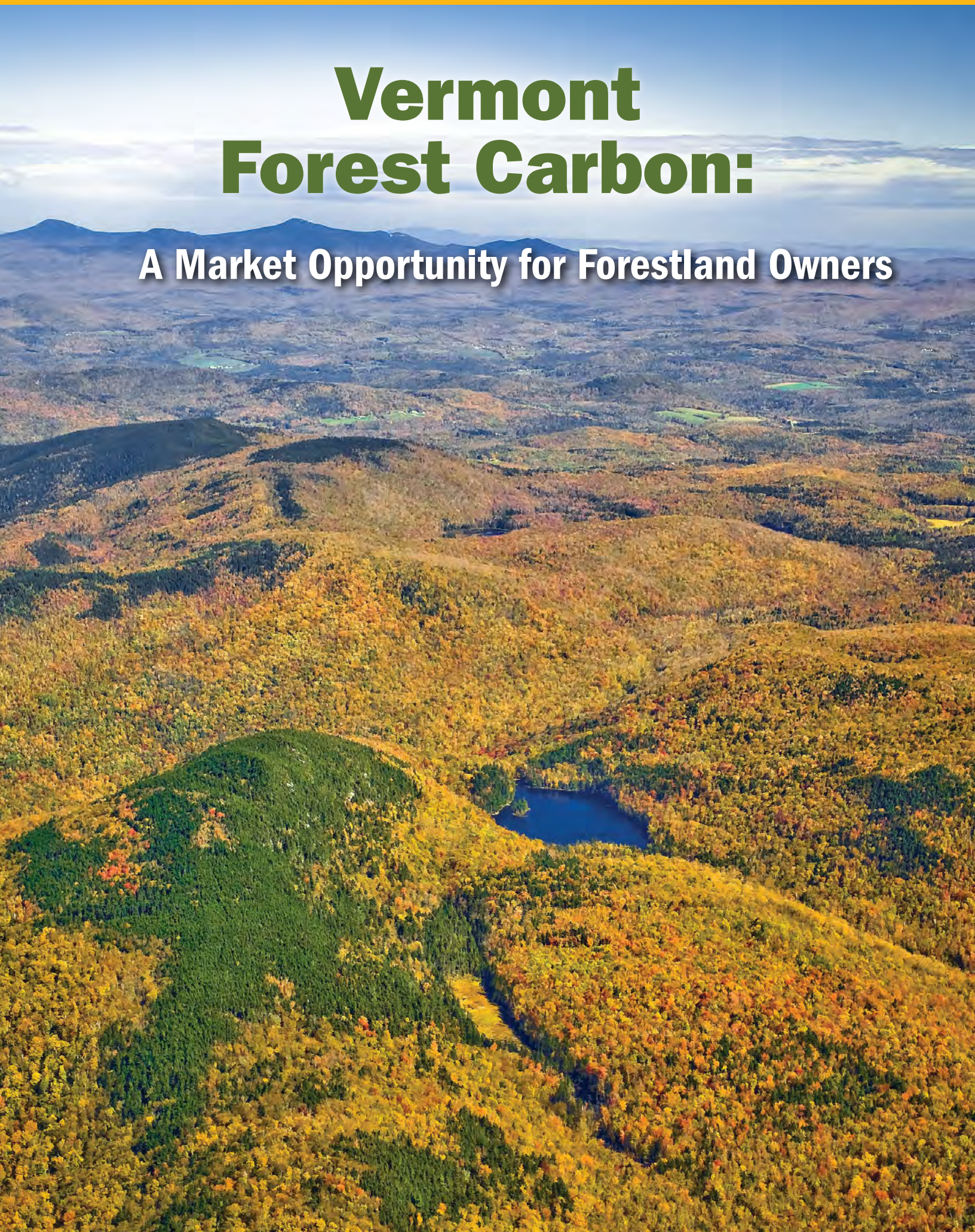
Vermont Forest Carbon:

A Market Opportunity for Forestland Owners



Authors

William S. Keeton
Director of the Carbon Dynamics Laboratory,
Rubenstein School of Environment and Natural Resources, University of Vermont

William VanDoren
Senior Scientist, Spatial Informatics Group

Charles Kerchner
Senior Scientist and Director of Forest Carbon Projects, Spatial Informatics Group

Mackenzie Fuqua
Carbon Dynamics Laboratory, Rubenstein School of Environment and Natural Resources, University of Vermont

Advisory Committee

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Spatial Informatics Group

Carbon Dynamics Lab
University of Vermont
Rubenstein School of Environment and Natural Resources

Vermont Land Trust
Conserving Land for the Future of Vermont

Acronyms

ACR	American Carbon Registry
ARBOC	CARB Offset Credit
ATFS	American Tree Farm System
CAP	Conservation Activity Plan
CAR	Climate Action Reserve
CARB	California Air Resources Board (abbreviation for California compliance market)
CIG	Conservation Innovation Grants
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ESTA	Ecologically Significant Treatment Area
FLA	Forest Legacy Area
FLP	Forest Legacy Program
FMP	forest management plan
FSC	Forest Stewardship Council
GHG	greenhouse gas
HCVF	High Conservation Value Forest
IFM	Improved Forest Management
MMC	Mine Methane Capture Project
MRMP	Multi-Resource Management Plan
$MtCO_2e$	Metric Tonne of CO_2 Equivalents
NGO	non-governmental organization
NPV	net present value
ODS	Ozone Depleting Substances Project
OPR	Offset Project Registry
PEFC	Programme for the Endorsement of Forest Certification
RCPP	Regional Conservation Partnership Program
REC	recognized environmental condition
REDD	reduced emissions from deforestation and degradation
RGGI	Regional Greenhouse Gas Initiative
ROC	registry offset credit
SIG	Spatial Informatics Group
SFI	Sustainable Forestry Initiative
TNC	The Nature Conservancy
UVA	Vermont Use Value Appraisal Program (Current Use)
VCS	Verified Carbon Standard
VCU	Verified Carbon Unit
VLT	Vermont Land Trust

Table of Contents

Executive Summary

Domestic and international carbon markets provide considerable but as yet largely untapped opportunities for forestland owners and conservation organizations in Vermont. This report is intended to encourage landowners and other entities to consider market participation through generation of forest carbon credits. It describes the most relevant carbon market systems, reviews forest stewardship and conservation mechanisms complementary of carbon projects, and recommends an integrated path for project development in Vermont. The path stresses aggregation opportunities under the voluntary market and building on incentives/synergy from multiple stewardship mechanisms. The report presents data on the financial outcomes (net revenue) of a modeled aggregation project, as well as maps showing the statewide distribution of medium- to large-sized forested parcels most conducive to carbon market participation and most likely to contribute to forest block conservation and flood resilience objectives.

There are two types of carbon market systems that landowners in Vermont should consider. Compliance schemes are aimed at large, energy-intensive emitters and commonly adopt cap-and-trade market-based regulation designed to reduce greenhouse gases (GHGs) from multiple sources. The voluntary market serves businesses, government departments, NGOs, and individuals wanting to manage their GHG emissions or pursue carbon reduction proactively. Carbon credits are defined as reductions in emissions of GHGs compensating for emissions made elsewhere. Forest landowners anywhere in the United States may participate in both compliance and voluntary markets through Improved Forest Management projects that generate carbon credits.

The main compliance carbon market operating in the U.S. is the California Air Resources Board's (CARB) cap-and-trade program, although the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort among nine U.S. states in the Northeast, also functions to cap and reduce emissions from the power sector. A variety of voluntary market standards and registries are also available for landowners in Vermont, with the American Carbon Registry providing particularly attractive prospects here.

To be financially viable under CARB, forest carbon projects generally require large (e.g., 5,000 acre) forest holdings; aggregation is not currently allowed under CARB. Conversely, aggregation of smaller properties is acceptable under voluntary market standards, and therefore the voluntary market is the more feasible opportunity for most forest owners in Vermont. However, to gain the economies of scale needed for financial viability, individual properties in an aggregation scheme generally will need to be about 200 acres or larger in size, with total project area adding up to several thousand acres or more. A major uncertainty in voluntary markets, however, is credit prices, whereas these have been higher and more stable in the compliance market. In the voluntary market, negotiating an attractive price for carbon credits directly with a buyer is essential and is often helped by "charismatic" carbon from projects providing other ecological and social co-benefits.

Supplemental revenue generated by an aggregated project developed under the voluntary market could be attractive to some landowners in Vermont. We modeled a hypothetical project involving a collection of seven properties totaling 5,900 acres in northern Vermont. The exercise assumed that moderate timber harvest levels would continue as currently planned and that an external project developer would finance the project in return for 40 percent of the credits generated. Net revenue to the landowners (after expenses) over 10 years was estimated at $943,284. This equates to $16 per acre per year for each landowner—income that could be layered on top of other revenue streams (e.g., timber and nontimber), cost share, and tax incentives.

There are substantial opportunities in Vermont for aggregated carbon projects providing co-benefits under voluntary market standards. Co-benefits of primary interest in this study were forest block conservation and flood resilience. Our spatial analysis identified 328,461 acres of privately owned parcels >500 acres in size and having at least 450 acres of forest each. Of these, about 285,000 acres are within or adjacent to the priority forest blocks mapped statewide and highly ranked for flood resilience benefits. When these parcels were filtered based on whether they currently have a conservation easement, we identified about 140,000 acres not yet conserved in this way. In terms of conservation priority, these parcels represent the greatest potential for aggregated carbon projects to contribute to the sustainability and functionality of Vermont's working landscape. There are, however, also opportunities for compliance market projects: we identified at least six privately owned forested properties in the state that are >5,000 acres in size and more than 60 private and town-owned parcels >1,500 acres in size and having varying conservation status.

Carbon project development in Vermont is compatible with, and in fact would be aided by, participation in other forest stewardship programs. These include forest certification, cost-share by EQIP and the Forest Legacy Program, and Vermont's Use Value Appraisal (UVA) Program (also known as Current Use). All three major certification

systems in the U.S. (Forest Stewardship Council [FSC], Sustainable Forestry Initiative, and American Tree Farm System) can be employed to meet various requirements under CARB and the voluntary markets, such as the need to have a comprehensive forest management plan.

There is no inherent incompatibility between carbon projects and UVA; in fact, the latter also provides an acceptable means of meeting management plan requirements. And because Improved Forest Management for carbon typically favors production of high-quality sawtimber, it is complementary of UVA objectives in that regard. However, integration of carbon and UVA will require application of management that generally increases or maintains high overall timber stocking on a property, and these carbon forestry approaches will need to be approved by Vermont's country foresters.

Conservation easements help landowners meet the "permanence" requirements of market protocol, and carbon financing can help all parties to cover their costs. However, pre-existing easement terms are considered legal restrictions by the protocols, and depending on the specific (if any) harvesting restrictions within a given easement, these terms may affect the project baseline and thus the potential for carbon storage additionality (or credits).

The "Vermont Path" toward expanded participation in carbon markets involves harnessing existing capacity for stewardship planning and integrating this within a uniquely Vermont-branded program. Such a program would have distinct marketing advantages compared to stand-alone carbon projects. It would promote a multifunctional and landscape-oriented approach to conservation in Vermont, integrating working forests, open space conservation, flood protection, and climate mitigation. The most promising path for carbon projects in this state would layer conservation and stewardship mechanisms to make projects as financially feasible and attractive as possible. Consideration of a governance structure for a program promoting this path and working directly with landowners will be an important first step.

Carbon market participation will not work for everyone or everywhere. It will work best through project aggregation of properties that are medium (e.g., several hundred acres) to large (e.g., >1,000 acres) in size, well-stocked, and managed and where the potential to provide co-benefits attractive to buyers in the voluntary market is greatest. In conclusion, this feasibility study demonstrates that forest carbon projects can be successful in Vermont, providing benefits to landowners, communities, and the state.

Introduction

Rapidly developing compliance (or "cap-and-trade") and voluntary (or "over-the-counter") carbon markets present new opportunities for forest landowners in Vermont as throughout the country. Yet to date only one project generating forest carbon credits—an accounting instrument used to assess how forest carbon sequestration offsets greenhouse gas emissions—has been developed in the state. Meanwhile, forest carbon projects have been successfully developed in several other northeastern states. Prices in North American carbon markets have remained robust, especially for "charismatic" carbon projects (i.e., those proving multiple ecological and social benefits) and increasingly represent an attractive financial opportunity for privately owned forestlands. Carbon credit revenue adds value to working forests, helping to keep them financially viable, conserve open space, and encourage sustainable forest management. There is a need, therefore, for information on market opportunities and forest carbon project feasibility to help guide Vermont landowners in considering the risks and benefits of broader market participation.

With Vermont's commitment to fighting climate change through an 80 to 95 percent reduction in greenhouse gas emissions below 1990 levels by 2050,[1] there is wide interest in exploring carbon sequestration on our forested landscape. Carbon markets incentivize activities sharing this goal. Furthermore, there is potential to achieve other co-benefits through carbon projects. This is because carbon projects typically entail a variety of conservation mechanisms to ensure the "permanence" of emissions offsets and a landowner's long-term commitment to forest stewardship. In addition, carbon markets require landowners to manage forests for high levels of stocking (i.e., biomass or carbon storage).

Forest carbon is sequestered—soaked up from the atmosphere—by plants through photosynthesis, stored in living and dead biomass, and ultimately released back to the atmosphere in the form of carbon dioxide through plant and animal respiration and decomposition. After years of debate over the best way to account for the carbon cycle benefits of forests, all major market standards today stress carbon storage (the density of carbon held within a forest, both aboveground in organic matter and belowground in the soil), while also accounting for sequestration rates (uptake) and the life cycle of carbon in wood products.

Because of this accounting approach, carbon forestry, as incentivized by the markets, generally equates with contemporary standards of excellent forestry, such as those required by major certification systems. These include practices that encourage good tree growth, healthy forests, and both high-quality mature forest habitats for wildlife and larger dimension sawtimber. And for these reasons, carbon forestry is often complementary of other objectives, such as conserving unfragmented forested habitats and watersheds with high resilience to flooding.

Purpose of this Study

The purpose of this study is to provide landowners, conservation organizations, policy makers, and others with targeted information on market opportunities and forest carbon project feasibility, in a manner specifically applicable to Vermont. In so doing, the study aims to stimulate broader consideration of carbon market participation within our state, benefiting landowners, communities, and the working landscape generally.

The study provides a comprehensive assessment of carbon market opportunities available to landowners in Vermont, with an emphasis on privately owned forests. The report reviews major market systems available to landowners in Vermont, describing alternative standards within both the compliance and international voluntary systems. In addition, emphasis is placed on integration with complementary forest stewardship mechanisms that help pave the way toward carbon market participation. We evaluate the mechanisms most compatible with carbon projects, identifying pros and cons of each with respect to carbon complementarity. Based on this analysis, we recommend a "Vermont Path" charting a course toward the most financially viable scenarios for forest carbon project development. This path considers the generally small average parcel size on the Vermont landscape and the constraints this imposes on the choice of relevant market standards.

In the appendixes we present data on the potential financial outcomes of a hypothetical (or modeled) aggregated carbon project under one of the voluntary market standards (American Carbon Registry), using inventory data from seven properties totaling 5,900 acres in northern Vermont. These are presented to demonstrate the financial feasibility and supplementary revenue that would be generated over 10 years after accounting for all project

1 http://climatechange.vermont.gov/vermonts-goals

expenses. We hope this information will be informative for other landowners considering carbon market participation.

The appendixes also present data and maps identifying the location and acreages of privately owned lands that: (1) have the highest potential viability for carbon projects, and (2) that have the greatest potential for yielding forest block conservation and flood resilience co-benefits. This analysis is intended to guide aggregation of forested properties into projects specifically endeavoring to provide multiple co-benefits and, therefore, gain a price premium on the voluntary market while accomplishing important conservation work for the Vermont landscape.

How to Read This Report

This report is divided into three sections providing different types of information for a range of potential stakeholders. Readers looking for a general overview of carbon market systems relevant to forestry projects in Vermont, as well as market trends and an explanation of "aggregation," should concentrate on Section 1. The second section explores the compatibility between carbon projects and a variety of forest stewardship and conservation mechanisms available to landowners in Vermont. The report distills "key findings" for each of these, providing a snapshot of take-home messages relevant to integration with carbon projects. In Section 3 we propose a number of elements that could be folded into a comprehensive program encouraging forest carbon project development in Vermont. This section integrates the information and analysis presented in the first two sections. For those looking for the "Vermont Path" to carbon market participation, Section 3 is recommended.

And finally, Appendix 1 and 2 present the quantitative and map-based components of the feasibility study. These include an analysis of financial outcomes for a hypothetical aggregation project under the voluntary system for a collection of properties in northern Vermont and a spatial analysis of the parcels meeting carbon market feasibility criteria and having high priority for forest block conservation and flood resilience.[2] Readers looking for the financial data and maps of high priority parcels, plus histograms showing parcel size distributions, will find the appendixes particularly valuable.

2 Flood resilience rankings were contributed by K. Bryan-Watson and T. Ricketts, UVM Gund Institute for Environment

SECTION I.
Overview Of Compliance And Voluntary Carbon Markets

Carbon markets are used to efficiently allocate resources to reduce atmospheric CO_2 levels and can be either voluntary or mandatory. Mandatory or compliance markets are regulated by law and used by companies and governments to account for and manage their GHG emissions. The voluntary market is regulated by standards that monitor and verify the quality and validity of voluntarily traded carbon credits.

Compliance schemes are generally aimed at large, energy-intensive emitters and commonly adopt cap-and-trade market-based regulation designed to reduce greenhouse gases (GHGs) from multiple sources. Cap-and-trade sets a limit or "cap" on GHG emissions, which declines over time. Allowances equal to the cap are distributed to emitters by free allocation and/or through auctions, and emitters can trade allowances such that those with lower emission reduction costs can sell to those with higher costs, which reduces overall compliance costs. At the end of a compliance period, emitters are required to hold allowances equal to their emissions.

The voluntary market serves businesses, government departments, NGOs, and individuals wanting to manage their carbon emissions or pursue carbon reduction proactively. There is no cap, and all action is voluntary. A wide range of participants are involved, including providers of different types of offsets, developers of quality assurance mechanisms, third-party verifiers, and consumers. As well as allowing investment in GHG emissions reduction, voluntary markets serve as a more flexible testing ground for methodologies or protocols that may later be adopted by compliance markets and allow private companies to gain experience with market-based tools in anticipation of carbon regulations.

Carbon credits play an important role in GHG emissions reduction efforts and are defined as reductions in emissions of GHGs made to compensate for an emission made elsewhere. In order to "offset" a ton of carbon emissions in one place, a ton of carbon must be captured or "credited" somewhere else. Offsets are, to a limited extent, often permitted in cap-and-trade systems and allow emitting entities to comply with caps on the total amount of GHGs they are allowed to emit by balancing them with credits produced elsewhere. Entities that are not part of a compliance market may also voluntarily offset their emissions by purchasing carbon credits either from voluntary or compliance carbon markets.

Carbon offsets represent reductions in GHG emissions to the atmosphere or additional sequestration of existing atmospheric carbon. Emission reductions may come from renewable energy projects that displace fossil fuels, landfill capture of methane gas, or the replacement of open fires with efficient cookstoves. Forestry and agriculture offset projects sequester additional carbon in trees and soil. Carbon offset production is based on the difference in emissions between project and baseline scenarios. Baselines are defined according to the project type and can be based on common practice, business as usual, standardized emissions estimates, profit maximization, or minimum legal requirements. Offset projects often provide co-benefits such as better air and water quality, biodiversity and forest conservation, and/or healthier communities. In compliance markets, capped entities are often allowed to offset a small portion of their emissions with these credits, allowing caps to be met by an efficient combination of reductions, allowances, and offsets. More broadly, offsets facilitate cost containment in compliance markets and help maintain economic stability by allowing carbon to be purchased from areas and entities with a lower carbon price.

The program rules supporting all offset systems are fundamental to their "fungibility." As general principles, offsets must demonstrate that they are real, additional (i.e., extra in relation to the baseline and not achievable without carbon finance), verifiable, permanent, and enforceable. Compliance systems are considered to have tighter regulatory controls (e.g., stronger program rules and protocols) and more stringent oversight. In compliance markets, confidence and stability—through policy and rulemaking—are built into the program. These systems often exercise some level of control over both supply and demand, which can impact offset price. In voluntary markets, demand is reliant on buyers' interest, and markets have tended toward an oversupply. From the project owner's perspective, demand is more likely to vary throughout the period of credit issuance, which may last for decades. Voluntary programs, however, are generally more flexible and credit issuance is a more predictable process.

Domestic Compliance Carbon Markets

The main compliance carbon market operating in the U.S. is the California Air Resources Board's (CARB) cap-and-trade program, although the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort among nine U.S. states in the Northeast, also functions to cap and reduce CO_2 emissions from the power sector. Compliance markets accept projects from private, public (non-federally owned), and American Indian owned land.

California Air Resources Board Cap-And-Trade Program

The cap-and-trade program is a key component of California's goal of returning to 1990 GHG levels by 2020 as set forth under California's Global Warming Solutions Act of 2006, commonly referred to as AB 32 (Assembly Bill 32). The California Air Resources Board (see Box 1) adopted the state's cap-and-trade rule on October 20, 2011, and implements and enforces the program. CARB's major goals for the state's cap-and-trade rule (see Box 1) align with protocol set forth in the Montreal Process. In 2016, the Legislature passed SB 32, which includes a 2030 GHG emissions reduction target of 40 percent below 1990 levels. In February 2017, California's Legislative Analyst's Office (LAO) recommended the state legislature authorize its cap-and-trade program to continue after 2020, although with certain changes, such as a stronger price ceiling.

The program covers 85 percent of GHG emissions in California and includes around 360 companies; companies may offset up to 8 percent of emissions, though this limit may be lowered even further in the future. Currently, only about 2 percent of offset credits generated under CARB are from the forest sector. The cap was set in 2013 at about 2 percent below the forecast 2012 emission level and declined by about 2 percent in 2014 and by 3 percent annually from 2015 to 2020. The cap-and-trade rules were applied first to electric power plants and industrial plants emitting >25,000 metric tons of carbon dioxide equivalent (CO_2e) per year. In 2015, the rules were also applied to fuel distributors meeting the 25,000-metric ton threshold. Currently the cap-and-trade program expires in 2021 but efforts are underway to extend the program in support of California's goal of reducing 2050 CO_2 emissions by 80 percent compared to 1990 levels.

California Carbon Allowances are distributed by a mix of free allocation and quarterly auctions. Allowances for large industrial facilities and electric utilities are set at about 90 percent of average emissions. The percentage of free allowances allocated to the businesses will decline over time. A business may also buy allowances at quarterly auctions from other entities that have reduced their emissions below the amount of allowances held. If emissions reduction is easier than expected, allowance prices fall; if harder than expected, allowance prices rise.

Organizations and entities entering into compliance markets, as a part of entrance, need to assess the risk of conversion. Based on the potential for environmental hazards, or encroachment on parcels, a percentage of an organization's carbon credits are set aside in a buffer pool to offset any decreases in productivity or "reversals" in carbon storage resulting from disturbances, such as wind, fire, or insect-caused damages.

An auction reserve price acts to limit the minimum price of allowances. The auction reserve price in 2012 and 2013 was set at $10/allowance for both the current and advanced auctions. From 2014, the Auction Reserve Price began an annual increase of 5 percent plus the rate of inflation. At the end of each compliance period, each regulated emitter must surrender enough allowances to cover its actual emissions during the compliance period.

Offsets from emissions reduction projects in the United States may be used for up to 8 percent of a facility's compliance obligation, and international offsets may be allowed in the future. The auction reserve price influences the price of offsets, but there is no actual floor on the price of offsets. Offsets sell at around 80 percent of allowance prices, owing to the risk some compliance buyers associate with offsets. Projects producing offsets must be certified according to CARB regulations.

CARB has adopted Compliance Offset Protocols in the following areas:

- U.S. Forest Projects (Reforestation, Improved Forest

Box 1.

California Air Resources Board

The California Air Resources Board (CARB) is a part of the California Environmental Protection Agency, an organization that reports directly to the Governor's Office in the Executive Branch of California State Government. CARB's mission is to promote and protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the state.

The Major Goals of the Board Are To:

- Provide Safe, Clean Air to All Californians
- Protect the Public from Exposure to Toxic Air Contaminants
- Reduce California's Emission of Greenhouse Gases
- Provide Leadership in Implementing and Enforcing Air Pollution Control Rules and Regulations
- Provide Innovative Approaches for Complying with Air Pollution Rules and Regulations
- Base Decisions on Best Possible Scientific and Economic Information
- Provide Quality Customer Service to All CARB Clients

Management, Avoided Conversion)
- Urban Forest Projects
- Livestock Projects
- Ozone Depleting Substances (ODS) Projects
- Mine Methane Capture (MMC) Projects
- Rice Cultivation Projects

Projects may be overseen by landowners or authorized project designees, which may be "any person/entity, interim manager, provided the landowner has greater than 50 percent interest or control." Project designees may range from an individual, general partnership, LLC, LLP, joint venture, or trust. The process to develop an offset project involves registration, listing, monitoring and reporting, verification, determination of registry offset credits, and, finally, determination and issuance of CARB offset credits. The most common types of forest projects under CARB are termed Improved Forest Management, or IFM, which aim to increase carbon stocks compared to the baseline by increasing the rotation period across multiple forest stands, improve productivity, or shift to selection harvesting or retention forestry practices that retain greater amounts of forest structure postharvest. To assess credit generating potential, IFM projects must compare their carbon stocking against a variety of baselines, including those maintained by common practices in the same geographical region.

The IFM project development procedure requires the following main stages:

Stage 1: Data mining and feasibility
- Assess property characteristics (Stocking, Size, Forest type)
- How property characteristics intersect with selected forest offset protocol (Start date, Legal constraints, Future management, Consider reversals)

Stage 2: Contract Agreement and Listing
- Emission Reduction Project Agreement outlines responsibilities & sale agreement
- List with registry

Stage 3: Inventory design and implementation

Stage 4: Growth and yield modeling/quantification/linear optimization

Stage 5: Project Design Document (PDD), verification, offset sales
- Project documentation includes inventory manual; document describing project design
- Third-party verification
- Offset sales negotiated directly with buyers, project story provided

All offset projects developed under a CARB Compliance Offset Protocol must be listed with a CARB-approved Offset Project Registry (OPR) to help facilitate the listing, reporting, and verification of compliance offset projects and issue registry offset credits (ROCs). CARB has approved three OPRs that also function in voluntary markets as follows (see also below):
- American Carbon Registry (ACR)
- Climate Action Reserve (CAR)
- Verified Carbon Standard (VCS)

Upon acceptance of the project by CARB, ROCs are cancelled and CARB Offset Credits (ARBOCs) are issued for compliance in the cap-and-trade program. Project owners have a range of commitments they must meet following project initiation. Forest project owners must commit to initial site verification, data reports every 12 months, site-visit verification every six years, and a full inventory of carbon plots at least every 12 years. The crediting period lasts for 25 years, but forest project owners must monitor and verify a project for a period of 100 years following the last credit issuance. Eligibility criteria include:
- Canopy cover must exceed 10 percent;
- Project consists of ≥95 percent native species with no single species prevalence where the project area consists of a mixed species distribution;
- All forestland holdings owned or controlled by the forest owner must be under one or a combination of the following:
  - Certification of forest management by the Forest Stewardship Council (FSC), the Sustainable Forestry Initiative (SFI), or the American Tree Farm System (ATFS), or
  - Operating under a renewable long-term management plan that demonstrates sustainable harvest levels and is sanctioned and monitored by a state or federal agency, or
  - Application of uneven-aged silvicultural practices and canopy retention averaging at least 40 percent across the forest, as measured on all contiguous 20-acre areas and 20 acres between harvested tracts within the entire forestland owned by the forest owner(s).

Although the California cap-and-trade market initially limited entry to projects in the U.S., a framework is in place for international expansion. As such, California is working closely with four Canadian provinces through the Western Climate Initiative to develop harmonized cap-and-trade programs that will expand the market and help deliver cost-effective emission reductions. CARB is already linked to new compliance markets in Ontario and Quebec. And although as yet uncertain, CARB may admit REDD+ offsets to the cap-and-trade program from Chiapas, Mexico, and Acre, Brazil.

In spite of considerable success in reducing emissions and increasing state revenues, the California cap-and-trade market is subject to change through legislation that may alter its structure and requirements post 2020.

3 "REDD" stands for Reducing Emissions from Deforestation and forest Degradation; the "+" stands for enhancement of forest carbon stocks.

Recent litigation challenging CARB's auction process as an unconstitutional state tax has been settled.

Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort among the northeastern states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector. Additional states may join in the future, and discussions are underway to possibly extend RGGI compliance requirements to other sectors.

To reduce emissions of greenhouse gases, the RGGI States use a market-based cap-and-trade approach that includes:

- A multistate CO_2 emissions budget ("cap");
- Requirements for fossil-fuel-fired electric power generators with a capacity of 25 megawatts or greater to hold allowances equal to their CO_2 emissions over a three-year control period;
- Allocating CO_2 allowances through quarterly, regional CO_2 allowance auctions; and
- Allowing offsets (greenhouse gas emissions reduction or carbon sequestration projects outside the electricity sector of up to 10 percent) to help companies meet their compliance obligations.

Under recent changes enacted in December of 2017, RGGI States limit the award of offsets to three project categories provided they meet all requirements in RGGI State regulations:

- Landfill methane capture and destruction;
- Sequestration of carbon due to U.S. forest projects (reforestation, improved forest management, avoided conversion) or afforestation (for Connecticut and New York only);
- Avoided methane emissions from agricultural manure management operations.

Improved forest management plans, similar to CARB, aim to increase or maintain carbon stocks relative to baseline. Enrolled properties must:

- maintain at least 40 percent canopy cover as measured on any 20-acre stand;
- include natural forest management practices, which include uneven-aged forestry practices and not more than 40 acres harvested at a given time in a single block;
- ensure that adjacent stands or compartments are not harvested within five years of one another; and
- maintain stable or increasing stocking during the project period, with exceptions made for unanticipated reductions due to disturbances or planned reductions to achieve improved age class balance or for fuels treatment and fire risk reduction.

The RGGI States cooperatively developed prescriptive regulatory requirements for each of the five offset categories. All offset projects must be located within one of the RGGI States. The low price of auction allowances has meant that no forest projects have been used to comply with RGGI. Projects under RGGI must provide annual reports (no site visit required) and a verification of certification by a third-party every six years (at most). Verification under the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), or American Tree Farm Systems (ATFS) must meet and exceed RGGI's standards for verification.

Key Findings

- Vermont-based carbon projects, due to small average property size, would not fare well entering into CARB due to poor economies of scale, a function of high transaction costs compared to relatively low credit yields on smaller properties.
- Compliance markets do not formally allow for aggregated projects, though indirect mechanisms of registering multiple properties under a single project are being explored. This may expand opportunities under CARB for Vermont properties in the future.
- Landowners having already gained certification under major forest certification programs are well placed for subsequent enrollment in CARB because of having met requirements such as development of management plans. This has the added advantage of reducing project development costs and is a benefit for landowners in Vermont who may be interested in both mechanisms.
- Compliance markets require a 100-year contractual commitment, which some private forest owners in Vermont may find overly burdensome.

Voluntary Carbon Markets

The majority of voluntary carbon projects use third-party verified standards to guide project development and to ensure that emissions reductions are real and additional. In 2016, for example, 99 percent of voluntary offset credits were certified by a third-party standard.[4] To accomplish this, most standards require projects to assess feasibility and risks and later to outline project activities and establish a baseline level of emissions. A third-party auditor then validates assumptions, and after project implementation and

4 Ecosystem Marketplace. 2017. Unlocking Potential: State of the Voluntary Carbon Markets 2016. https://www.cbd.int/financial/2017docs/carbonmarket2017.pdf

monitoring, a verification process assesses actual emission reduction claims. Offset project registries then give each tonne of emissions reduction a unique serial number, and the emissions reductions can then be tracked and transacted before being retired on a registry.

For organizations wishing to purchase emissions reductions, retailers, or brokers can match buyer needs and available emissions reductions, or buyers or project developers may choose the most popular transaction type, transacting directly with one another. Hamrick and Goldstein (2015) found that 98 percent of the market chooses to transact or track offset credits through registries versus direct exchanges between sellers and buyers without the use of a registry. Organizations may also finance emissions reduction projects during the conception or start-up phase before emissions reductions are generated.

In North America, there are four key voluntary carbon market standards offering protocols for certifying projects. These are:

- Climate Action Reserve (CAR)[5]
- American Carbon Registry (ACR)[6] controlling 19.2 percent of the market
- Verified Carbon Standard (VCS)[7] controlling 37.2 percent of the market
- Gold Standard[8]

Protocols offered by the different standards cover a wide range of project types from forestry and land management to transport and renewable energy. Globally, VCS is the leading quality assurance standard trading the majority of carbon credits. Gold Standard also operates globally and focuses on energy projects. In the U.S., voluntary carbon projects are most frequently developed under ACR, VCS, and CAR protocols.[9]

Applications are accepted from forest owners of any type, including private, municipal, county, state, federal, and tribal landowners. Of these projects, over 50 percent involve offsets generated through some form of forest management or conservation. Forest-related protocols offered by the different standards cover afforestation/reforestation, improved forest management, and reducing emissions from deforestation and degradation (REDD). The most popular subtype of forest projects is REDD, but these typically have had the lowest credit prices. The highest paying forest project type is Improved Forest Management (IFM). Under the voluntary market protocol, credit eligibility is generated by comparing IFM project activities against baselines representing legally acceptable management practices that could be used to maximize net present value (NPV). To achieve the "additionality' (i.e., enhanced carbon storage) that generates credits, a landowner must schedule timber harvests or incorporate management practices that increase average carbon stocking above the baselines over time. VCS currently offers 21 approved methodologies in agriculture, forestry, and land use, several of which are relevant for Vermont forest owners. Protocols from VCS, ACR, and the top registries comply with established guidelines set under the Montreal Process in a manner similar to the compliance market. New methodologies can be developed and approved by VCS through a rigorous third-party review process.

Verified Carbon Standard (VCS)

The Verified Carbon Standard[10] was created with the intension to create a trusted, fungible greenhouse gas (GHG) credit for the market, later termed the Verified Carbon Unit (VCU). The VCS covers projects related to GHG emission reductions/removals and REDD but does not cover carbon neutrality or footprint assessments. VCS allows projects that are formed under different market mechanisms to be converted into a VCS project if methodologies used are approved by VCS. Projects are enrolled on 40-year commitments and must be verified by a third party every five years, with written updates yearly. The majority of VCS's projects have other conservation mechanisms in place, such as FSC certification, Climate, Community and Biodiversity Standards (CCBS) certification, and conservation easements.

Forest projects under Agriculture, Forestry and Other Land Uses (AFOLU) cover projects ranging from afforestation, reforestation, revegetation, agricultural land management, improved forest management, REDD, avoided conversion of grassland and shrubland, and wetland restoration and conservation.

VCS suggests two options for aggregated projects. These are:

- "Multiple Instances of Project Activities," which has one start date and one overall baseline; or

5 Climate Action Reserve protocols include: Coal Mine Methane, Forest, Grassland, Landfill, Livestock, Ozone Depleting Substances, Nitric Acid Production, Nitrogen Management, Organic Waste, Rice Cultivation, Urban Forest. See: http://www.climateactionreserve.org/how/protocols/

6 ACR protocols are available in a range of sectors including: Energy, Transport, Fugitive emissions from industrial gases, Waste Handling and disposal, Agriculture, Forestry, Land Use, and Livestock. See: http://americancarbonregistry.org/carbon-accounting/standards-methodologies

7 VCS protocols are available in a range of sectors including: Energy, Industrial Processing, Construction, Transport, Waste, Agriculture, Forestry, Mining, Livestock & Manure, Wetlands, and Grasslands. See: http://www.v-c-s.org/methodologies/find

8 Gold Standard Protocols are available in a range of sectors including: Energy, Afforestation/Reforestation, Agriculture, and Water. See: http://www.goldstandard.org/

9 CAR's forestry protocol has been largely adopted/superseded by the CARB Compliance Offset Protocol for U.S. Forest Projects and interest in CAR voluntary forest carbon projects has therefore declined.

10 Now a program of Verra. See www.verra.org.

- "Grouped Projects," which allows for an expansion of projects over time within a certain geographical area and forest type.

Aggregation through these two mechanisms is possible but requires a lengthy validation process, which can be onerous for some landowners.

American Carbon Registry (ACR)

The American Carbon Registry (ACR), created in 2007, has developed into a widely used offset registry by projects enrolling under CARB. The ACR addresses emissions of CO_2, CH_4, $N2_O$, HFCs, PFCs, SF_6, and black carbon. The ACR requires projects be verified remotely by a third party every year and site visits every five years over the course of the 40-year commitment period.

In order to submit a proposal, organizations must exhibit additionality by either:

- Exceeding approved performance standards as defined by existing methodologies; or
- Passing a three-pronged test of additionality by showing proof of:
  - Exceeding current effective/enforced laws and regulations
  - Exceeding common practice for both region and forest type
  - Proof of facing one of three implementation barriers:
    * Financial
    * Technological
    * Institutional or Social

.

As a part of the proposal process, project developers must assess risks of "reversal" (e.g., unanticipated emissions dues to disturbances or salvage logging) and, dependent on level of risk, set aside a portion of the eligible offset credits in a buffer pool in a manner similar to the compliance markets. ACR allows projects to manage risks not covered by the buffer pool by employing an actuary and purchasing an insurance policy. Projects under additional management plans that "run with the land," such as conservation easements and current use value appraisal, lower risk factors for parcels.

IFM projects can include conversion from conventional logging, conversion of managed forests to protected forests, extended rotations, conversion of low-productivity to high-productivity forests by removing invasive or diseased species, increasing stocking, managing competing species, increasing carbon stocks in durable wood products, increasing production efficiency, and shifting wood production from short term to long term. Improved forest management projects include two 20-year crediting periods within the 40-year contract commitments, whereas REDD project credit periods are 10 years.

ACR, unlike compliance market mechanisms, allows and even encourages aggregated projects. ACR protocol requires

Key Findings

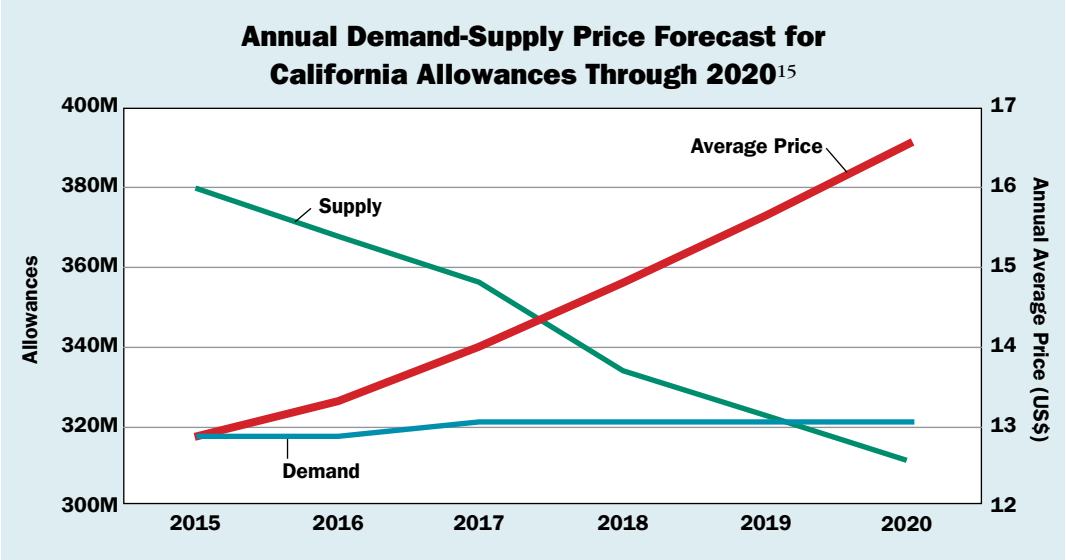
- The range of management methodologies allowed by voluntary programs are consistent with the kinds of management practiced on Vermont forestlands.
- Offset prices have been consistently lower (averaging about \$3 per $MtCO_{2e}$ in 2016) under voluntary markets in North America as compared to CARB (currently about \$11 per $MtCO_{2e}$).[11] This may lessen the attractiveness of voluntary markets for some. However, in Spatial Informatics Group's experience, prices negotiated with voluntary credit buyers can be considerably higher (e.g., \$8 or more per $MtCO_{2e}$), particularly for forest carbon projects carrying added cachet or "charisma" such as biological, ecological, or community co-benefits. This experience is corroborated by recent market research.[12] This has the effect of reducing the price point advantage of the compliance market in those cases.
- The 40-year commitment period may be significantly more attractive to private land owners, depending on long-term stewardship objectives, compared to the 100-year commitment required by compliance markets. It is important to note, however, that the commitment period does not end until 40 years after the last offset is credited.
- ACR will be an attractive option for Vermont due to the potential for including multiple medium (e.g., >100 acres or more in size) to large properties under a single project, thereby improving economies of scale. Aggregation will be less cost prohibitive for family forests. The ACR facilitates market entry for aggregated projects, allowing individuals to use Programmatic Approaches to Development and aggregated sampling techniques.
- Other forest stewardship programs and mechanisms, such as certification, Use Value Appraisal (Current Use), and conservation easements are readily compatible with or required by the voluntary markets. This provides an opportunity to "layer" multiple mechanisms that encourage open space conservation and working forest viability.
- Voluntary Markets appear to provide the easiest entry for Vermont properties, provided they are of sufficient size and stocking to have potential within an aggregate project.

11 Hamrick, K., and M. Gallant (2017). Unlocking Potential: State of the Voluntary Carbon Markets 2017. Forest Trends' Ecosystem Marketplace, Washington, D.C. https://www.cbd.int/financial/2017docs/carbonmarket2017.pdf.

12 See, for example, http://www.ecosystemmarketplace.com/articles/study-finds-symbiotic-relationship-between-voluntary-and-compliance-markets-in-north-america/

that project representatives choose forests that are within a single geographical area, are similar in forest type, and maintain similar baselines. Aggregated projects are represented by project proponents that commit to 40 years, whereas the individual landowners involved in aggregation do not sign a commitment directly with ACR. ACR's traditional aggregated protocols set one start date and do not allow for removal or entrance of projects after commencement, unless the project is terminated and redeveloped. Projects may choose to enroll in Programmatic Approach to Development projects, allowing landowners to leave and join at numerous start dates, baselines, and credit periods throughout the lifetime of the project. If parcels are somewhat homogeneous, aggregated projects may use stratified sampling techniques to lessen sampling intensity and lower inventory costs for landowners.

Figure 1



Climate Action Reserve (CAR) and Markit Registry

Providing enrollment access for both the voluntary and compliance markets, the Climate Action Reserve (CAR) is one of the largest carbon offset registries in North America. CAR is a California Offset Project Registry (OPR), similar to ACR, that lists offset projects, collects project reporting documentation, facilitates verification, and issues registry offset credits (ROCs)

In addition to ACR, VCS, and CAR, there are other carbon registries that comprise a lesser share of the market. These include Markit Registry, a global registry that acts as a tool for managing global carbon, water, and biodiversity credits. It allows participants to track projects and to issue, transact, and retire credits. Projects listed on the Markit Registry[13] are primarily developed under the Gold Standard and the Verified Carbon Standard (VCS).

Market Trends, Opportunities, and Uncertainties

In 2015, offsets originating from the U.S. transacted the most of any country (15.4 $MtCO_2e$, up 71 percent from 2014) with the majority destined for U.S. buyers. Fears that linkage of California's cap-and-trade carbon market with Quebec's would undermine voluntary offset demand in North America have not been realized, and voluntary markets have grown over the last two years (see footnote 8 above).

Compliance and voluntary transaction volumes across all project types in North America in 2014 were nearly equal, with 12.5 $MtCO_2e$ bought by voluntary buyers and 11.5 $MtCO_2e$ sold to compliance entities.[14] The value, however, differed drastically: with an average price of $3.5 per tonne in North America, the voluntary markets generated $40.5 million in value—only half of the value attributed to compliance markets. Part of this value gap can be ascribed to the dominant project type: the most common voluntary offsets were wind and landfill methane, which traditionally sell for much less than the IFM or Ozone Depleting Substances (ODS) Project types eligible for the compliance markets.

Trends in Domestic Compliance Markets

The California cap-and-trade carbon price is driven by allowance trading, and the price in the Regional Greenhouse Gas Initiative (RGGI) is linked to this by a commonality of buyers. At the beginning of 2014, California Carbon Allowance prices stood at $11.69/$MtCO_2e$ and in February 2017 allowances were at $12.95, while offsets were selling at approximately $10–$10.50 (~80 percent of allowance value).

Figure 1 shows the projected allowance demand-supply forecast through 2020. Overall, the allowance prices are expected to be at the floor price, which rises to $16.50 in 2020. If offsets continue to sell at approximately 80 percent of allowance value, the price in 2020 will be ~$13.50.

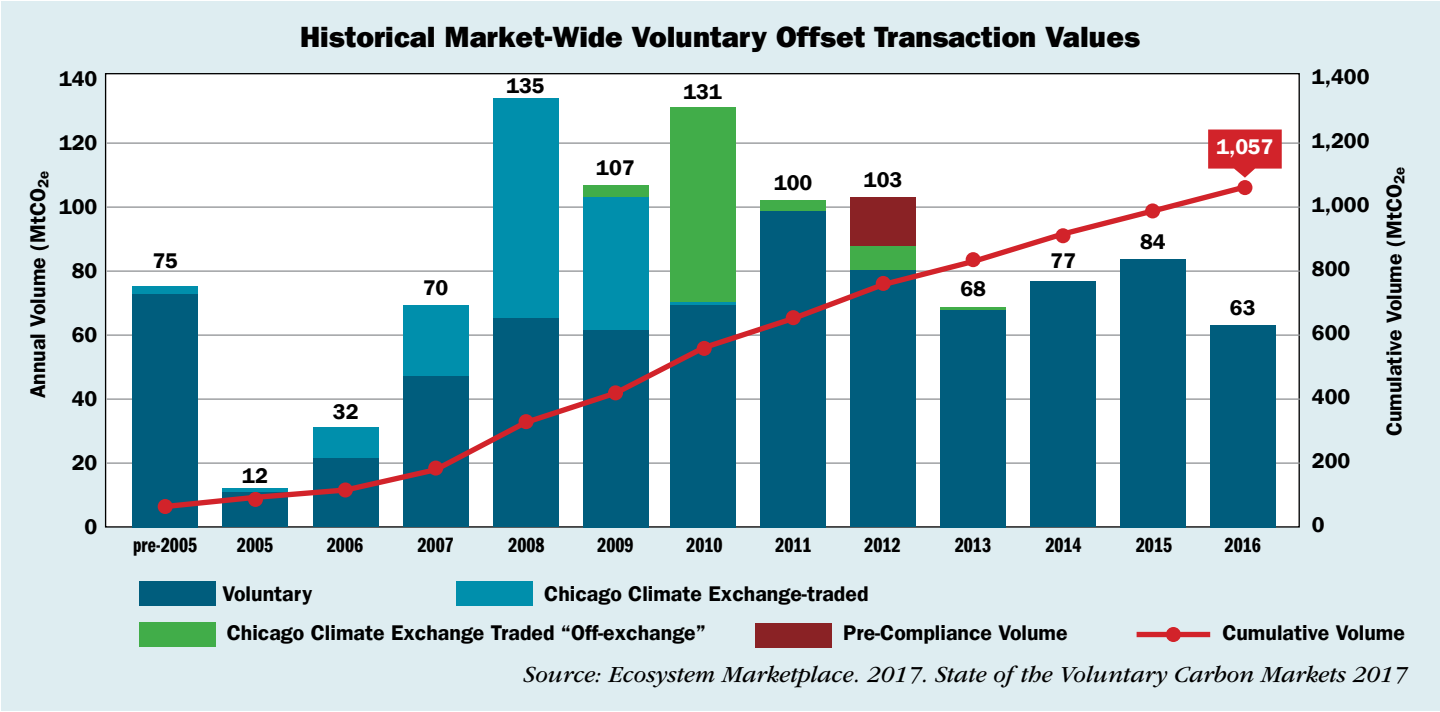
Various factors are expected to affect future demand and prices, including cap adjustments, the success of regulated entities in reducing emissions, potential invalidations, and

13 The Markit Registry: http://www.markit.com/product/registry

14 More than 100 million California Carbon Offsets have been issued as of May 2018.

15 California Carbon Info. http://californiacarbon.info/

Figure 2



Source: Ecosystem Marketplace. 2017. State of the Voluntary Carbon Markets 2017

the availability of offsets from other jurisdictions. However, the biggest influence moving into the third California commitment period (2018–2020) is regulatory uncertainty. According to Bloomberg, even with a strengthened cap, there will be an oversupply in credits up to 2029, and the allowance price is therefore likely to remain at the floor price. Offsets hover at around 80 percent of allowance prices.

Regarding offsets from other jurisdictions, key events to watch include:

- Compliance markets in Ontario and Quebec have linked with CARB (in 2017 and 2014 respectively). National level moves in Canada could also affect prices, for example if a minimum price is set across all the different provincial schemes.
- Whether California moves ahead with a Memorandum of Understanding with Chiapas and Acre, Mexico, and admits REDD credits. This would be a major shock to the market, although many questions are being asked regarding social issues.

Regarding regulator uncertainty the key issues are as follows:

- The Trump administration has canceled the Obama administration's Clean Power Plan. Were a comparable plan to return under a future administration, state-level responses could alter the offset markets. Under the Obama administration, the EPA's Clean Power Plan[16] denied the use of offsets for compliance with the EPA regulations but did not explicitly restrict the use of offsets in state programs.
- AB 398, passed in July 2017, extends the framework for the California compliance market to 2030. These amendments to the cap-and-trade program tighten regulation of economic and emissions "leakage" (movement of companies out of state to avoid compliance burdens) and are intended to create greater efficiency.

Trends in Voluntary Carbon Markets

In 2015, voluntary demand for carbon offsets grew 10 percent to 84.1 million tonnes of carbon dioxide equivalent ($MtCO_2e$) transacted. Voluntary demand for carbon offsets is valued at $4.6 billion over the past decade, including $278 million newly contributed in 2014 as shown in Figure 2.

Between 2014 and 2015, average volume weighted price of offsets dropped from $3.8 to $3.3/$tCO_2e$. Voluntary prices have dropped every year since 2011 due to weak policy signals and fewer new corporate offsetting programs. However, prices of clean cookstove and forestry offsets averaged $4.9–$7.5/tonne in 2015 and can be on par with compliance market prices of $7–$12 per credit if a buyer is identified.

In 2015, offsets from forestry and land-use projects were the second most sought-after offset type after wind although Reduced Emissions from Deforestation and Degradation (REDD+) projects, which account for the bulk of forestry and land use offsets, generated a higher overall value than wind. Offsets from landfill methane, tree planting, clean cookstoves,

16 On February 9, 2016, the U.S. Supreme Court issued a stay against the Obama administration's Clean Power Plan (CPP), which puts greenhouse gas emission reduction requirements on the nation's power plants. This caused a price fall in the California Carbon Market, but the ruling does not disturb the CPP's status, and ARB is moving ahead to plan for implementation of CPP.

hydropower, and water filtration were also popular. Fuel switching and ozone-depleting substances offsets achieved the highest average prices by project category in 2015 at $\$11/tCO_2e$. Buyers paid more for particular project types with co-benefits, and VCS offsets labeled with the Climate, Community, and Biodiversity Standards (CCB) certification sold for an average of $4.8 per tonne.

Voluntary offset prices have remained relatively stable over the last 10 years, seeing an average high of $\$7.3/MtCO_2e$ in 2008 to a low of $\$3.3/MtCO_2e$ in 2015. The voluntary market has recently experienced a small resurgence with more charismatic projects such as REDD+ fetching higher prices. Policy developments and carbon price regulations (actual or anticipated) are the single greatest determinant of future market performance. Estimates are, however, that prices will not increase substantially in the next five years.

Aggregation Opportunities

Vermont has at least 4.5 million acres of forest cover of which roughly 80 percent is privately owned. Among private owners, families and individuals predominate, and parcel sizes are typically small. A recent study in the U.S. Northeast indicated that the financial attractiveness of projects is directly related to initial carbon stocking and property size. Financially viable projects ranged in size from about 1,500 to 12,000 acres, depending on carbon stocking, management, and policy assumptions affecting long-term monitoring costs. To increase participation in forest carbon offset production to support statewide conservation goals, carbon project aggregation presents a number of opportunities for smaller forest owners.

Project aggregation can reduce transaction and overall costs per carbon offset generated by enabling efficiencies of scale related to precision requirements and field verification frequency. Monitoring and forest growth and yield modeling costs may also be shared among aggregate participants to reduce costs to individual forest owners. As such, forest owners with insufficient forestland to generate carbon revenues that compensate the costs of accessing carbon markets may group together to improve the economics of carbon offsets production. Different standards have different rules that determine the extent to which project aggregation can be implemented, for example:

- Under CARB:
  - Aggregation is not permitted, and each forest owner must act as project proponent (Offset Project Operator) or one forest owner or an entity may act as project proponent for a group of ownerships. Regarding the latter, all forest owners will remain ultimately responsible for all forest project commitments although internal agreements can allocate responsibility in relation to different commitments;
  - CARB uncertainty requirements are stringent (estimated carbon stocks must fall within ±5 percent of the mean with 90 percent confidence) and inventory costs are therefore high;
  - A group of projects may, however, used "batched" verification and harmonize inventory and monitoring processes to reduce costs.
  - Entering or exiting an "aggregated" project is likely to be difficult given strict rules on adjusting project areas, but proposals could be made based on existing CARB requirements.

- Under CAR's "Guidelines for Aggregating Forest Projects":[18]
  - Each forest owner must have a separate account and an individual Project Implementation Agreement (PIA), which alleviates much of the risk involved in the CARB option.
  - Uncertainty requirements (which are the same as CARB's for individual projects) are reduced as the number of ownerships in an aggregated project increases, which significantly reduces sampling and monitoring costs;
  - Field verification must occur every 12 years on each property rather than every six years, which is the norm for individual projects;
  - Individual projects (< 5,000 acres), which each have their own baseline, can leave, but a replacement must be included within a year. If not, sampling and monitoring arrangements for the remaining projects must be adjusted.
  - Entering or exiting an aggregated project is permitted and facilitated by rules on uncertainty requirements (if >15 forest owners are in the aggregate, the target sampling error per ownership is 20 percent, so for projects with >15 forest owners, one can leave without changing the sampling error applicable to remaining participants).

- Under ACR's Standard, version 4.0, January 2015, there are two possible aggregation options for small scale (<3000 acres) improved forest management (IFM) projects:
  - Aggregation under which project boundaries, baseline definition, and all other requirements are applied at the level of the aggregate. ACR precision requirements (±10 percent of the mean at a 90 percent confidence level) apply to the aggregated ownerships; and

17 Kerchner, C. , and W. S. Keeton (2015). California's regulatory forest carbon market: panacea or Pandora's box for northeastern landowners? *Forest Policy and Economics* 50: 70–81.

18 As CAR's forestry protocol has been largely adopted/ superseded by the ARB Compliance Offset Protocol for U.S. Forest Projects the CAR Guidelines serve mainly as an example.

  - Program of Activities (PoA) allows project to be added. Project boundaries, a baseline scenario, and a monitoring/verification plan are specified for the entire PoA, which has multiple start dates and crediting periods. The ACR Standard requirements for precision (±10 percent of the mean at a 90 percent confidence level) are applied at the level of each cohort of projects added to the PoA.
  - For both above options, the aggregator acts as the project proponent rather than individual landowners and any agreements between the project proponent and landowners are separate. Individual landowners can leave with the condition that carbon offsets are repaid.

- Under VCS Requirements Document version 3.5, March 25, 2015, two aggregation options are possible:
  - Multiple Instances of Project Activities under which inclusion of further projects subsequent to initial validation of a nongrouped project is not permitted and the baseline for all projects is combined; and
  - Grouped Projects under which expansion subsequent to project validation is allowed and a single or multiple baseline scenario/s is/are determined according to the initial project activity and the number of geographical areas included. If a new project proponent is included, inclusion should be within five years of the project start date.
  - However, expensive early double validation and long baseline decline periods under the VCS protocol can reduce profitability.

In determining whether to pursue one of the options above, several factors need to be considered including:

- Applicability of the specific forest carbon offset protocol to local conditions (baseline methodology, additionality requirements, etc., in comparison with carbon stocks, property size/s and/or dispersion, species type and timber value, prevailing regulatory environment and harvesting restrictions, historic forest management practices);
- Price of and demand for offsets produced under the different protocols and profitability of selling forest carbon offsets in comparison with—or in combination with—alternative land use options;
- Protocol implementation costs, aggregation potential and associated costs/benefits, and policy risks, etc.;
- Interest of registry organizations in pursuing and supporting aggregation initiatives; and
- VLT's existing stewardship infrastructure as a means of facilitating aggregation of multiple forest parcels.

SECTION II.

Compatibility Between Carbon Projects and Forest Stewardship Programs In Vermont

Projects looking to enter either compliance or voluntary carbon markets in Vermont may have more financial gain if developed in conjunction with other types of management plans. Formal management plans, such as those required by Vermont's Use Value Appraisal (UVA) Program (often referred to as Current Use) and all major forest certification systems work in conjunction with carbon management and, in fact, are required by carbon markets. Programs such as UVA and conservation easements lessen tax burdens, whereas grants from cost-share programs lessen the cost of administering management plans, either carbon specific or certification specific. Consequently, layering these mechanisms with carbon projects provides a means for maximizing the potential financial feasibility of working forest ownership and stewardship, as well as open space conservation.

Use Value Appraisal Program

Established in 1980, UVA aims to conserve Vermont's working landscape while promoting active forest stewardship, including timber harvesting. Under UVA, landowners may register their land under long-term forest management and pay property taxes at forestry appraised rate versus fair market value. The former is defined as "the price per acre which the land would command if it were required to remain henceforth in agriculture or forest use, as determined in accordance with the terms and provisions of [Vermont's UVA Program Manual]'s subchapter… UVA means zero percent of fair market value" (p. 10).[19] Farm buildings are included within the appraised rate.

Enrollment in UVA lessens property tax burdens on landowners and offers great potential for integrating carbon with other management objectives through mandated forest management planning. Participation in UVA has increased significantly since its inception in 1980. From 1987 to 2011, the land area enrolled in UVA increased 225 percent to 1,734,012 acres, representing 39 percent of privately owned forests in the state and approximately 14,000 landowners (Leonard et al. 2012). In the most recent year for which data are available (2012), 76 percent of the harvested for timber was on lands enrolled in UVA, demonstrated the disproportionate role of this program in encouraging forest stewardship.

Landowners interested in UVA work with county foresters to establish forest management plans (FMPs), taking into account silvicultural principles of harvesting, regeneration, and conservation, as well as other specific objectives landowners may have for their parcels.

Property types eligible for UVA include:

- Managed forestland—any property 25 acres or larger in size of which at least 20 acres must be classified as "productive forestland." Areas outside Ecologically Significant Treatment Areas (see below) and classified as productive must be under active, long-term management for forest products, with scheduled and prescribed silvicultural treatments.
- Agricultural lands—lands actively used to cultivate crops, pasture livestock, or to cultivate fruits over 25 acres in size. This includes pasture lands and open lands.
- Ecologically Significant Treatment Areas (ESTA)—areas with special ecological values, such as endangered species or habitat. ESTAs may be enrolled on their own, as well as part of a larger parcel. If enrolled as part of a larger parcel, under the recent UVA revisions there is no maximum limit on the proportion of a property that may be classified as an ESTA provided it meets the criteria for the latter. Management may occur within ESTAs as long as it is consistent with the values (e.g., habitat or rare plant communities) target for conservation.

Landowners looking to enroll properties must create and renew forest management plans (FMPs) every 10 years with consulting foresters. Consulting foresters' fees range based on size of parcel, from $20/acre for the first 50 acres to $10/acre for subsequent acres. Parcels enrolled in UVA will have to be inventoried every 10 years and changes submitted as they arise. The subsequent tax year that a parcel is enrolled, the tax rate will be lowered from fair market value to UVA taxation, as seen in Table 1 below.

There is no inherent reason why carbon projects would conflict with UVA enrollment, so long as active management

19 Vermont Department of Forests, Parks, and Recreation, Forestry Division, County Forester Program (2010). *Use Value Appraisal: Program Manual*. Vermont Agency of Natural Resources, Montpelier, Vermont.

Table 1.

Taxation rate in 2017 for properties enrolled in Vermont's Current Use Value Appraisal Program

	Acres	$/Acre	Total	Tax Rate	Annual Tax
UVA- Forest	100	$135	$13,500	2%	$270
UVA- Agriculture	100	$326	$32,600	2%	$652
Fair Market Value	100	$1000	$100,000	2%	$2000

for sawtimber continues consistent with current guidelines within the UVA program. Improved Forest Management (IFM) projects under both compliance and voluntary market protocol most often involve continued and sustainable forest management for a range of commodities including wood products. The main shift in management approach under IFM is toward scheduling and harvesting practices that maintain or promote high levels of stocking. This most certainly may include practices that improve forest health, composition, tree growth, and sawlog quality. Consequently, the types of practices encouraged by carbon projects are fully consistent with the sustainable forest management objectives embodied in UVA plans.

In addition, if ESTAs are managed more lightly than non-ESTAs, they would typically add carbon stocking—and therefore additionality if net stocking remains above a baseline—under the accounting frameworks required by the carbon markets. A caveat is that the project baseline may consider whether or not ESTAs could be legally managed more intensively were IFM not employed, depending on the particular market standard. Therefore, ESTAs will influence additionality differently depending on the type of carbon project but pose no inherent limitation on overall feasibility.

The main requirement for integration of carbon (and therefore market participation) within the Current Use program will be the willingness of Vermont county foresters to sanction carbon as an acceptable management objective, since they approve UVA plans. Dissemination of technical information on carbon forestry and market participation benefits could broaden awareness of this opportunity among county foresters as well as certified consulting foresters, who are often instrumental in helping landowners write management plans. This would encourage consideration of carbon forestry and market enrollment as professional foresters work with landowners through the UVA program. Over time, it will be important to demonstrate that forest carbon projects are consistent with sawtimber management objectives in order to maintain state-side support for the UVA program as currently framed.[20]

Key Findings

- Lands enrolled in UVA may include both productive timberland and areas of statewide ecological significance.
- Management plans must be reviewed and approved by county foresters every 10 years.
- Projects enrolled in UVA have significantly lower property tax burdens compared to properties appraised based on "best and highest use" value.
- Properties enrolled in UVA are completely eligible for carbon projects under both voluntary and compliance market systems. The authors of this study could find no incompatibility between carbon and UVA, based on literature review as well as interviews with county foresters.
- There is no reason to believe that UVA management plans could not be adapted to conform to carbon market protocol. On the managed portion of UVA enrolled properties, the management plans would simply need to have a carbon emphasis that maintains stable or increasing stocking.[21] Within ESTAs, passive or light management would be consistent with carbon market protocol and generally have the potential for enhanced carbon stocking over time.[22]
- Development of aggregated forest carbon projects in Vermont will require increased awareness of carbon forestry and market protocol by the consulting foresters who prepare UVA management plans and the county foresters who approve those. With greater awareness will come acceptance of carbon as a legitimate emphasis for the full spectrum of management activities and intensities on UVA enrolled parcels. This will lead to greater willingness of county foresters to approve carbon-focused UVA plans accordingly.

20 Personal communication with Keith Thompson, Private Lands Program Manager, VT Agency of Natural Resources, Department of Forests, Parks, and Recreation. Interview conducted Sept. 8, 2017.

21 Urbano, A. R., and W. S. Keeton (2017). Forest structural development, carbon dynamics, and co-varying habitat characteristics as influenced by land-use history and reforestation approach. *Forest Ecology and Management*. 392: 21–35

22 Nunery, J. S., and W. S. Keeton (2010). Forest carbon storage in the northeastern United States: Net effects of harvesting frequency, post-harvest retention, and wood products. *Forest Ecology and Management* 259: 1363–1375.

Conservation Easements

Deed restrictions on potential project lands and any restrictions they impose may limit the potential for managing the target forest to achieve additionality against a given baseline. Prescriptive easements may legally constrain the scope of proposed baseline activities. The use of carbon financing to generate revenue for previously conserved parcels may be limited depending on the nature and longevity of the easement, and the implications of potentially exiting or adjusting existing commitments to improve the incentive available from carbon markets. However, carbon offset sales may facilitate easement transactions on newly conserved parcels.

Conservation easements give landowners the opportunity to sell one or more of the "bundle" of property rights to a third-party buyer in exchange for a forfeiture of development rights in perpetuity or the lifetime of the deed. Property rights that may be sold include: commercial development, residential development, mineral extraction, and potential golf course development. The conservation easement is attached to the deed and, thus, passes from owner to owner. Easements provide a predictable and widely accepted means for meeting permanence standards required under carbon market protocols. Easements are often donated or purchased with the assistance of state or federal funding, examples including the Forest Legacy Program. Easements are held by both governmental and non-governmental entities that are required to verify the easement restrictions are upheld over time.

Pre-existing easement terms are considered legal restrictions by the carbon market protocols, and depending on the specific restrictions within a given easement, these terms may affect the project baseline. For example, Vermont Land Trust has required more prescriptive easements in some cases. Where these restrict timber harvesting they would limit project baselines (i.e., the potential for timber harvesting in the absence of carbon market enrollment) and thus could reduce potential additionality. Where timber harvesting or management activities are not significantly prescribed in easement terms, there would be no impairment of additionality potential.

Conservation easements are intended to ensure the permanence of forested lands and may include benefits such as state income tax reductions under IRC 2031(c), assessed as a one-time charitable gift by a land appraiser. The value of said gift is assessed as the difference between "best and highest use" value of the property pre-easement and the restricted development value post-easement. Up to 50 percent of a household's gross adjusted income can be deducted through donation of an easement.

If a landowner is interested in selling a conservation easement, as with most management plans, the land must be appraised by a third party. Parcels most likely to be considered for conservation easements are larger (e.g., over 100 acres), have a special significance to the purchasing entity that agrees with their mission, hold significance for "the greater good," or border other protected areas. Parcels that have conservation easements may be working forestlands or agricultural areas depending on particular rights that are sold.

Key Findings

- Landowners interested in selling conservation easements, as well as the easement buyers, benefit from public assistance or cost-share programs that help them finance the transaction costs. Because conservation easements complement and even facilitate carbon market participation on private lands, expanded cost-share availability has the potential to significantly promote carbon project development.
- Properties already under conservation easements are ineligible for "avoided conversion" mechanisms afforded by some market standards but remain eligible for all Improved Forest Management standards. However, an important caveat is that forest practice requirements attached to a deed through an easement may limit additionality depending on the specific restrictions.
- As with carbon projects generally, land trusts, non-governmental organizations, and public agencies are most interested in conserving, with easements, larger and/or ecologically significant forest blocks. Consequently, layering easements with carbon provides a means for achieving multiple co-benefits simultaneously.
- Because conservation easements provide additional tax savings and because they allow continued forest management, layering easements with carbon and other mechanisms can further strengthen the long-term financial viability of working forests.

Cost Share Programs

Landowners who have interest in enrolling land in carbon projects may not have the financial means to do so on their own. Cost-share programs such as Environmental Quality Incentives Program (EQIP) and the Forest Legacy Program are federally managed programs that assist landowners in financial and technical aspects of implementing management of conservation practices.

Environmental Quality Incentives Program

EEQIP, administered by the Natural Resources Conservation Service (NRCS), provides financial and technical assistance to project purveyors looking to meet

the following priorities:

- Reduction of nonpoint source pollution;
- Conservation of ground/surface water;
- Reduce emissions;
- Forestry and wildlife;
- Carbon Storage; and
- Energy Conservation.

Projects may apply for assistance from different funding pools, such as Regional Conservation Partnership Programs (RCPPs), Forestry and Wildlife pools, and Conservation Activity Plans (CAPs). Most RCPP projects in Vermont pertain to water quality and soil erosion. Forestry and wildlife projects provide cost-share for silvicultural activities with clearly articulated wildlife objectives; whereas CAP projects provide funding for developing management plans benefiting specific conservation needs, such as wildlife habitat.

To qualify for EQIP, projects must be under ownership by a single entity and have a better chance of obtaining leveraged grant funding if larger. Additionally, projects that have the greatest potential for positive environmental impact and public benefits for the least cost are most likely to gain support. Projects are funded over six-year periods; forest management plans are required to be in place prior to commencement of project activities. Projects will be reimbursed up to 50 percent of project costs.

Conservation Innovation Grants (CIG), a subsection of EQIP, providing matching funds at a 50:50 ratio between agency and applicant for projects three years in length. Under CIG, many agencies or parties my come together to apply under one party's names for eligible lands, which include nonindustrial private forests.

One of the national priorities listed for the EQIP is "biological carbon storage and sequestration," although the Vermont EQIP program does not explicitly mention carbon or climate as an additional state-level priority. Some practices cost-shared by EQIP, such as patch cutting to create early successional habitat, may meet landowner objectives and are permitted under carbon market protocol but would reduce overall stocking and therefore potential additionality. Early successional habitat management is emphasized in the current EQIP funding priorities, yet typically runs counter to carbon objectives as articulated in current market protocol. Therefore, rotations, total extent, and placement of these activities would have to be carefully scheduled so as to meet overall carbon stocking objectives. In Spatial Informatics Group's experience, early successional habitat management can be integrated into property-scale carbon management plans through optimization modeling.

On the other hand, stand improvement thinnings are also cost-shared by EQIP and are generally conducive to carbon management if they improve stand quality, growth, and ultimately stocking. From this standpoint, EQIP funding could be used to help achieve carbon management objectives where these types of activities are cost-shared.

Cost-share for aspects of management planning is another benefit of EQIP that would help landowner meet carbon market requirements

Forest Legacy Program (FLP)

The Forest Legacy Program (FLP), a part of the Farm Bill Act and implemented by the U.S. Forest Service, provides cost-share grants to state partners. The grants incentivize forest products and resource-based jobs, as well as management for air and water quality, recreational opportunities, and fish and wildlife habitat. Projects either may be purchased by state governments to acquire public lands (35 percent of all FLP projects), or purchase conservation easements to prevent development (65 percent of all FLP projects). Lands purchased under FLP may not be held by nonprofits, although nonprofits can hold lands fully donated to the program. Projects must originate from a willing landowner seeking assistance from the appropriate state agency, which subsequently submits project proposal to the Forest Legacy Program.

Projects to be considered for funding are evaluated for:

- the public benefits to be gained by protecting and managing property;
- a demonstrable threat of imminent conversion to nonforest use; and
- a property's strategic contribution to larger scale conservation initiatives, such as protection of large forest blocks that complement existing federal lands.

Projects receiving FLP assistance must have Multi-Resource Management Plans (MRMP) that are reviewed and approved by county foresters. Third-party forest certification may be used in place of MRMPs as long as the management plan meets similar standards as those required for MRMPs.

Areas potentially eligible for FLP may be identified as a Forest Legacy Area (FLA), an area providing unique or important forest and environmental value. These areas must have at least 75 percent forest cover, must be managed consistent with FLP guidelines, and must have conservation easements held by a government entity if the land is privately owned or purchased under FLP. The Forest Legacy Program encourages other types of management, including carbon market participation, conservation easements, forest certification, and UVA enrollment.

Forest Certification

Forest Certification encourages landowners to establish sustainable forest management practices, thereby providing market access to buyers with a specific interest in certified wood products. The three main certifying bodies are Sustainable Forestry Initiative (SFI), Forest Stewardship Council (FSC), and American Tree Farm System (ATFS). Though each certifying body caters to somewhat different forest management sectors, all encourage sustainable and transparent timber management. Certifying bodies

Key Findings

- FLP and EQIP provides grants for projects that conserve and improve management on forested parcels. FLP prioritizes forest conservation whereas EQIP cost-shares on forest management activities, including management planning and silviculture.
- Some EQIP cost-shared forest management practices, such as stand improvement thinnings, are more conducive to current market standards because they can improve stocking and growth. Others, such as patch cutting to create early successional habitat, are permitted by market standards but would require careful activity scheduling so as to not erode overall project-level carbon stocking.
- Existing cost-share programs encourage leveraging of public assistance funding against other opportunities, such as carbon projects, conservation easements, forest certification, and UVA. FLP provides a broader playing field on which to employ these than does EQIP.
- The requirement for management plans under FLP can be met by third-party certifications, such as forest certification, whereas they may not be used under EQIP.
- Easements on lands purchased under FLP may not be held by non-governmental organizations. For carbon projects, this limits leveraging FLP funding to properties with publicly held easements only. Thus, FLP may have less relevance as a cost-share mechanism promoting carbon market participation in Vermont, where the majority of easements are held by land trusts or other non-governmental organizations.

require certification and inventory by a third party, such as consulting foresters. Each requires periodic recertification and annual updates on project status. SFI, FSC, and ATFS are all accepted under both compliance and voluntary carbon markets as a means for meeting the requirement for having a management plan.

Sustainable Forestry Initiative (SFI)

Sustainable Forestry Initiative (SFI) is a certification system originally created by the American Pulp and Paper Association and most widely used on private industrial forestland in North America. SFI promotes sustainable forest management and is endorsed by the internationally recognized Programme for the Endorsement of Forest Certification (PEFC). It certifies forest management operations based on a set of standards comprising 13 principles, 15 objectives, 37 performance measures, and 101 indicators.

Principles include:

- Sustainable forestry,
- Forest productivity and health,
- Protection of water resources,
- Protection of biological diversity,
- Aesthetics and recreation,
- Protection of special sites,
- Responsible fiber sourcing practices in North America,
- Legal compliance,
- Research,
- Training and education,
- Community involvement and social responsibility,
- Transparency,
- Continual improvement, and
- Avoidance of controversial sourcing.

Once a property is certified, SFI requires a third-party audit every three years for forest management plans, and every five years for chain of custody. Reports on conformance with certification standards are due every 12 months. SFI certifies both products and chain of custody of forest products via these principles. Unlike FSC (see below), chain of custody certification in SFI is based on the percentage of the fiber or material in a given forest product originating from a certified forest and does not require that all fiber or material in a product originate from a certified operation.

Forest Stewardship Council (FSC)

The Forest Stewardship Council (FSC) certifies forest management operations on productive parcels, as well as businesses involved with wood product chain of custody. FSC certification stresses environmentally, socially, and economically conscientious management. Properties certified under FSC must commit to long-term (i.e., 30 to 50 years) management plans that address 10 principles:

- Compliance with laws and FSC principles,
- Tenure use rights and responsibilities,
- Indigenous people's rights,
- Community relations and workers' rights,
- Benefits from the forest,
- Environmental impact,
- Management plan,
- Monitoring and assessment,
- Maintenance of high conservation value forests; and
- Plantations.

FSC requires annual updates to management plans and fully revised plans every 10 years. Monitoring under FSC protocol may vary in intensity by size of parcel. Larger parcels (>2,475 acres) require systematic and robust data collections, whereas small or family forest parcels (up to 2,470 acres) have lax protocols that may be informal and qualitative in nature.

FSC includes specific provides for High Conservation Value Forests (HCVF) to protect unique conservation values where those occur either across or within properties. HCVF projects require monitoring of conservation attributes yearly to ensure projects are promoting, restoring, and conserving natural forests. Projects seeking certification as HCVF are more likely to be approved if over 500 acres and when they have demonstrable ecological significance.

FSC contains a subprogram allowing family foresters to aggregate projects through group certification. This encourages smaller, nonindustrial timberland owners to participate through somewhat less restrictive standards and the economies of scale gained through aggregation, an efficiency very similar to aggregated forest carbon projects. If group certification projects are under 2,500 acres in total size, scoping and peer review of projects are not required. Group certification projects are often linked to other program encouraging forest stewardship and open-space conservation, such as The Nature Conservancy's Working Woodlands program.

American Tree Farm System (ATFS)

The American Tree Farm System (ATFS) provides an option for meeting the management planning provisions of carbon market protocols. The 2015–2020 ATFS standards require management plans that meet widely accepted certification stands under the International Programme for the Endorsement of Forest Certification (PEFC). ATFS has been expanding in recent years, moving far beyond its original emphasis on Christmas tree farms and woodlots. As a holistic and widely accepted certification framework, ATFS meets carbon market requirements, though standards are not as widely known as other certification systems. Sustainability is assessed on enrolled properties through a set of eight standards, each with performance measures, indicators, and guidance on how to meet the standard. The standards include an explicit focus on management plans, mapping, ecological values, and legal compliance and thus meet carbon market requirements just like the other major certification systems.

Programs and Service Providers Combining Forest Stewardship, Conservation, and Carbon

There are several ongoing programs that have potential for integrating the stewardship and conservation mechanisms described above. These programs generally provide "one stop shopping," assisting landowners in obtaining conservation easements, forest certification, and/or cost-share in conjunction with carbon project development. They facilitate marketing, provide technical

Key Findings

- Forest management operations and properties certified under all major forest certification systems employed in North America are accepted by CARB, providing one option for fulfilling management plan requirements. This is true for FSC, SFI, and ATFS.
- FSC certification can be labeled on ACR credits as an additional certification; SFI and ATFS are not currently eligible in this regard.
- FSC or Climate, Community and Biodiversity Standards (CCBS) certification is recommended (though not required) for meeting environmental requirements under VCS; SFI and ATFS are not mentioned specifically in the VCS guidelines.
- Forest certification fulfills carbon market requirements for sustainable management plans and thus provides another entry point for carbon project development, much like UVA.
- FSC has a mechanism available for group certification on small- to medium-sized properties and thus is highly conducive toward or complementary of aggregated carbon projects.
- Certification is not considered to be a legal constraint limiting project baselines by market protocol.
- Areas designated as HCVFs through FSC certification are recognized as such by CARB and voluntary systems.
- FSC, SFI, and ATFS are all recognized internationally: FSC through its global scope and SFI and ATFS through their participation in PEFC. International voluntary markets emphasize compatibility with FSC.
- Other forest stewardship programs and mechanisms, such as conservation easements and cost-share, are not in conflict with forest certification. Similarly, forest management emphasizing carbon is entirely compatible with certification standards, though this is less well established for SFI.
- Although compatible and helpful to carbon projects, forest certification is expensive and benefits vary by landowner. Depending on the offset program, certification may help landowners meet certain requirements, such as demonstrated commitment to long-term management.

assistance, and help landowners develop management plans. Examples include the Working Woodlands program administered by The Nature Conservancy, and services provided by NativeEnergy and Boulder Creek Partners. Programs combining and integrating multiple stewardship mechanisms help landowners meet the management, compliance, and financial requirements of carbon project development and implementation more efficiently. Several such programs provide a template for an integrated program that could be developed for or applied in Vermont. These are described below.

An important consideration affecting carbon project feasibility is the operability from a timber management perspective of a given forest ownership, which determines whether there is real additionality as compared to the possibility of more conventional management. For example, regulatory restrictions on harvesting can be triggered by the extent of stream systems on a property, as well as presence of endangered species, steep slopes, wetlands, unique ecological communities, archeological sites, and other features. For this reason as well as others, having a pre-existing management can help establish operability baselines, and therefore stewardship programs facilitating those have the added advantage of helping to prepare properties for potential carbon market participation. However, revising those management plans to better incorporate carbon objectives, thereby enhancing additionality, may be warranted in some cases, and therefore stewardship programs that help landowners with long-term management planning play an important role in this respect as well.

Working Woodlands

The Nature Conservancy (TNC) has sought new ways to work directly with private landowners to protect large forest blocks that might otherwise remain beyond their conservation reach. This goal stimulated development of what is now known as the Working Woodlands program. Through this program, TNC rewards landowners for good past forest management and works closely with private and public landowners to continue to improve the quality of their forestlands. About 80 percent of the Working Woodlands projects have been on privately owned lands. Originally started in Pennsylvania, TNC has to date protected over 27,000 acres through forest carbon agreements and has a number of projects in various stages of development in Michigan, New York, Pennsylvania, Tennessee, and West Virginia.

The Working Woodlands program provide a model for integrated forest conservation aiming to protect forests and watersheds while fighting climate change via incentives that reward landowners for exceptional forest management practices. This new conservation model leverages the market demand for certified forest products and carbon offsets to help forest landowners achieve their forest management goals while also promoting long-term biodiversity conservation, protection of water resources, and improvements of forest health. For landowners who wish to maintain their forestlands as forest long into the future, Working Woodlands provides an option for securing additional revenue from the forest carbon market and while also capturing revenue from timber operations.

Through Working Woodlands, parcels larger than 1,500 acres gain assistance in writing improved management plans harnessing numerous conservation mechanisms. TNC's most common type of certification under Working Woodlands is Forest Stewardship Council (FSC), though American Tree Farm System (ATFS) has been gaining popularity among participating small family forests. Mechanisms such as conservation easements and cost-share programs enable landowners to offset some of the initial transaction costs of management plans, certification, and enrollment in carbon markets. In the Working Woodlands program, conservation projects also may be partially funded via philanthropy.

As part of Working Woodlands, The Nature Conservancy partners with a for-profit expert in carbon markets. In the case of Working Woodlands projects in New York, TNC has chosen Spatial Informatics Group (SIG) as its primary partner. TNC and SIG have partnered on multiple forest carbon projects over the past decade, building a program that benefits their mutual goals as well as the goals of the landowner.

NativeEnergy

Founded in 2000, NativeEnergy is an expert provider of carbon offsets carbon accounting software. They help businesses and individuals identify and reduce their greenhouse gas pollution and attain their sustainability goals. Clients include pioneers in corporate social responsibility, including eBay, Keurig Green Mountain, Ben & Jerry's, Interface, Stonyfield Farm, Esurance, and National Geographic.

Through the Help Build carbon offsets, businesses and individuals help finance new wind, water, biogas, solar, and other carbon-reducing projects with strong social and environmental benefits. More than 60 community-scale NativeEnergy Help Build projects have been made possible due to investments from business and individuals, reducing two million metric tons of greenhouse gases. Examples of projects include renewable energy at schools, methane digesters on family farms, household water filters in rural Kenya, and even the first large scale Native American–owned wind turbine in the U.S. In total, NativeEnergy has more than six million metric tons under contract in Help Build offsets, vintage offsets, and recognized environmental conditions (RECs). All NativeEnergy carbon offsets undergo third-party validation and verification.

For corporate clients, in addition to Help Build offsets, NativeEnergy offers a portfolio of vintage offsets and RECs from exclusive and diverse projects around the world. All NativeEnergy carbon offsets undergo third-party validation

and verification to leading standards, and its renewable energy credits are Green-e certified.

Boulder Creek Partners

Boulder Creek Partners (BCP) is a boutique consultancy helping landowners evaluate the full range of options for carbon and other ecosystem markets. The company has a focus on forest aggregation methodology and development services. BCP is led by Jeff Cole who supports companies, organizations, and individuals integrating climate and sustainability strategies in their operations, investments and legacy planning. Focus areas include GHG mitigation and eco-efficiency strategies and systems, carbon project development services, biosequestration (forestry, agriculture, biochar) and ecosystem service markets, climate change adaption, and resilience approaches. Prior to BCP, Cole was a vice president at Blue Source for nine years and led sourcing, evaluation, and implementation of carbon reduction projects for equity investment and carbon credit development and marketing. Cole sourced and led the development of the first eight North American forest carbon projects.

SECTION III.

The Vermont Path: An Integrated Program for Carbon Project Promotion and Development

Harnessing existing capacity for integrated stewardship planning, like the examples described in the preceding section, would facilitate development of a uniquely Vermont-branded program. Spearheaded by VLT and/or other conservation partners such as The Nature Conservancy, this approach would have distinct marketing advantages compared to stand-alone carbon projects. It would promote a multifunctional and landscape-oriented approach to conservation in Vermont, integrating open space conservation, flood protection, and climate mitigation (see Appendix 2).

As shown in Figure 3 (see also Table 3), the most promising path for carbon projects in Vermont would layer conservation and stewardship mechanisms to make projects as financially feasible and attractive as possible. For example, projects developed under a voluntary market standard, such as ACR, could combine forest certification, UVA enrollment, and conservation easements, while in some cases benefiting from cost-sharing. These would layer financial incentives benefiting landowners while helping to conserve working forests. Projects facilitated by VLT would allow the organization to integrate a consistent flow of revenue into a long-term conservation finance budget. Isolated carbon projects help land trusts' bottom line but limit their ability to incorporate a reliable stream of revenue into strategic planning. A branded, integrated program with clear objectives linking to VLT's mission would provide a unique financing package mutually beneficial to landowners and project facilitators.

If scaled up further, a statewide carbon program has great potential to take advantage of the normative, cognitive, and affective origin attributes associated with the Vermont brand in marketing efforts. Previous studies have shown cognitive attributes of Vermont's brand is a cue of product quality (Kerchner et al. 2006). Affective attributes highlight consumer emotional ties to the region, such as memories of past vacations or cultural/political beliefs (Verglegh and Steenkamp 1999). Normative aspects of the Vermont brand represent an ethical choice by businesses to purchase carbon offsets in close proximity to a company's location (i.e., the U.S. Northeast). All three of these attributes lead to increased consumer willingness to pay for Vermont branded products (Kerchner et al. 2006). As Vermont's largest economic and GHG-emitting sector, tourism-based organizations have stated their potential interest in purchasing carbon credits from voluntary markets, specifying Vermont carbon credits. Organizations ranging from ski resorts to retailers are willing to pay for local Vermont-branded products (Saligman et al. 2013).

Compliance versus Voluntary Market Options

In general, a Vermont-branded forest carbon offset program is best suited for the voluntary market, though there are opportunities under the compliance market as well (see below). Forest offset protocols (e.g., VCS and ACR) in the voluntary market are likely to work better, on the whole, in Vermont because of: (1) the relatively small average parcel size of privately owned forestlands; (2) the ability to aggregate projects under voluntary standards like VCS and ACR; (3) the cost-effectiveness of voluntary projects compared to compliance projects; (4) the potentially higher price point in the voluntary market as compared to the compliance market for small- and medium-sized projects; and (5) the consistent annual flow of credits over a crediting period (compared to larger, upfront payment with compliance), which may better meet financial objectives for some landowners.

One possibility for a Vermont carbon program would be to first target the 17 parcels, each greater than 1,500 acres, identified as VLT prospects in Table 2. If two or three of these projects are aggregated under one voluntary project, they are likely to be at a scale that is economically viable.

But other opportunities offer prospects for the voluntary market as well. In the spatial analysis presented in the appendixes, 328,461 acres of privately owned parcels >500 acres in size and having at least 450 acres of forest each were identified statewide (Table 3). Of these, about 285,000 acres are within or adjacent to the priority forest blocks mapped statewide (and thus of particular important for habitat and maintaining unfragmented open space) and highly ranked for flood resilience benefits (based on work by the UVM Gund Institute for Environment). Thus, there is a substantial and as yet unrealized opportunity for aggregated carbon projects in Vermont. These might aggregate properties of even smaller size (e.g., down to about 200 acres) as long as the total project acreage exceeds approximately 5,000 acres and is cost efficient,

Table 2

Distribution of Medium- to Large-Sized Parcels by VLT and Town-Owned Conservation Status in Vermont

	All Parcels		Parcels ≥500-<1,500 Acres		Parcels ≥1,500 Acres	
	#	Acres	#	Acres	#	Acres
VLT	6,579	472,850	50	38,225	17	130,001
VLT Prospects	4,938	497,474	127	97,049	32	85,097
ConsLand-Town	627	63,600	16	14,025	3	4,815
ConsLand-Private & Unknown	1,263	103,774	21	16,003	7	17,343
Tax Parcels	NA	NA	126	89,458	7	16,923
TOTAL			340	254,760	66	254,179

which generally will require at least one or two larger parcels (e.g., >500 acres) as anchors. Aggregation in this way would open up additional acreage exceeding the numbers presented in Table 3.

One distinctly attractive possibility for land trusts and other conservation organizations in Vermont is to use carbon financing to incentivize conservation of parcels not yet under easement. When the privately owned, forested parcels >500 acres in size are filtered based on whether they currently have a conservation easement, just under 210,000 acres remain unconserved in this manner. There are about 140,000 acres in parcels meeting these criteria that are within or adjacent to forest blocks and ranked highly for flood resilience contribution. In terms of conservation priority and ecosystem service co-benefits, these 140,000 acres represent the greatest potential for aggregated carbon projects to contribute to the sustainability and functionality of Vermont's working landscape.

Supplemental revenue generated by an aggregated project developed under the voluntary market could be attractive to some landowners. In the analysis presented in Appendix 1, we modeled carbon credit generation for a hypothetical project following the ACR Improved Forest Management standard for a collection of seven properties totally 5,900 acres in northern Vermont. The inventory data for these properties were contributed by several landowners participating in the Cold Hollow to Canada initiative.[23] The exercise assumed that moderate timber harvest levels would continue as currently planned, capturing 75 percent of net annual growth. Furthermore, it was assumed that an external project developer would finance the project in return for 40 percent of the credits generated, sold at a negotiated price of $\$8/MtCO_2e$ based on SIG's professional experience.

In this project feasibility analysis, gross revenue after 10 years was projected to be $1,850,844, with expenses totaling $278,703. Once the project developers take their share of the revenue ($628,856), net revenue to the landowners was estimated at $943,284. This equates to $16 per acre per year for each landowner—an attractive sum considering this would be supplemental income layered on top of other revenue streams (e.g., timber and nontimber), cost-share, and tax incentives. Based on this exercise, we conclude that aggregated projects under the voluntary market system

Table 3

Acreage of Privately Owned Parcels in Vermont By Size, Forest Cover, Potential to Yield Co-Benefits (Forest Block Conservation/Buffering And Flood Resilience), and Conservation Easement Status

Category of Privately Owned Parcels in Vermont	Conservation Easement*	No Conservation Easement*
Area in parcels >500 acres	422,461	252,376
Area of parcels from row A with >450 forested acres each	328,469	209,658
Area of high priority parcels from row B**	284,859	139,690

* Acres. To convert to hectares, divide by 2.47.

** Priority assigned based on percent forest cover, proximity (within or adjacent) to forest blocks, and flood resilience ranking (see Appendix 1 for methodology), representing potential to provide co-benefits.

23 For more information, see https://www.coldhollowtocanada.org/.

are not only financially feasible in Vermont but would add revenue that could help working forests remain in business. The co-benefits of this outcome are clear. They include climate mitigation, habitat, ecological connectivity, watershed protection, and open space conservation.

Despite the attractiveness of the voluntary market for a Vermont program, there are also opportunities for carbon projects under the compliance market. In SIG's experience, projects become most economically viable on well-stocked properties that are 5,000-plus acres in size. Thus, VLT could explore the possibility of CARB enrollment on the six privately owned properties >5,000 acres that it has mapped in Vermont. Larger tracts of land that yield more credits may exceed the voluntary market demand capacity or "sweet spot" for small- and medium-sized projects. California's compliance market has a consistent price signal and an established demand pool that often matches well with large landowners. For these reasons, it may be more attractive under some circumstances, and therefore a Vermont carbon program should remain open to both voluntary and compliance market opportunities depending on landowner preference and parcel-specific feasibility.

Procedures for Determining Individual Project Feasibility

Were a Vermont-branded carbon program to be launched, an essential function would be connecting landowners to the rapidly developing sector providing carbon consulting services. Although in-house technical expertise (i.e., based within participating Vermont-based organizations) would be facilitative, in most cases external service providers will be required to guide projects through the demanding registration, inventory, analytical, verification, and credit marketing and sales processes.

Summarized briefly, the Vermont program would need to develop and maintain the capacity for advising landowners on the feasibility of individual carbon projects, helping them to assess the financial risks and benefits under each protocol (i.e., aggregated or individual property; compliance versus voluntary markets, etc.). This preproject planning and assistance would entail the following general procedures:

1. Calculate the monetary value of the projected forest carbon offsets under each protocol over a common planning horizon using published prices;
2. Estimate initial listing, project development, and verification costs, as well as ongoing monitoring expenses under each protocol;
3. Estimate projected net cash flows under each protocol; and
4. Identify the optimal listing scenario (e.g., protocol and project land arrangement) to maximize project viability after considering financial returns and risk.

With the results of this type of analysis in hand, landowners will be better prepared to make a determination as to the optimal standard under which to develop a forest carbon project (see Appendix 1 as an example). Furthermore, project-specific assessments will help identify data gaps and needs under selected protocol. As a general rule, larger ownerships with high carbon stocking, fewer harvesting restrictions, high conservation priority, and interested owners will be most attractive for carbon project development.

Best Pathways for Developing a Vermont Carbon Program

There are two paths the Vermont Land Trust can take in developing the Vermont forest carbon offset program. The first path is a do-it-yourself approach. This approach includes providing soup-to-nuts project development services, including management, project origination, landowner contracting, inventory, GIS, carbon quantification and modeling, and credit marketing and sales. A variety of for-profit companies provide these services and can contract for individual projects (single parcel or aggregated).

The second approach entails VLT taking on some of the project development services and partnering with other companies to provide technical and marketing support. From SIG's experience, there are distinct advantages if VLT partners, at least at the outset, with existing entities who have established experience and relationships in the carbon arena. There are two primary benefits to VLT in leveraging existing partnerships. The first is the technical expertise required to develop a carbon project. For example, SIG has successfully developed projects with > ~$110 million worth of credits sold to the California regulatory and voluntary market and has the tool set and capacity to develop projects in a timely and cost-effective manner. Thus, it would behoove VLT to work with an entity (like SIG) who has the technical expertise to bring carbon projects efficiently to market and reduce verification risk exposure.

The second benefit, if VLT partners with an existing entity, is gaining easier access to carbon credit buyers. One of the most challenging aspects of developing voluntary offset projects is securing a stable, consistent demand at an attractive price (e.g., >$8 per credit). Previously in this report, we recommended partnering with The Nature Conservancy (via Working Woodlands), NativeEnergy, and Boulder Creek Partners. But the field is rapidly developing, and VLT should explore other potential partners as well.

Developing a Branded Offset Program for Vermont

Were VLT to work with others in developing a branded offset program, it would provide economies of scale in marketing and selling carbon credits. Most buyers are looking for a one-stop shop for offsets. Thus, it would

behoove VLT (or other conservation groups leading the effort) to bundle credits under a branded program so a portfolio of carbon offset projects, each with its unique story, can be created and sold to buyers. A branded program needs to have a consolidated vision for qualifying the niche "brand."

There are many value-added benefits of a branded carbon project compared to other projects. For example, if effectively marketed to buyers, the story told by the Vermont location could be that the projects are contributing to regional biodiversity conservation, open space, viability of working landscapes, and watershed protection. It could be that each landowner has an easement, FSC certification, management plan, and commitment to long-term sustainable management. These bundled stewardship commitments add cachet and value to carbon credits on the voluntary market. The Vermont program oversight committee or leadership should decide the eligibility criteria at the outset for effective marketing.

Developing a Governance Structure

In addition to examining opportunities to develop strategic partnerships to leverage technical and marketing capacity, one of the first steps should be to define the governance structure. The governance structure should focus on the following questions, among others:

1. What type of entity (e.g., corporation, partnership, cooperative) is most appropriate for a carbon monopsony that manages a landowner aggregate?
2. Who will take on the role of the monopsony? A new entity? An existing entity like VLT?
3. How do landowners enter and leave the program without affecting the baseline or putting the project at risk?
4. How are payments made to landowners? Are they annual payments? Is there an internal buffer for the company to manage and mitigate risk?
5. Which markets would Standards allow such a monopsony to manage a carbon aggregate?

For legal and management level questions (i.e., type of business entity, operating agreement, fund distributions, etc.), VLT should work with a business attorney with experience in this area of law. SIG has worked with Moulton Law Group located in Burlington, Vermont, as an example.

For answers to technical questions, SIG and UVM can work with existing registries to propose methodology revisions to allow for aggregations under existing Standards. We recommend working with the ACR Standard to propose a new aggregation methodology.

The ACR Standard currently allows for programmatic aggregated projects. However, while there is wording in the Standard that allows for such aggregated projects, the mechanisms for when landowners can enter and leave a project need to be further fleshed out (personal communication 11/30/2017, ACR). For example, there may be one agreement between a monopsony and ACR and individual contracts between the monopsony and landowners. However, the mechanisms for how landowners are compensated and the nuances of carbon quantification under an aggregate need to be approved by ACR. The Standard alludes to allowing for baseline adjustments every five years. This means landowners could feasibly enter every five years and adjust for the baseline accordingly. As part of the methodology revisions, SIG would propose that landowners be allowed to join on an annual basis.

As of November 2017, programmatic aggregation under ACR has been used in afforestation and reforestation projects because of there being just one baseline. Programmatic aggregation has not been performed for IFM projects because of some more complicated baseline calculations. SIG has developed a strawman for adjusting the baseline as new landowners enter an IFM program that is scientifically defensible.

If SIG were able to propose a solution to the baseline approach, ACR would support and encourage us to submit a methodological revision. ACR has informed SIG that the new baseline aggregation revision "is a nut they want to crack." The revised methodology would go through a peer-reviewed process (ACR would establish the time line for that review) and public consult (30 days). There are likely no ACR costs, but the registry has stated to SIG that they must confirm this point.

Conclusion: The Vermont Path

This feasibility study demonstrates that forest carbon projects can be successful in Vermont, providing benefits to landowners, communities, and the state. Working forests face many pressures in an increasingly globalized wood products sector, and forestland owners often find it difficult to meet property tax obligations while maintaining their lands as open space. Intergenerational continuity of forestland ownership is another concern in the region, necessitating careful estate planning. Consequently, keeping working forests in business—as forests—can be challenging, often hovering along a tight financial margin. For these reasons, forestland conservation often depends on layering as many different revenue streams, innovative market opportunities, tax incentives, and participation in cost-sharing programs as possible.

Carbon markets offer new potential for adding value to conserved and working forests, providing supplemental revenue that can be layered on top of the other stewardship mechanisms available to landowners in our region. The savvy landowner in Vermont should see carbon markets as an increasingly attractive possibility to consider from this perspective. Both compliance and voluntary market opportunities are available, though we conclude the latter have much greater potential in Vermont due to the mechanisms allowing aggregation of medium- to large-sized parcels. Projects generating credits for the compliance

markets are currently viable, most likely, only for the relatively small number of very large (i.e., >5,000 acres) privately owned forestland properties in the state. These differences are driven primarily by the economies of scale needed to generate sufficient revenue to cover the often formidable project development costs and generate enough net profit to make the endeavor financially worthwhile.

Carbon market participation will not work for everyone or everywhere, however—the conclusions of this study are quite clear on that point. It will work best on properties that are medium (e.g., several hundred acres) to large (e.g., >1,000 acres) in size, well-stocked and managed, and where the potential to develop aggregated projects is greatest. Forest carbon projects are not readily feasible on smaller or poorly stocked properties.

The Vermont path toward forest carbon projects, both in terms of stimulating landowner interest and getting projects up and running, would be facilitated by active branding by offset credits generated here, telling the "story" of the multiple co-benefits (climate, working landscapes, biodiversity, open space, flood resilience, etc.) provided by "grown in Vermont carbon." In this feasibility study, we demonstrate the significant potential to generate these co-benefits through aggregated, voluntary market projects on the approximately 140,000 acres of priority forestland identified in the spatial analysis (see appendixes). Conservation of these properties, aided by carbon financing, would contribute significantly to statewide goals of reduced fragmentation from rural sprawl within forest blocks and maintenance of flood resilience capacity on the

Decision Tree for Integrated Forest Conservation, Stewardship Program Enrollment, and Carbon Project Development in Vermont

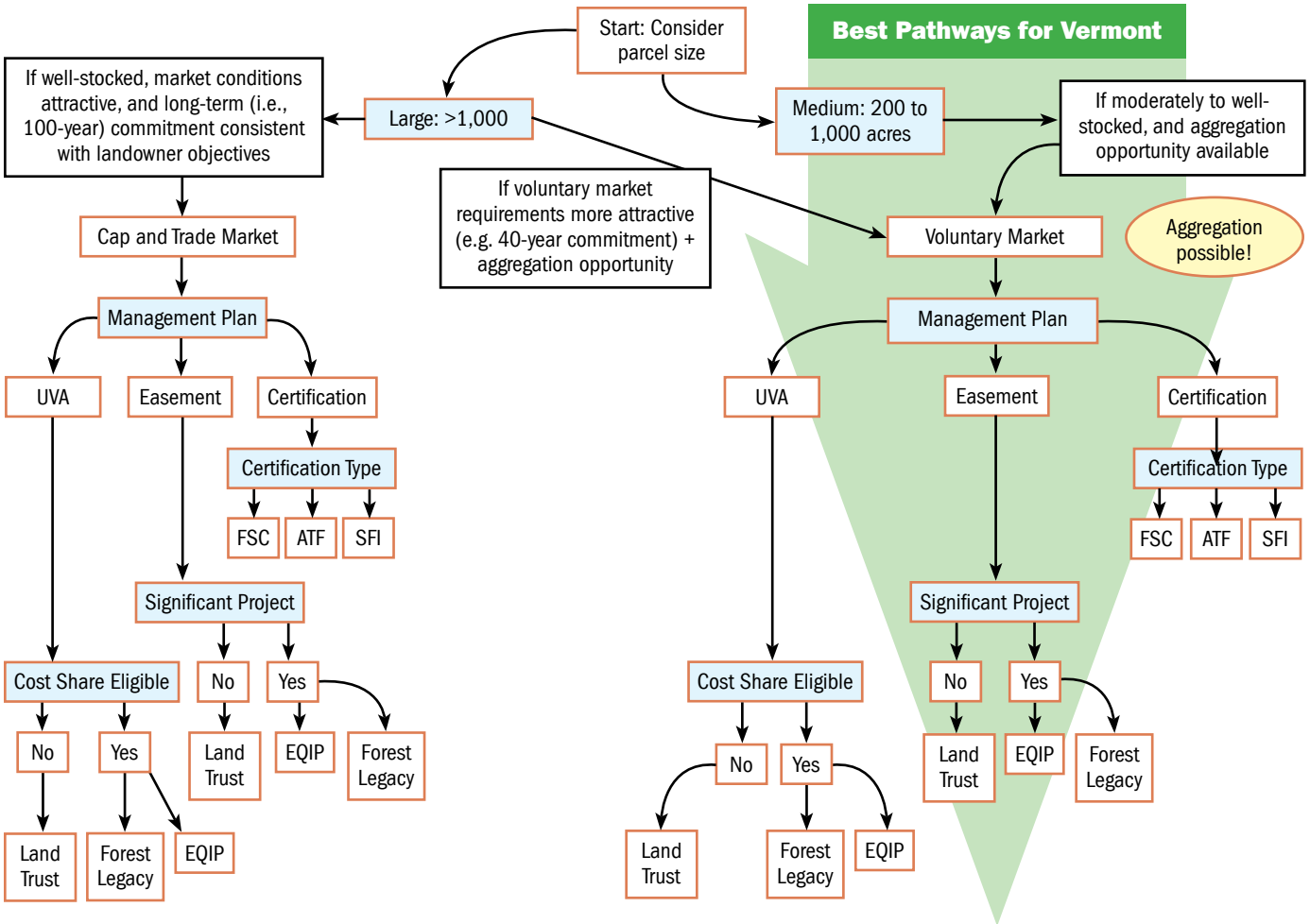


Figure 3

The flowchart is designed to show the most feasible and financially viable pathways for forest carbon project development on private lands in the state. The pathways integrate multiple forest stewardship mechanisms. The parameters considered at each split on the tree are given in Table 4 (below).

Table 4

Parameters and rules set for determining choice of carbon project pathway combining multiple stewardship mechanisms, as influenced by market type and parcel size. See key below for explanation of symbols. This table provides additional clarity to the pathways shown in Figure 3 (see above). Note that the table summarizes complex requirements that may vary in specific cases and that may change over time. Feasibility is assessed generally and not intended as a definitive determination. For the purpose of this table, parcel size categories are generally considered as follows: small, 25 to 200 acres; medium, 200 to 1,000 acres; and large, >1,000 acres..

Cap and Trade/Compliance Market

	UVA	Easements	SFI Certification	FSC Certification	ATF Certification	EQIP	Forest Legacy	Aggregation of Mechanisms	Aggregation of Projects
Small Parcel*		✔	♦	♦	♦			✔	✖
Medium Parcel*		✔	♦	♦	♦			✔	✖
Large Parcel		✔	♦	♦	♦			✔	✖

Voluntary Market

	UVA	Easements	SFI Certification	FSC Certification	ATF Certification	EQIP	Forest Legacy	Aggregation of Mechanisms	Aggregation of Projects
Small Parcel		✔	♦	♦	♦			✔	
Medium Parcel		✔	♦	♦	♦			✔	
Large Parcel		✔	♦	♦	♦			✔	

* Note that small and medium sized properies are generally not financially viable under CARB.

Symbol	Meaning	Explanation
	Most Feasible	*Feasiblity of integrating forest stewardship*
	May Be Feasible	*Mechanism with market protocol as a function of parcel size*
	Less or Not Feasible	*Mechanism with market protocol as a function of parcel size*
✔	Necessary or required as part of management plan	*Required under market protocol*
♦	Satisfies management plan and/or environmental performance requirements; under ACR provides additional labeling opportunity	*Recommended or provides an option, but not mandated under market protocol. Management plans required for all three certification systems may satisfy the same function for voluntary markets on a case-by-case basis.*
✖	Not acceptable under market protocol	

working landscape. Even broader opportunities exist if we consider the advantages of adding supplemental carbon revenue on the full 285,000 acres of priority parcels, an area that includes already conserved properties.

To achieve this goal—and for greatest viability in terms of landowner financial benefit—carbon projects will need to take advantage of as many stewardship and conservation mechanisms as possible, adding value to these. Thus, the Vermont path, charting a course through Improved Forest Management standards under voluntary market protocol, involves building on complementary mechanisms like Use Value Appraisal Program (Current Use), forest certification, cost-share (EQIP and, where possible, FLP), and conservation easement transactions (see Figure 3 and Table 4). To reiterate, we can find no inherent conflict between carbon market participation and UVA enrollment or other timber management objectives, though both will require careful integration and activity scheduling to optimize attainment of the full array of landowner objectives. Increasing the level of familiarity with carbon forestry—and how to optimize the mix of ecosystem goods and services so provided—within the profession will also be important for these reasons.

The next steps are threefold. First, the carbon working group led by VLT and others should consider the governance structure of a Vermont-branded carbon program and identify and meet with potential partners (such as those listed in this report) who may provide market access to willing voluntary buyers. Once there is a better understanding of the governance, business, and partner structure, the carbon working group should approach a collection of interested owners of medium- to large-sized forested properties to determine interest in being the initial participants in the Vermont-branded carbon program. Secondly, we recommend proposing an aggregation methodology revision under the ACR Standard to facilitate a smallholder carbon aggregation project in Vermont. And thirdly, we recommend moving forward aggressively to a feasibility demonstration through an aggregated carbon project under a voluntary market standard. With these steps, the authors of this report see a bright future for carbon market participation in Vermont.

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APPENDIX I

Report Summarizing Spatial Analysis of Priority Parcels for Carbon Projects in Vermont

This appendix presents the following components:

1. **Parcel identification for carbon project suitability and co-benefit enhancement**
2. **Forest carbon project feasibility assessment**
3. **Aggregation/market assessment for forest carbon projects**

Parcel Identification for Carbon Project Suitability and Co-Benefit Enhancement

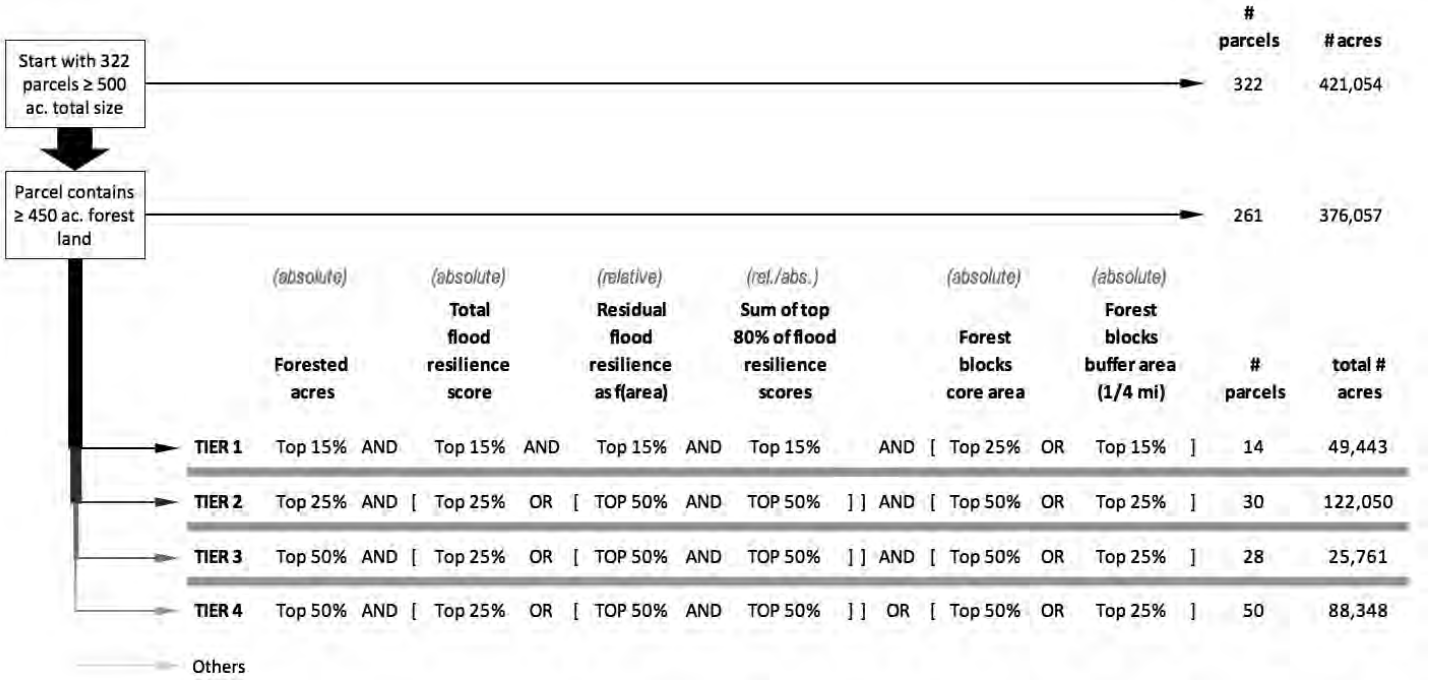
Spatial Informatics Group (SIG) has worked with project partners to identify key attributes and datasets to be used to identify parcels statewide that might be suitable for both development of a forest carbon offset project and to help protect and enhance key co-benefits.

- **Parcel forest area** is a key determinant of forest carbon project viability. This threshold was initially set based on a parcel size of 500 acres, with a minimum of 450 forested acres used as a threshold for higher-ranked parcels. This is because, while well-stocked parcels help to improve viability, a forest carbon project is simply not viable without a minimum number of acres over which credits can be generated from both baseline reductions and annual growth.
- **Flood mitigation demand** was identified as a key co-benefit of the forest conversion protection and forest stocking/complexity enhancements afforded by a forest carbon project. Special thanks are extended to Keri Bryan Watson and Taylor Ricketts of UVM's Gund Institute for sharing their dataset, which was used to help identify parcels that would play a key role in supplying resiliency to floodplains.
- Protection and enhancement of **interior forest blocks** were identified as additional co-benefits for which a forest carbon offset project would be useful. These areas were identified as part of a larger body of work on Vermont's Conservation Design project. The highest priority interior forest blocks (ranked by Sorenson and Osborne 2014) were buffered by an arbitrary distance of one-quarter mile, and the area of each parcel within both the interior block and buffer was identified.

These attributes were then used in an algorithm designed to help identify a suite of parcels that would be potentially well suited to development of a forest carbon offset project and the protection and enhancement of the co-benefits identified above. The algorithm and attributes are more fully explained in Figure 1, and resultant map identifying several tiers of highly ranked parcels is included as an addendum to this memo. It is an important note that this map is no substitute for detailed and rigorous due diligence to assess current stocking and eligibility of any given parcel or group of parcels for both development of a forest carbon project and a parcel's relevance to co-benefits. Rather, this effort is intended as a high-level screening to identify potential "hotspots" and participants.

Parcel rankings:

Federal, state, municipal, and most NGO ownership/protection *excluded;* VLT owned or protected lands *included.*



Metrics used in figure:

- **Forested acres:** NLCD 2011 classes 41, 42, 43: forest land, related to stocked/stockable, manageable forest land.
- **Flood resilience:** Watson, K.B., and T. Ricketts, 2017. Flood mitigation demand raster [GIS Dataset]. Raster cell scores are related to the number of structures for which the cell is part of contributing area, with each structure distributed evenly over its contributing area cells.
  - ∑FLOOD: sum of the raster cell values within each parcel – somewhat related to area.
  - Residual FLOOD: difference between the actual ∑FLOOD and value of predicted ∑FLOOD based on parcel size; how much better the ∑FLOOD score is than expected from its area.
  - ∑FLOOD80: sum of the values of the raster cells with values above the 80th percentile; how much of the most important contributing area does the parcel encompass.

  Forest blocks:
  - Core area: Area of the parcel within highest priority interior forest blocks.
  - Buffer area: Area of the parcel within a simple one-quarter mile buffer of those blocks.

Figure 1. Data sources and algorithm used to identify preliminary parcel ranks/tiers shown on Map 1. (Appendix 2). Federal, state, municipal, and most NGO ownerships are excluded; VLT owned or protected lands are included. Parcels were ranked in descending order for each metric. Greater weight was generally assigned to metrics derived from absolute forest area, under the assumption that sheer area of forest land is important for carbon projects and protection/buffering of interior forest blocks. However, relative value/importance was acknowledged, especially for the flood mitigation metrics, since some contributing area may be relatively more important and some parcels may protect more of that most important contributing area than would otherwise be expected for its size.

Forest Carbon Project Feasibility Assessment

SIG also worked with the project partners to develop a forest carbon feasibility assessment within the Cold Hollow to Canada focus area. Several willing cooperators worked to make the type of recent forest inventory data available that is needed to conduct a detailed feasibility assessment; special thanks is extended to Charlie Hancock who collated and provided the information. These data included a treelist from a typical timber inventory and maps and other data used to summarize the current character and condition of the subject tracts. All told, data were provided from seven properties, spanning 5,900 acres, from over 1,000 variable-radius plots. Summary statistics from the inventory data are provided in Table 1.

As is common in feasibility studies, data from timber inventory can be used to provide reliable results, but gaps relative to forest carbon inventories for common project protocols are present. Most notably, the timber inventory sampling frame included (1) only live trees, and (2) only trees with a diameter at breast height (dbh) greater than or equal to five inches. Tree lists for those segments of the population were estimated from applicable local FIA data, as were estimates of rotten/missing and form cull.

Experience has proven that the American Carbon Registry's (ACR) Improved Forest Management (IFM) protocol is a good fit for small- to medium-sized projects on private lands, especially in the northeastern United States. Thus, modeling was undertaken to estimate credit yield under this protocol. Credit yield is a function of comparing stocking differences between a hypothetical baseline scenario, and what actually occurs to carbon stocks within the project area.

The ACR IFM protocol's baseline scenario is based on the maximization of the net present value (NPV) of harvested wood products from the project area, using the discount rate for the landowner class specified in the protocol (5 percent), subject to all legal and operational constraints (see Table 2 for summary). Thus, preliminary modeling was used to estimate the financially optimal rotation length for even-age management, and the maximum tree size for uneven age management. Growth-and-yield modeling was then used to estimate tree numbers and dimensions over 100 years for a variety of even- and uneven-age management prescriptions, as well as a let-grow (no-disturbance) regime. The tree dimensions and stocking were converted to estimates of carbon dioxide equivalent using the quantification models required by the protocol to determine streams of standing and harvested carbon and timber volume over time for each management prescription. Those streams were then entered into a harvest scheduling model to estimate the baseline scenario and model various actual management scenarios that might occur within the project area, ranging from do-nothing (let-grow), light harvesting, maximization of the NPV of carbon and timber, to harvesting all of net growth.

Table 1. Key summary statistics from inventory data for sample tracts in the Cold Hollow to Canada focus area, assuming a project start date at the end of the 2017 growing season. Green line indicates actual stocks; gray indicates theoretical distribution for given q-value and basal area.

Property	Forested acres	# plots	MBF/ Ac	Cords/ ac	Tons/ ac	BA (ft^2/ac)	TPA	QMD	q	TPA v. DBH	MTCO2e/ac - CRM		MTCO2e/ac - Jenkins/FVS	
											LIVE	DEAD	LIVE	DEAD
ATP	2,099	373	5.3	9.2	1.2	124.6	732.6	5.6	1.2		133.0	1.4	160.1	4.8
GUE	606	121	4.2	10.4	0.6	120.7	735.4	5.5	1.2		126.1	1.3	151.6	4.5
HAI	635	111	8.7	8.6	3.5	144.6	727.3	6.0	1.2		138.5	1.3	174.2	4.7
HAZ	691	108	3.7	8.6	0.5	107.7	772.4	5.1	2.0		110.1	1.5	135.0	4.7
HIV	445	31	5.4	5.8	4.0	110.6	730.5	5.3	1.2		106.1	1.8	133.6	4.8
JOU	289	63	5.2	11.1	2.8	137.8	731.1	5.9	1.2		134.9	1.0	166.5	4.2
MCG	1,165	215	5.7	9.3	2.1	128.1	728.3	5.7	1.2		127.5	1.3	155.1	4.6
TOTAL	**5,931**	**1,022**	**5.4**	**9.1**	**1.8**	**124.7**	**735.9**	**5.6**	-	-	**127.2**	**1.4**	**155.2**	**4.7**

Table 2. Summary of project area and estimated harvest constraints. Additional due diligence is needed for subject tracts upon full project development to determine legal and operational constraints.

	Total Forest		Inoperable areas		AMP Areas		Other sensitive areas	
Property	Acres	# Plots	Acres	Percent	Acres	Percent	Acres	Percent
ATP	2,099	373	121	5.8%	235	11.2%	234	11.1%
GUE	606	121	0	0.0%	43	7.2%	4	0.6%
HAI	635	111	17	2.7%	30	4.7%	110	17.3%
HAZ	691	108	0	0.0%	50	7.2%	29	4.1%
HIV	445	31	4	1.0%	33	7.4%	0	0.0%
JOU	289	63	0	0.1%	19	6.5%	19	6.7%
MCG	1,165	215	3	0.3%	61	5.2%	83	7.1%
TOTAL	**5,931**	**1,022**	**146**	**2.5%**	**471**	**7.9%**	**478**	**8.1%**
Types of encumbrances			Wetlands, slope ≥ 45%		Variable-width buffer strips for streams and ponds		Deer wintering area, R/T/E spp. habitat, elevation ≥ 2,500 ft.	
Allowed silvicultural prescriptions			Let grow		Let grow, low-intensity uneven-age management		Let grow, uneven-age management	

ACR IFM projects have a minimum project duration of 40 years (two, 20-year-long crediting periods). Because of the nature of the way the baseline is constructed, greatest credit issuance typically occurs during the first four to eight years of the first crediting period. SIG chose to initially evaluate credit issuance and project finance under a scenario of moderately aggressive landowner management, whereby the project participants are harvesting 75 percent of net growth after accounting for tree mortality. Expressed as estimates of net merchantable timber, this scenario has projected actual harvest levels of 660 MBF per year, 601 cords per year, and 182 green tons of softwood pulp per year, expressed as an average value over the first 20-year crediting period that are cut during each of the 20 years of the first crediting period. Using assumptions of $8 per credit sold, 120 CFI plots for the entire project installed at a cost of $300/plot, and other development costs related to project aggregation, the net revenue to the landowner aggregate over the first 10 years of the first crediting period would be approximately $940,000 (see Table 3 for additional detail).

Table 3. Estimated finances given the carbon project conditions and sample tracts as evaluated and described above. Net revenue to the owners of the 5,931 acres assessed is projected to be approximately $943,284 over the first 10 years, which equates to about $16.00 per acre per year for each landowner. Again, this is net revenue after all expenses have been paid and the project developers have taken their assumed 40% share of offset credits. The revenue is supplemental on top of other income, for instance from timber and non-timber forest products.

Project year	1	2	3	4	5	6	7	8	9	10	TOTAL
Credits (ERTs)	35,963	35,963	35,963	35,963	35,963	35,963	6,812	2,922	2,922	2,922	231,355
Price/credit	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
Gross revenue	**$287,703**	**$287,703**	**$287,703**	**$287,703**	**$287,703**	**$287,703**	**$54,493**	**$23,378**	**$23,378**	**$23,378**	**$1,850,844**
Total direct expenses	*$91,394*	*$21,394*	*$21,394*	*$21,394*	*$21,394*	*$64,394*	*$17,022*	*$16,438*	*$1,938*	*$1,938*	*$278,703*
Net revenue landowners[1]	**$117,785**	**$159,785**	**$159,785**	**$159,785**	**$159,785**	**$133,985**	**$22,483**	**$4,164**	**$12,864**	**$12,864**	**$943,284**
Net revenue developers[1]	**$78,523**	**$106,523**	**$106,523**	**$106,523**	**$106,523**	**$89,323**	**$14,989**	**$2,776**	**$8,576**	**$8,576**	**$628,856**

[1]Net revenue to be used for initial planning purposes only.

Aggregation Opportunities

It would be infeasible for individual small family forest landowners to independently develop and manage their own forest carbon projects. Thus, some kind of aggregate is necessary to allow for a pooling of resources and distribution of risk across project participants. This aggregation entity could take a variety of forms. On the one hand, participating landowners identified at the project outset could band together for the duration of the project to form a single legal entity that would interact with the registry, verifiers, and potential credit buyers. The entity would be closed to new participants for the sake of streamlining determination of the baseline and division of credits. Another entity type might involve a more open aggregate, where participants—while encouraged to stay—could enter and leave more flexibly as the realities of life dictate. The aggregate would again be set up as a third party and present a single face to the registry, verifiers, and credit buyers.

In both cases, the entity would necessarily assume all public risks of project development and management. All credits and losses would accrue to the entity. Participants would join the entity under specified terms, including minimum participation term, distribution of credits, compensating for involuntary reversals, and so on. The entity would receive a portion of the revenue for the credit sales to help cover costs, and possibly self-insure against reversals, above and beyond the mandatory buffer pool contributions determined by the protocol.

Many details would need to be negotiated. For example, how is the baseline determined or adjusted as landowners enter and leave the aggregate? The former scenario (a single cohort for the duration of the project) is simpler in this regard. How are credits distributed? While distribution proportional to area is perhaps simplest, the reality is that stocking at project start, area encumbered against timber harvesting, site productivity, and harvest levels—among other variables—all play a role in credit yield. How is the transition from baseline reduction to growth-only credits handled? Do early adopters get rewarded or does the aggregate reserve credits or revenue to smooth out annual fluctuations?

Although the former scenario would certainly be far simpler to implement, the latter—if reasonable terms can be developed—would do more to further development of a vibrant forest carbon "cooperative" in which medium- and larger-sized family forest land holdings could participate. In addition, before any projects were developed, the estimated scale of credits to be generated would ideally be pre-marketed to help stabilize revenue projections. With no compulsory buyer for voluntary forest carbon offset credits it can be difficult to determine pricing on an ad-hoc basis.

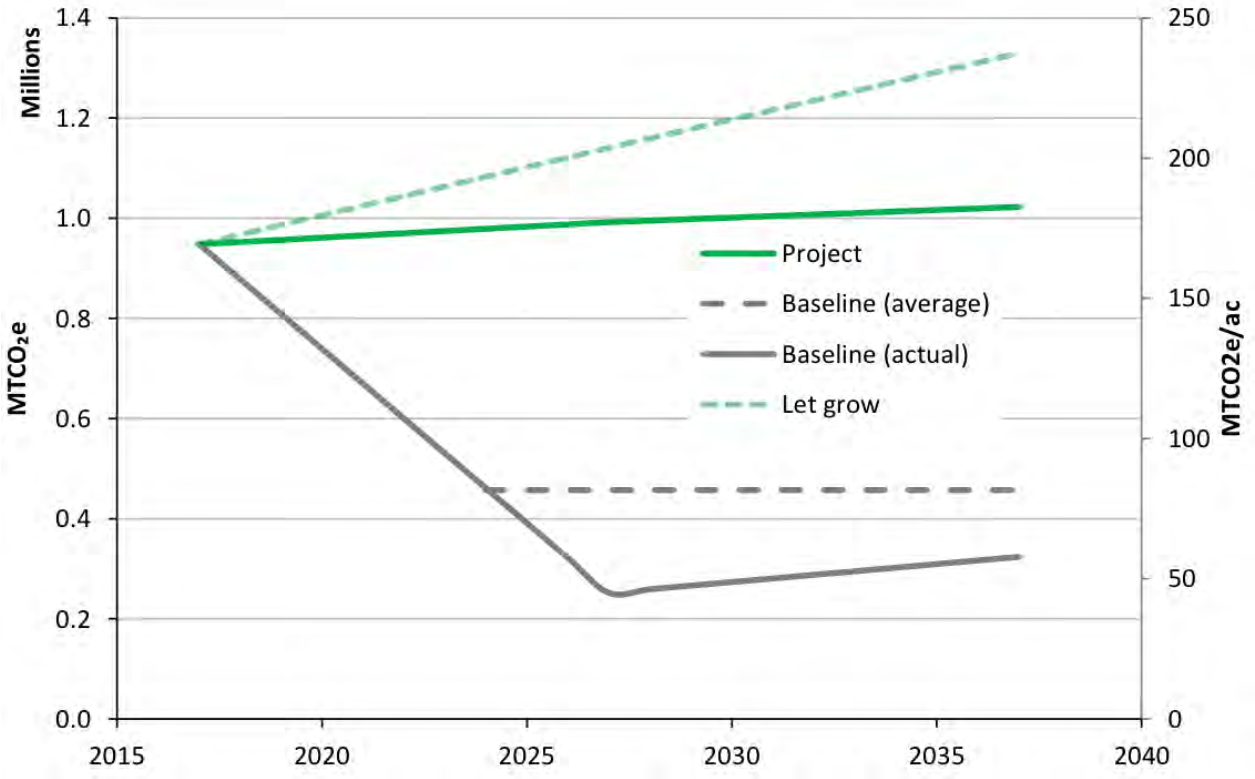
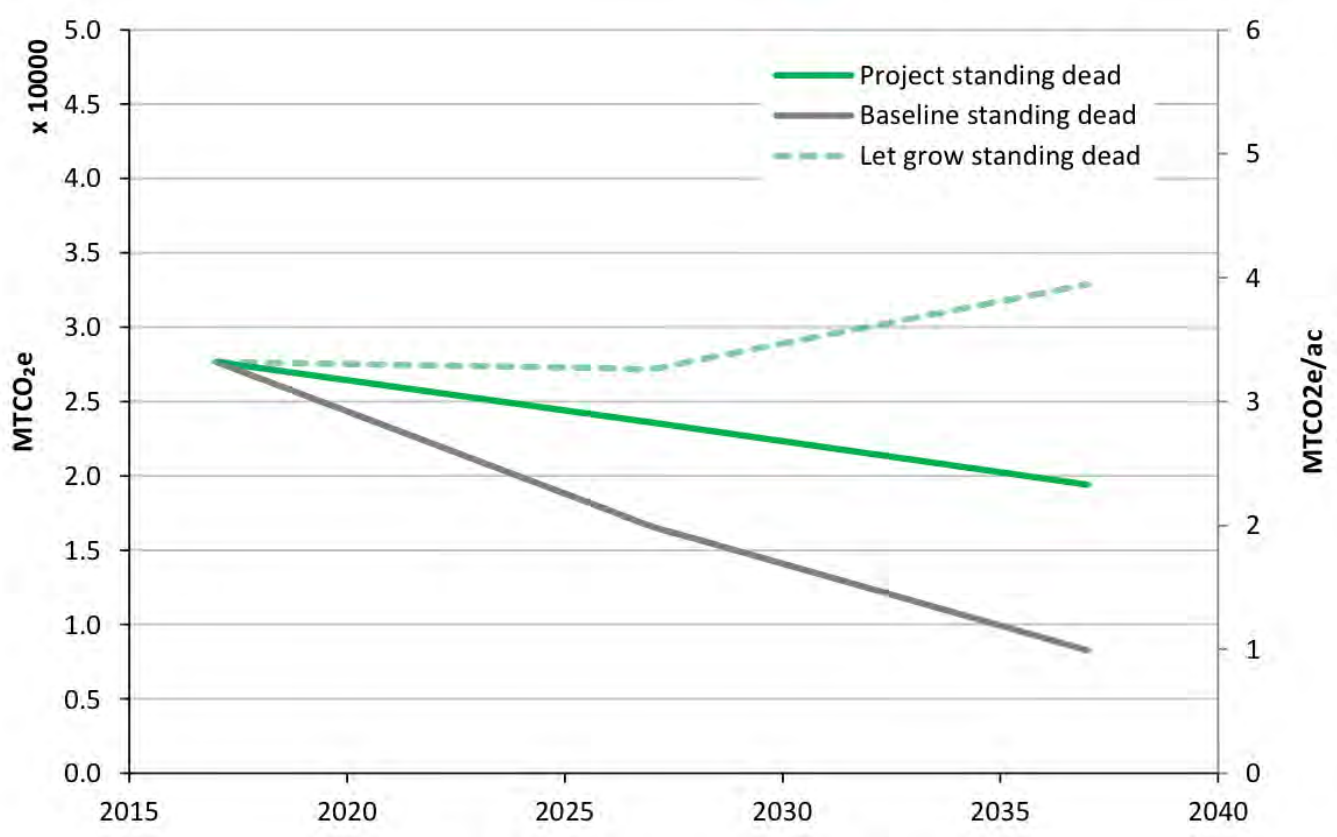


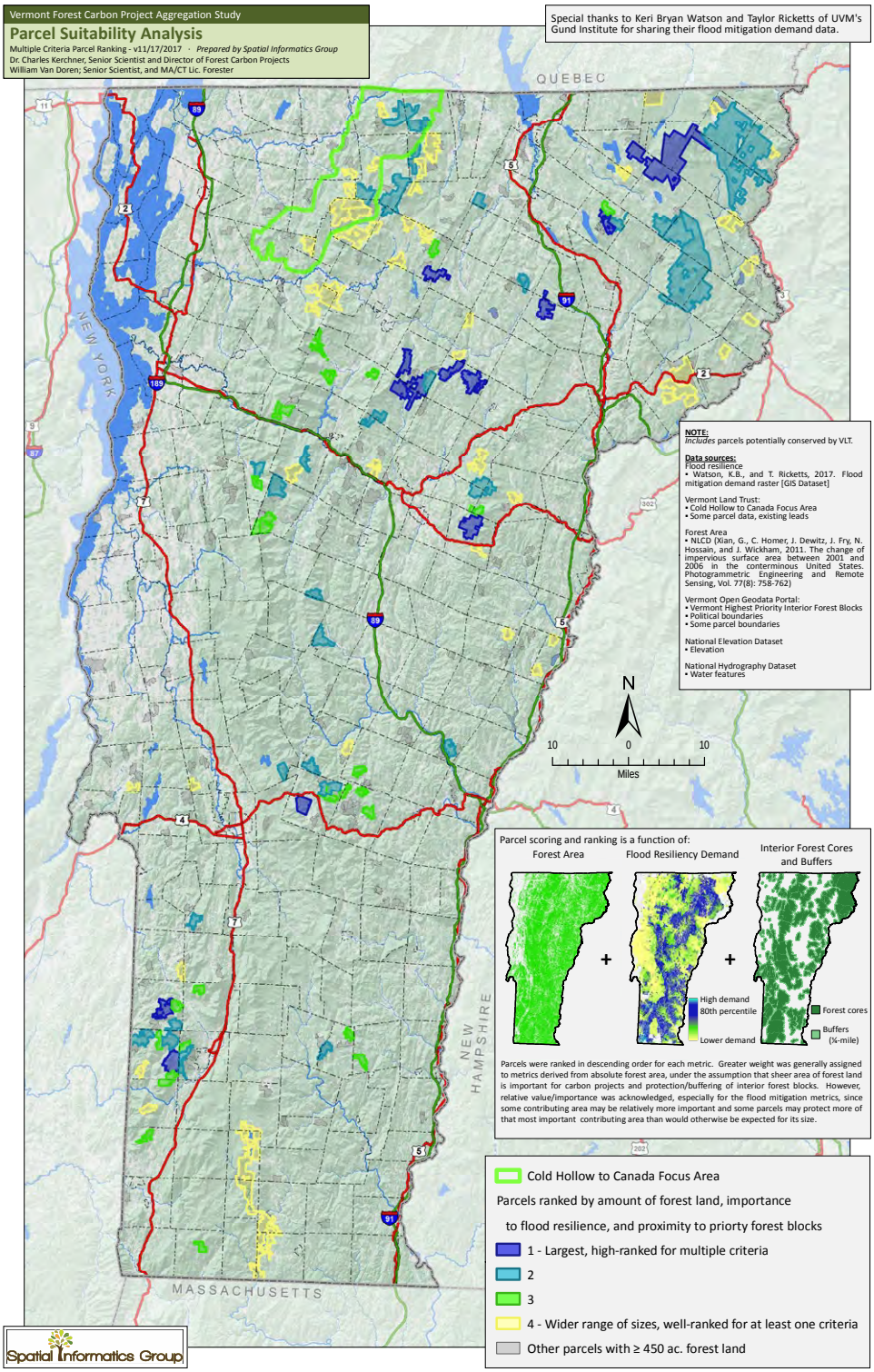
Figure 2. Projections of total live (below) and standing dead (next page) stocks in a let-grow scenario, and under the assumed carbon project baseline and project management.


x 10000
MTCO2e
MTCO2e/ac
Project standing dead
Baseline standing dead
Let grow standing dead
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
6
5
4
3
2
1
0
2015
2020
2025
2030
2035
2040

APPENDIX II
Supplementary Maps, Figures, and Tables

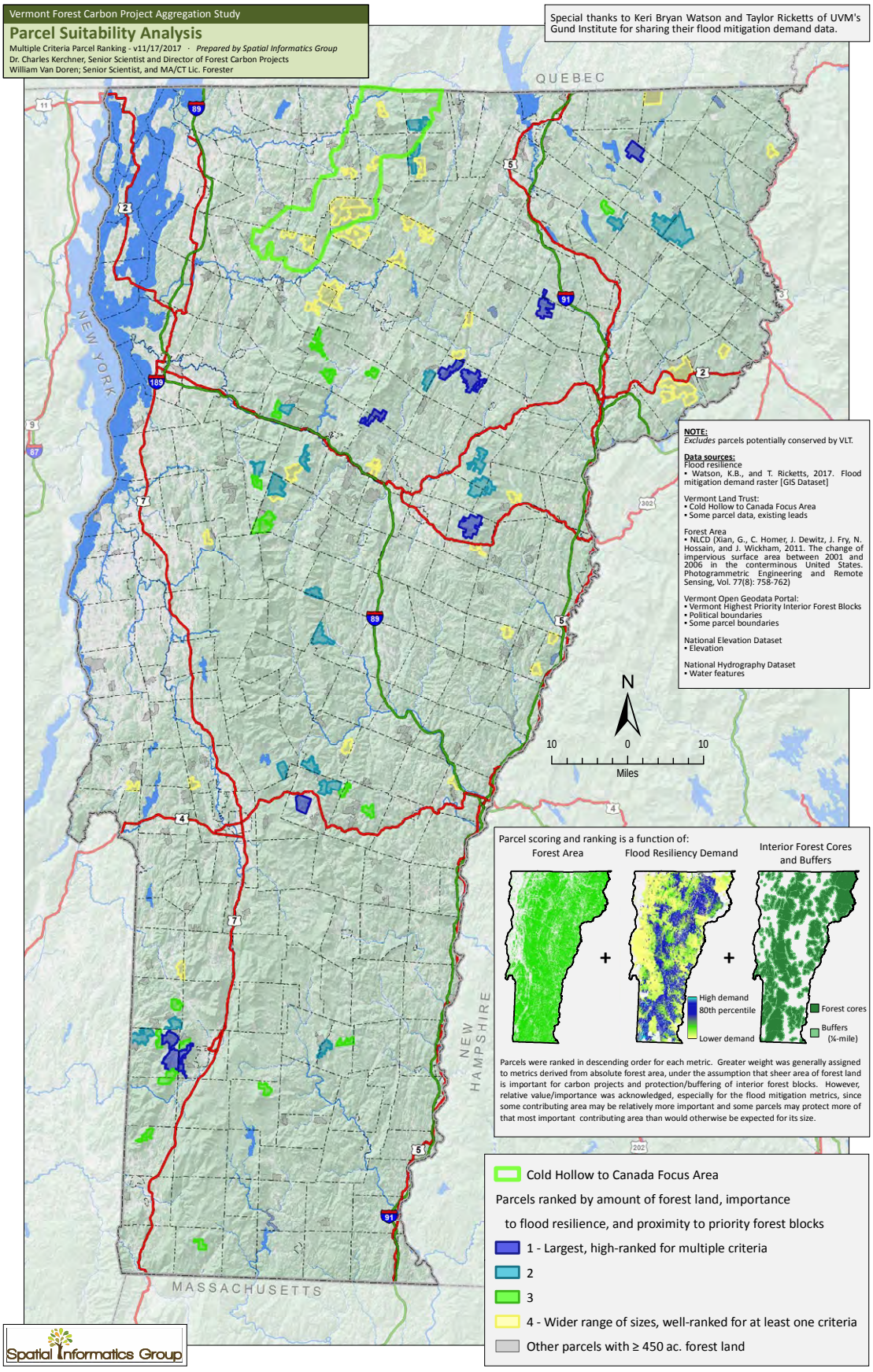
Map 1

Suitability analysis using all candidate parcels



Map 2

Suitability analysis using only parcels not already conserved by Vermont Land Trust



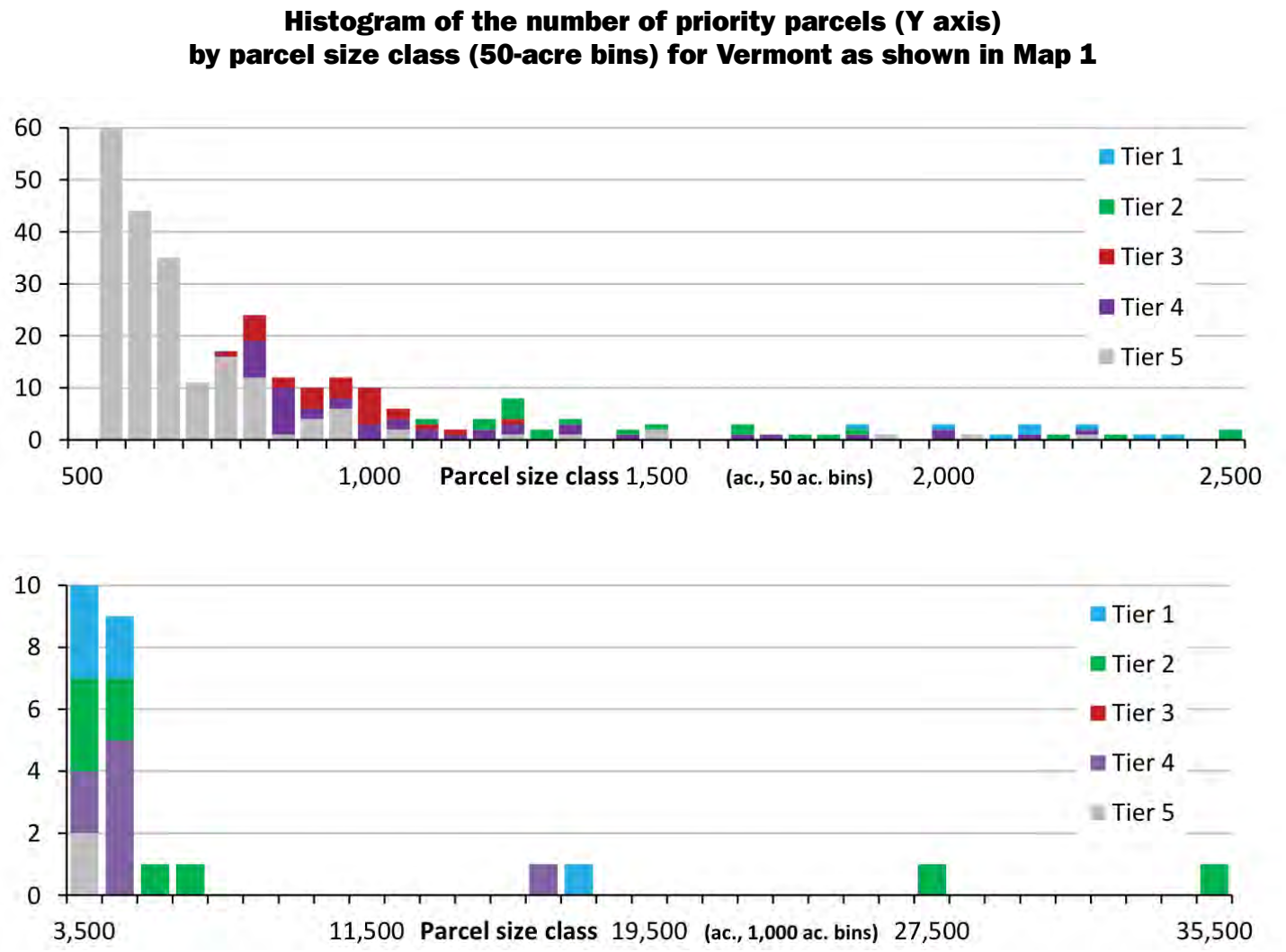
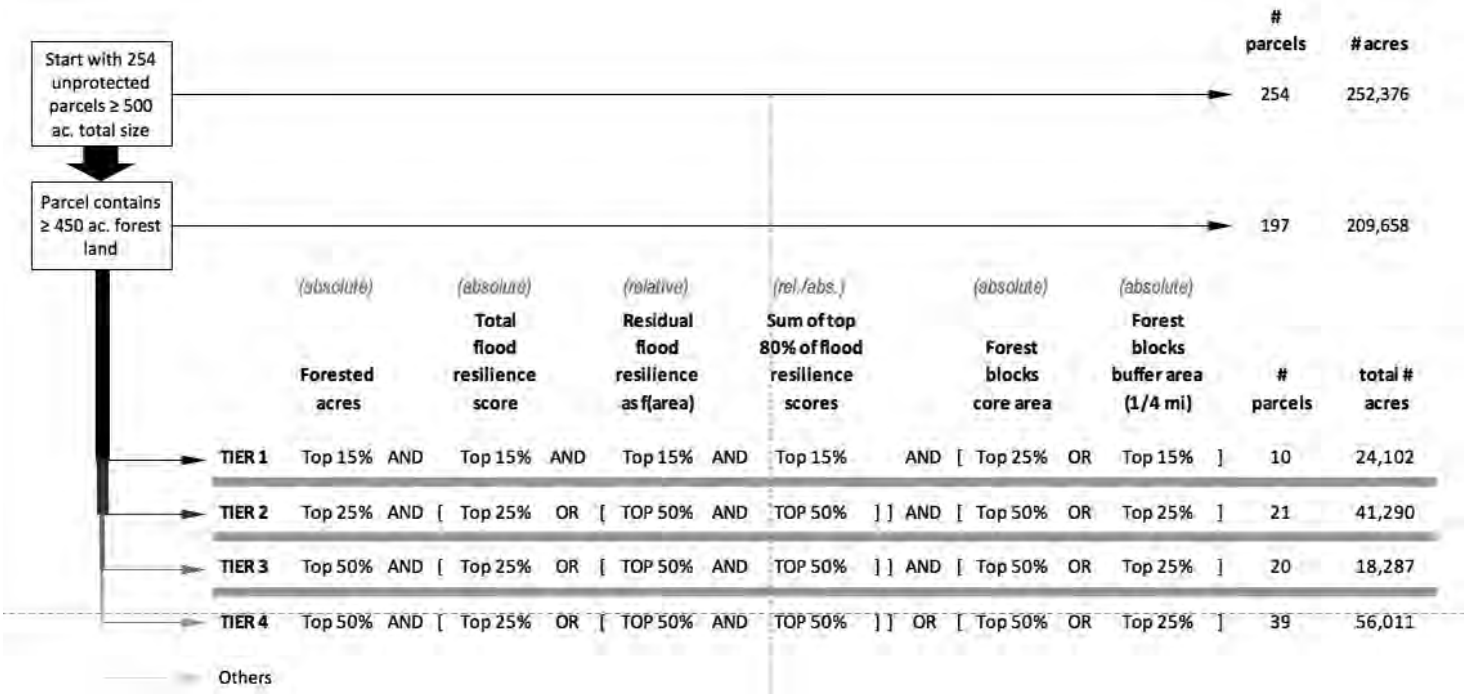


Figure A2.1. Histogram of the number of priority parcels (Y axis) by parcel size class (50-acre bins) for Vermont as shown in Map 1. Federal, state, municipal, and most NGO ownerships are excluded; VLT owned or protected lands are included. Note the split panels due to a skewed distribution. The x-axis on the top panel extends from 500 (the minimum parcel size considered in the exercise) to 2,500 acres; and the x-axis of the lower panel ranges from 2,500 acres to 35,500 acres (the largest parcel in the exercise). The range of the y-axis varies by panel as well. This allows for easier depiction of parcel by tier.

Ranking using only parcels not already conserved by VLT as shown in Map 2.



Metrics used in figure:

Forested acres: NLCD 2011 classes 41, 42, 43: forest land, related to stocked/stockable, manageable forest land.

Flood resilience: Watson, K.B., and T. Ricketts, 2017. Flood mitigation demand raster [GIS Dataset]. Raster cell scores are related to the number of structures for which the cell is part of contributing area, with each structure distributed evenly over its contributing area cells.

- ΣFLOOD: sum of the raster cell values within each parcel – somewhat related to area.
- Residual FLOOD: difference between the actual ΣFLOOD and value of predicted ΣFLOOD based on parcel size; how much better the ΣFLOOD score is than expected from its area.
- ΣFLOOD80: sum of the values of the raster cells with values above the 80th percentile; how much of the most important contributing area does the parcel encompass.

Forest blocks:

- Core area: Area of the parcel within highest priority interior forest blocks.
- Buffer area: Area of the parcel within a simple one-quarter mile buffer of those blocks.

Figure A2.2. Ranking using only parcels not already conserved by VLT as shown in Map 2. Federal, state, municipal, and most NGO ownership are *excluded;* VLT owned or protected lands are *excluded*. Parcels were ranked in descending order for each metric. Greater weight was generally assigned to metrics derived from absolute forest area, under the assumption that sheer area of forest land is important for carbon projects and protection/buffering of interior forest blocks. However, relative value/importance was acknowledged, especially for the flood mitigation metrics, since some contributing area may be relatively more important and some parcels may protect more of that most important contributing area than would otherwise be expected for its size.

Histogram of the number of priority parcels (Y axis) by parcel size class (50-acre bins) for Vermont as shown in Map 2, considering only those parcels not already conserved by VLT

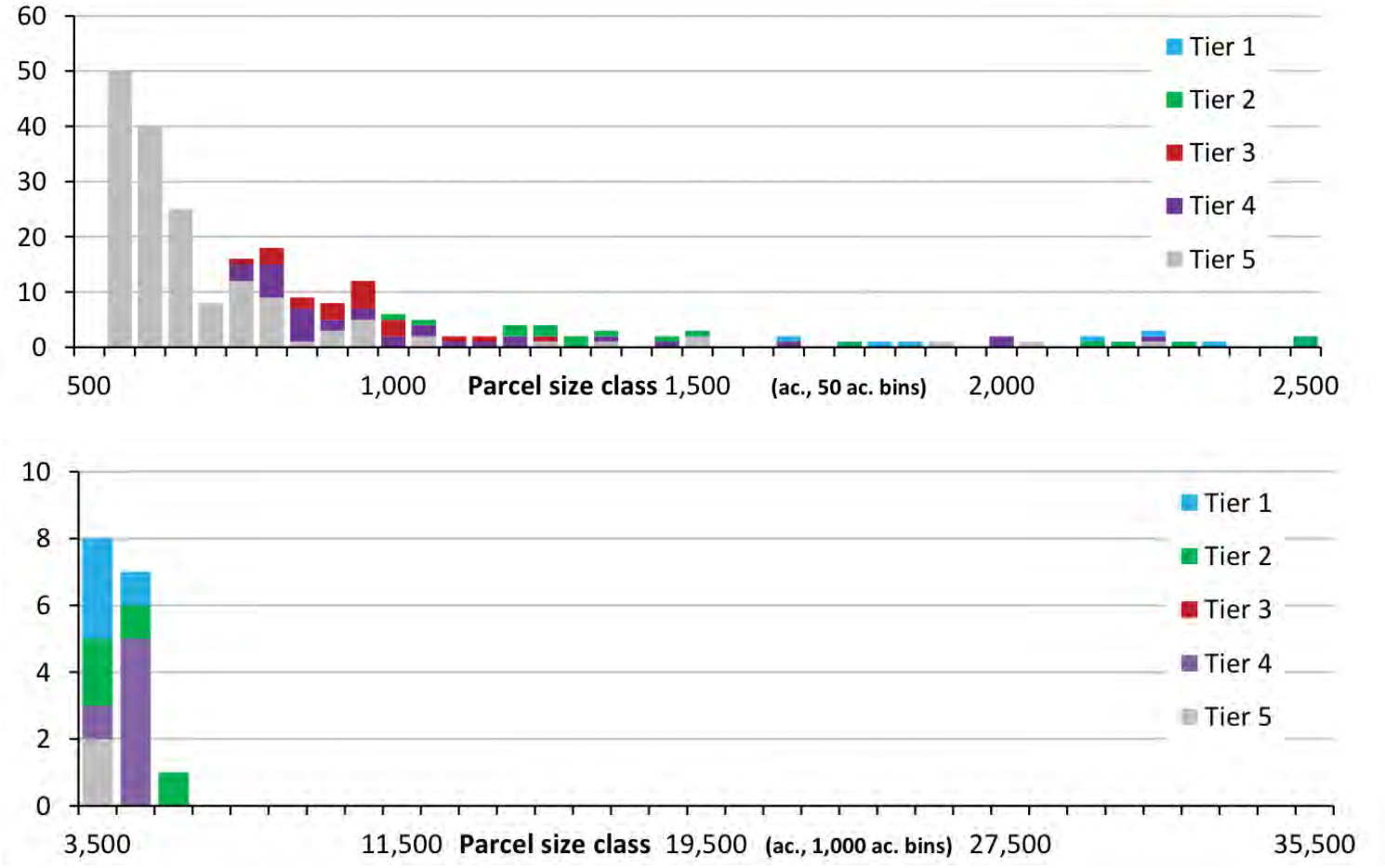
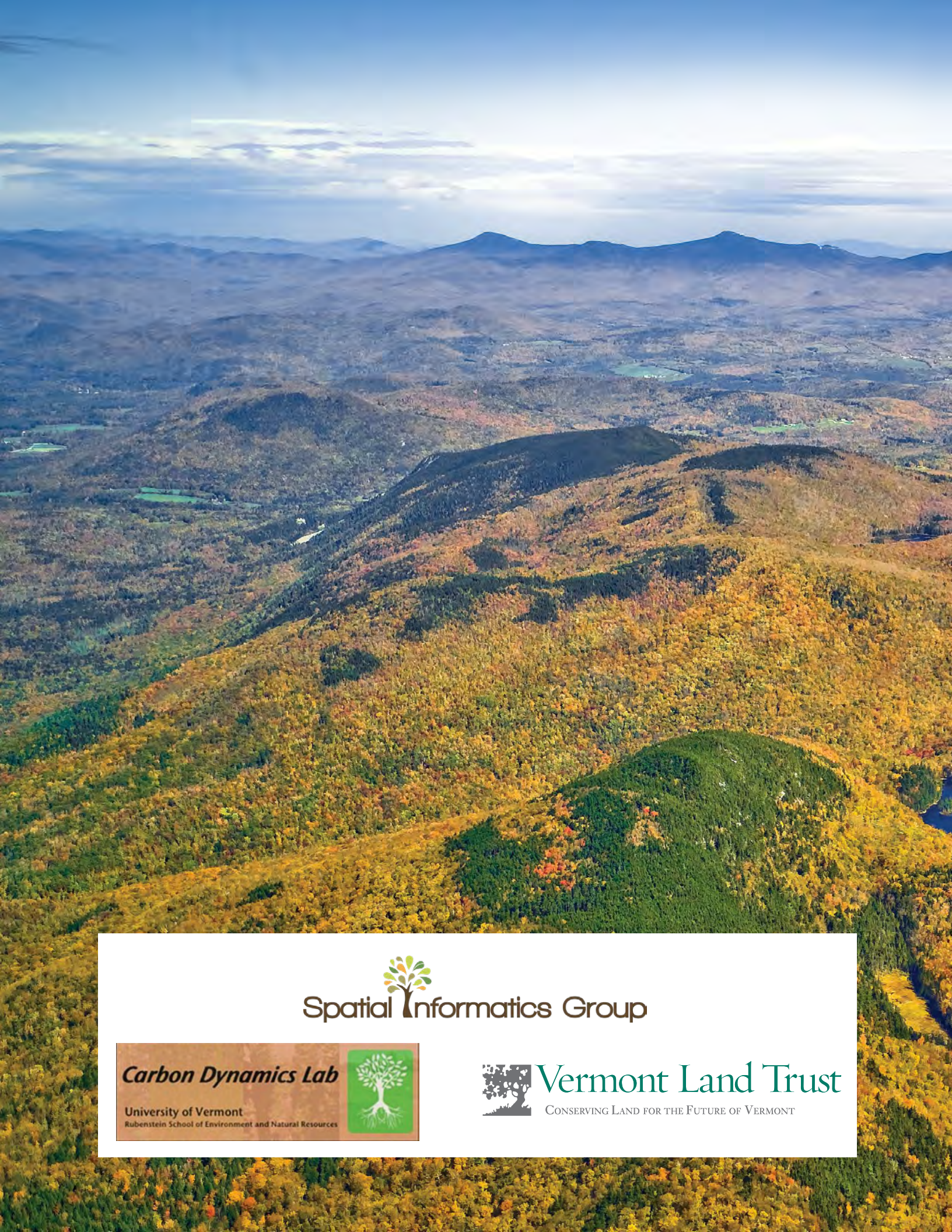


Figure A2.3. Histogram of the number of priority parcels (Y axis) by parcel size class (50 acre bins) for Vermont as shown in Map 2, considering only those parcels not already conserved by VLT. Federal, state, municipal, and most NGO ownerships are excluded; VLT owned or protected lands are excluded. Note the split panels due to a skewed distribution. The x-axis on the top panel extends from 500 (the minimum parcel size considered in the exercise) to 2,500 acres; and the x-axis of the lower panel ranges from 2,500 acres to 35,500 acres (the largest parcel in the exercise). The range of the y-axis varies by panel as well. This allows for easier depiction of parcel by tier.



Spatial Informatics Group

Carbon Dynamics Lab

University of Vermont

Rubenstein School of Environment and Natural Resources

Vermont Land Trust

Conserving Land for the Future of Vermont