000	\$10-20
Southeast Hardwood	\$200-800	\$10-30
Southeast Softwood	\$150-200	\$10-20
Lake States	\$100-400	\$5-20
Northeast	\$100-300	\$5-10

These estimates were confirmed to be reasonable by cross-checking the credit yields for two, existing projects, one in Vermont and one in Massachusetts. Since many of the costs to develop, verify, monitor and report on these projects vary little based on project size, one can reasonably expect the per-acre revenues to increase for larger projects, where more credits are generated to cover the fixed costs. The Working Group also examined a

Source: Data – (ACF Journal, 2018); Table – (Turner, 2019).

more detailed projection of costs and revenues over an entire crediting period, typically 25 years. This analysis demonstrated a rate of return in the range of 2% to 3% and a particular sensitivity to the per-ton price paid for an offset. As evidenced by the large range of first-year returns shown in the table and

the fact that these returns are generated early in the project, expected return on investment strongly influenced by the initial level of carbon stock inventory on the tract. Choosing the lowest points seem appropriate since the project size is close to the minimum considered feasible, and thus the most expensive on a per-acre basis—resulting in the lowest returns. A recent report suggests \$16/acre/year presumed to span the 25-year crediting period (Keeton, et al, 2018). Extending our assumptions over 25 years yields approximately \$11/acre/year.

Carbon offset programs will not solve the climate crisis, but they could be an important tool among many to mitigate GHG emissions. Awareness of forest carbon offset programs is growing, and the discussion in Vermont is just beginning. Research, public discussions, and case studies, such as those presented in this report and through the work of the Working Group can be a helpful avenue to advance the discussion.

Appendix A – 2019 Act 83, Section 9

Sec. 9. VERMONT FOREST CARBON SEQUESTRATION WORKING GROUP; REPORT

(a) Creation. There is created the Vermont Forest Carbon Sequestration

Working Group to study how to create a Statewide program to facilitate the enrollment of Vermont forestlands in carbon sequestration markets.

(b) Membership. The Working Group shall be composed of the following members:

(1) two members of the House of Representatives, not from the same political party, appointed by the Speaker of the House;

(2) two members from the Senate, not from the same political party, appointed by the Committee on Committees;

(3) the Secretary of Natural Resources or designee;

(4) four persons with expertise of or experience with the requirements for participating in carbon sequestration markets, two appointed by the Speaker of the House and two appointed by the Committee on Committees; and

(5) a private landowner or a representative of an association or organization representing private landowners, appointed by the Governor.

(c) Powers and duties. The Working Group shall study how to create a statewide program to facilitate the enrollment of Vermont forestlands in carbon sequestration markets, and shall:

(1) evaluate the current status of carbon sequestration markets, including:

(A) review of available information on the feasibility of enrolling public and private land from Vermont in a carbon sequestration market, including review of existing feasibility analyses specific to the development of forest carbon sequestration projects in New England and Vermont;

(B) examples from forest carbon sequestration project development on public land in other states; and

(C) if available, technical assistance programs developed by other states and organizations to assist private landowners in engaging in carbon sequestration markets;

(2) evaluate the economic and environmental case for encouraging forest carbon sequestration offset projects in Vermont;

(3) analyze how to best market and sell carbon credits from State-owned and privately owned forestland in carbon sequestration markets;

(4) determine how to develop economies of scale in marketing and selling carbon credits in carbon sequestration markets;

(5) evaluate how to utilize financial incentives and existing forest management and certification programs and Vermont's Use Value Appraisal program to maximize the potential value of forestland in carbon sequestration markets while also enhancing conservation and other goals;

(6) review how to structure and regulate a Statewide program to facilitate the enrollment of Vermont forestlands in carbon sequestration markets, including how the program should be governed, whether the program should be governed by a State agency, how forestland will be assessed and enrolled, how parcels and landowners will enter and leave the program, how landowners will be paid, and how requirements and standards concerning forest management will be applied and enforced;

(7) estimate expected revenue from enrolling forestland in carbon markets and how that revenue should be allocated to:

(A) support the governance structure, management, and oversight of the program;

(B) fairly compensate landowners; and

(C) encourage enrollment in the program; and

(8) any other issue the Working Group deems relevant to designing and implementing a statewide program to facilitate the enrollment of Vermont forestlands in carbon sequestration markets.

(d) Assistance. The Working Group shall have the technical and legal assistance of the Agency of Natural Resources. The Working Group shall have the administrative and legislative drafting assistance of the Office of Legislative Council and the fiscal assistance of the Joint Fiscal Office. The Working Group may consult with stakeholders and experts in relevant subject areas, including carbon markets, forest management strategies, and parcel mapping.

(e) Report. On or before January 15, 2020, the Working Group shall submit a written report to the House Committees on Agriculture and Forestry, on Natural Resources, Fish, and Wildlife, and on Energy and Technology and to the Senate Committees on Agriculture and on Natural Resources and Energy. The report shall include:

(1) specific and detailed findings and proposals concerning the issues set forth in subsection (c);

(2) a proposal for a pilot project to enroll State-owned forestland in a carbon sequestration market; and

(3) any recommendations for legislative or regulatory action. (f) Meetings.

(1) The Secretary of Natural Resources or designee shall call the first meeting of the Working Group to occur on or before July 15, 2019.

(2) The Secretary of Natural Resources or designee shall be the Chair.

(3) A majority of the membership shall constitute a quorum.

(4) The Working Group shall meet as often as necessary and shall cease to exist on January 31, 2020.

(g) Compensation and reimbursement.

(1) For attendance at meetings during adjournment of the General Assembly, a legislative member of the Working Group shall be entitled to per diem compensation and reimbursement of expenses pursuant to 2 V.S.A. § 406 for not more than five meetings. These payments shall be made from monies appropriated to the General Assembly.

(2) Any non-legislative member of the Working Group who is a State employee shall not be entitled to per diem compensation or reimbursement of expenses. Any member of the Working Group who is not a State employee shall be entitled to per diem compensation and reimbursement of expenses as permitted under 32 V.S.A. § 1010 for not more than five meetings. These payments shall be made from monies appropriated to the Agency of Natural Resources.

Appendix B: Carbon Offset Projects in Northern New England States

Table 1. Forest carbon project acres by program type and owner.

Owner Type ^a	MAINE	MASS	NEW HAMPSHIRE	NEW YORK	VERMONT	Grand Total
Compliance						
Non-Profit (11)	161,029	9,715	9,047			179,791
Private (4)	329,316					329,316
TIMO (5)			141,062	315,998		457,060
Tribe (1)	98,532					98,532
Compliance Total (21)	588,877	9,715	150,109	315,998		1,064,699
Voluntary						
Non-Profit (7)	15,181		2,141		8,073	25,395
Public (2)		13,536		4,439		17,975
TIMO (2)		2,835				2,835
Voluntary Total (11)	15,181	16,371	2,141	4,439	8,073	46,205
Grand Total (33)	604,058	26,086	152,250	320,437	8,073	1,110,904

Owner type categories were assigned based on the Owner's name and apparent affiliation. "TIMO" represents Timber Investment Management Organizations. "Public" includes City lands and watershed protection agencies. The number in parenthesis represents the count of projects in the different categories.

Table 2. Forest carbon project credits issued by program type and owner

Program	Owner Type	MAINE	MASS	NEW HAMPSHIRE	NEW YORK	VERMONT	Grand Total
Compliance							
	Non-Profit	1,050,773	811,941	483,873			2,346,587
	Private	44,499					844,499
	TIMO			2,013	4,594,287		4,596,300
	Tribe	4,076,024					4,076,024
	Compliance Total	5,971,296	811,941	485,886	4,594,287		11,863,410
Voluntary							
	Non-Profit	487,641		18,954		53,884	560,479
	Public		245,235		33,831		279,066
	TIMO				166,918		166,918
	Voluntary Total	487,641	245,235	18,954	200,749	53,884	1,006,463
	Grand Total	6,458,937	1,057,176	504,840	4,795,036	53,884	12,869,873

Data source: project listings on the registries' (ACR, CAR and Verra) published project databases, October 2019, as analyzed by Working Group member, Robert Turner, December 2019.

Appendix C: Bibliography – Sources, Testimony, and Resources

A.B. 32 – California Global Warming Solutions Act of 2006, Signed by the Governor September 27, 2006.

A.B. 398 – California Global Warming Solutions Act, Signed by the Governor July 25, 2017.

American Carbon Registry (ACR), carbon offset project registry, <https://www.climateactionreserve.org>.

Beane, Julie, (2012) “Selling Forest Carbon : A Practical Guide to Developing Forest Carbon Offsets for Northeast Forest Owners,” Manomet Center for Conservation Sciences, https://www.manomet.org/wp-content/uploads/old-files/Selling%20Forest%20Carbon_Final%20September%202012.pdf.

Beane, Julie and Whitman, Andrew, (2014) “Are Forest Carbon Offset Projects Feasible for Land Trusts and Communities?” Manomet Center for Conservation Sciences, https://www.manomet.org/wp-content/uploads/old-files/forestoffsets_casestudies.pdf.

Brighton, Deb, Fidel, Jamey, and Shupe, Brian, (2010), “Informing Land Use Planning and Forestland Conservation Through Subdivision and Parcelization Trend Information,” https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Vermont_Forests/Library/Full-Subdivision-Report-with-Appendices-optimized.pdf.

Butler, Sarah M., Brett J. Butler, Jaketon H. Hewes, (2014) “Vermont Woodland Owner Survey 2014 Final Project Report,” Vermont Forests, Parks and Recreation, U.S. Forest Service and University of Massachusetts, Amherst.

California Air Resources Board (CARB), “U.S. Forests Offset Projects,” public presentation, (<https://ww3.arb.ca.gov/cc/capandtrade/offsets/overview.pdf>), May 30, 2019.

California Air Resources Board (CARB), “Compliance Offset Program webpage,” <https://ww3.arb.ca.gov/cc/capandtrade/offsets/offsets.htm>, reviewed December 11, 2019.

Catanzaro, Paul and Anthony D’Amato, (2019), “Forest Carbon: An essential natural solution to climate change,” University of Massachusetts-Amherst, (http://masswoods.org/sites/masswoods.org/files/Forest-Carbon-web_2.pdf).

Climate Action Reserve (CAR), carbon offset project registry, <https://www.climateactionreserve.org>.

Danks, Cecilia, Public Testimony to Working Group, October 2019. See also University of Vermont website, <http://www.uvm.edu/~cfcml/>, publication forthcoming.

Dillon, Jon, "Money Growing on Trees? Vermont Forest First in State For California Carbon Market," Vermont Public Radio, (<https://www.vpr.org/post/money-growing-trees-vermont-forest-first-state-california-carbon-market>), June 26, 2019.

Division of Property Valuation & Review, "Annual Report: Based on 2018 Grand List Data," Vermont Department of Taxes, <https://legislature.vermont.gov/assets/Legislative-Reports/PVR-Annual-Report-Based-on-2018-Grand-List-Data-v2.pdf>, January 2019.

Forest Climate Action Team, (2018), "California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate," <http://resources.ca.gov/wp-content/uploads/2018/05/California-Forest-Carbon-Plan-Final-Draft-for-Public-Release-May-2018.pdf>.

Forest Ecosystem Monitoring Cooperative, "Vermont Forest Indicators Dashboard," University of Vermont, <https://www.uvm.edu/femc/indicators/vt>.

Hamrick, Kelley and Melissa Gallant, (2018), "Voluntary Carbon Markets Insights: 2018 Outlook and First-Quarter Trends," Forest Trends' Ecosystem Marketplace, (https://www.forest-trends.org/wp-content/uploads/2018/09/VCM-Q1-Report_Full-Version-2.pdf).

Intergovernmental Panel on Climate Change (IPCC), Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.), (2013), "Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change," Cambridge University Press, <https://www.ipcc.ch/report/ar5/wg1/>.

Keeton, W. S., (2018), "Source or sink? Carbon dynamics in old-growth forests and their role in climate change mitigation," in Ecology and Recovery of Eastern Old-growth Forests, eds A. Barton and W. S. Keeton (Washington, DC: Island Press).

Keeton, William S., William VanDoren, Charles Kerchner, and Mackenzie Fuqua, (2018) "Vermont Forest Carbon: A Market Opportunity for Forestland Owners," University of Vermont and Spatial Informatics Group, https://www.vlt.org/wp-content/uploads/2018/07/Vermont_Forest_Carbon.pdf.

Morin, Robert, (2018) "Vermont Forests, 2017," U.S. Department of Agriculture, Forest Service.

Moomaw, William, R., Susan A. Masino, Edward K. Faison, (2019), "Intact Forests in the United States: Proforestation Mitigates Climate Change and Serves the Greatest Good," Frontiers in Forests and Global Change, June 11, 2019.

New Wilderness Trust, newwildernesstrust.org – resource on preserving "forever wilderness" landscapes

North East State Foresters Association, (2013), “The Economic Importance of Vermont’s Forest-Based Economy,” https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Vermont_Forests/Library/NEFA13_Econ_Importance_VT_final_web_Jan29.pdf.

Nunery, J. S., and Keeton, W. S., (2010), “Forest carbon storage in the northeastern United States: net effects of harvesting frequency, post-harvest retention, and wood products,” *Forest Ecol. Manag.* 259, 1363–1375. doi: 10.1016/j.foreco.2009.12.029.

Oswalt, Sonja N. and W. Brad Smith, (2014), “US Forest Resource Facts & Historical Trends,” US Department of Agriculture, August 2014.

Saligman, L., E. Russell-Roy, W. S. Keeton, C. Danks, J. Gunn, and B. Machin, (2013), “Can Rehabilitative Forestry and Carbon Markets Benefit Degraded Forestland? A Case Study from Northeastern Vermont,” Vermont Natural Resources Conservation Service, <http://www.uvm.edu/rsenr/wkeeton/pubpdfs/Rehabilitative%20Forestry%20&%20Carbon%20Markets%20Final%20Report%20.pdf>, September 2013.

The Nature Conservancy’s Working Woodlands, (2019), The Nature Conservancy website, <https://www.nature.org/en-us/about-us/where-we-work/united-states/working-woodlands/>.

Turner, Robert, (2019), verbal and written testimony and analysis for Working Group.

Vermont Agency of Natural Resources, (2015), “2015 Vermont Forest Fragmentation Report,” https://fpr.vermont.gov/sites/fpr/files/About_the_Department/News/Library/FOREST%20FRAGMENTATION_FINAL_rev06-03-15.pdf.

Vermont Climate Action Commission (VCAC), Final Report to Governor Phil Scott, (<https://anr.vermont.gov/sites/anr/files/Final%20VCAC%20Report.pdf>), July 31, 2018.

Vermont Working Lands Enterprise Board Forestry Sub-Committee, (2016), “Vermont Forest Sector Systems Analysis: Exploring New Market Opportunities Across Value Chains,” https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Forest_Based_Business/Library/VT%20Forest%20Sector%20Analysis_2016b.pdf, January 2016.

Verra, carbon offset project registry, <https://verra.org>.