CARBON OFFSETS

in Michigan State Forests

DOW SUSTAINABILITY FELLOWS
UNIVERSITY OF MICHIGAN

The Nature Conservancy

The intent of this report is to discuss the theory, strategy, and practicality of selling sequestered carbon from the Michigan State Forest system in the form of carbon credits.

TEAM MEMBERS:
Amanda Willis
Clare Cutler
Kanchan Swaroop
Marc Jaruzel

CLIENT:
Richard Bowman, The Nature Conservancy

ADVISORS:
Michael Kay
Michael Moore

December 7, 2019
Ann Arbor, MI

CARBON OFFSETS IN MICHIGAN STATE FORESTS

Executive Summary

The Dow Sustainability Fellows program at the University of Michigan engage a multidisciplinary cohort of graduate students with clients on sustainability-oriented projects. This report for The Nature Conservancy explores the possibility for the Michigan State Forest System to sell the sequestered carbon from improved forest management practices to a carbon market. The intent of this report is to discuss the theory, strategy, and practicality of selling sequestered carbon from the Michigan State Forest system in the form of carbon credits.

The Michigan Department of Natural Resources (DNR) manages 4 million acres of state forest land in Michigan's upper and lower peninsulas. As a state in which the commercial timber industry plays an important part of the economic and social structure, Michigan has a significant role in managing this land. Data collected on the state forest land informs management practices for the Michigan DNR. A typical upper Midwest forest can achieve an average CO_2 capture rate of 3-4 metric tons per acre per year. Using rough numbers, the Michigan State Forest System has a baseline sequestration rate of approximately 15.4 million tons of CO_2 per year. An improvement in the DNR's management strategies can allow for increased carbon sequestration within the forest system above this amount. The DNR can capitalize on this additional sequestration above the baseline through carbon offset projects.

Carbon sequestration markets can be either voluntary or compliance markets. The Regional Greenhouse Gas Initiative (RGGI) and California's cap and trade markets are compliance-based in which industrial emission sources are legally required to reduce or offset their greenhouse gas (GHG) emissions to a specified level. Voluntary markets consist of all other transactions of carbon offsets. These offsets are not purchased with the aim of using them for compliance in an active regulated carbon market like RGGI. In both types of markets, companies and individuals can buy credits or offsets which allow them to emit or to change their practices to pollute less. Offset Project Registries are entities helping certify that carbon offset projects accurately measure sequestration and reduce carbon emissions.

The value chain of carbon offsets begins with generators (the forest system) and can often incorporate third parties such as aggregators, retailers, and brokers before the end buyer. These entities assist with the development of the carbon offset project and eventual sale of carbon. However, working with a third party can substantially reduce the revenue that can be collected by the State. Consultant companies specializing in carbon markets are able to manage the entire project

from start to finish by creating revenue models for improved management practices, monitoring and inventorying forests, and lining up buyers. They withhold an initial fee and take a percentage of revenue only once carbon is sold. Other costs involved with developing a carbon offset project could include costs for initial market research labor, forest inventory data collection, forest monitoring, third party verification, customer acquisition fees, and marketing. A successful carbon project will have to survive the policy life-cycle in Michigan. It is important that the project gather political support, account for stakeholder interests, be created through the proper authority, and determine the use of revenue.

To ensure success, we have developed a set of recommendations for the state. We recommend that the state of Michigan bypass working with an aggregator, broker, or retailer if a significant portion of land is used for the carbon project. The project should be managed by the Michigan DNR and, depending on the size of the project, can either use a consultant to collect data or utilize inventory expertise the DNR already possesses.

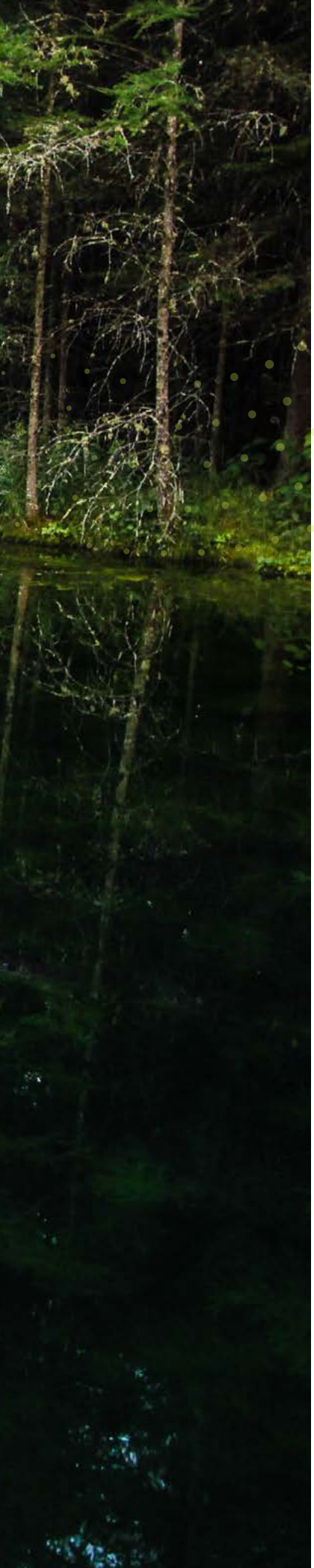
At minimum a conversation with various offset consulting services would be beneficial to better understand what value they provide when looking to enter the carbon offset market. Michigan may not possess the forest inventory staff necessary to provide data collection for the entirety of the project. Additionally, Michigan may benefit from branding offsets similar to the Pure Michigan campaign to appeal to Midwest corporate buyers. We recommend that the project minimizes the impact on forest stakeholders and is reinforced with a strong agreement from the proper authority, such as one passed through the state legislature. Finally, we recommend that revenue generated from the sale of carbon offsets be used for sustainability projects in Michigan. Investments in sustainability can allow this undertaking to result in further reductions of total emissions. Potential investments can include building weatherization for energy efficiency or funding for public transportation in urban regions. These investments could help expand the base of political support for the entire program.

TABLE OF CONTENTS

Introduction and Background

ABOUT THE PROJECT

In the interest of protecting the state's forests and investing in the future of Michigan's environmental health, The Nature Conservancy (TNC) approached Dow Sustainability Fellows at the University of Michigan to help TNC explore the possibility of selling the sequestered carbon from improved forest management strategies in the Michigan State Forest system. This report discusses the theory, strategy, and practicality of selling sequestered carbon from the Michigan State Forest system in the form of carbon credits. This report provides background on the Dow Sustainability Fellowship, the Nature Conservancy, the Michigan State Forest System, carbon markets, and conclude with business and policy recommendations.



ABOUT THE DOW SUSTAINABILITY FELLOWS PROGRAM

The Dow Sustainability Fellows is an interdisciplinary fellowship which supports approximately 45 masters and doctoral students per year. The mission of the program is to prepare sustainability leaders to have a future positive impact in real world organizations.[1] These students partner with each other and stakeholders to develop interdisciplinary, practicable, and meaningful sustainability solutions for local and global problems. Past projects include developing sustainable water policy in Mexico City, approaches to neighborhood-led green infrastructure in Detroit, and a feasibility study of a campus biodigester, among many others.[2] Four students comprise our team: Amanda Willis from Ross Business School and the School for Environment and Sustainability, Clare Cutler from the School for Environment and Sustainability, Kanchan Swaroop from the College of Engineering and the School for Environment and Sustainability, and Marc Jaruzel from the Ford School of Public Policy.

ABOUT THE NATURE CONSERVANCY

Our client, The Nature Conservancy, is a charitable environmental organization that has been protecting and preserving natural areas since 1954. It began in 1915 as the Ecological Society of America, and the group's vision initially was hazy. Some saw the group as an organization to support ecologists' research, while activists argued TNC should focus on protecting natural spaces. The Ecologist's Society changed its name to The Nature Conservancy and was incorporated as a non-profit in 1951.[3]

The group officially began protecting land on Christmas Eve in 1954, when a group of neighbors in Bedford, New York, joined forces to bid on a 60-acre forest in the Mianus River Gorge rather than see it developed. TNC financed $7,500 of the purchase to help the neighbors protect the land. From there, TNC expanded until there were chapters and offices across the United States. Today, The Nature Conservancy works to protect land all over the world.[4]

1 About. (2019, December). Retrieved from Dow Sustainability Fellows: http://sustainability.umich.edu/dow/about

2 Dmudie. (2019, February 12). Master's and Professional Projects. Retrieved from http://sustainability.umich.edu/dow/masters/projects?page=1&field_year_value=All&combine=.

3 Our History. (n.d.). Retrieved from https://www.nature.org/en-us/about-us/who-we-are/our-history/.

4 Our History. (n.d.). Retrieved from https://www.nature.org/en-us/about-us/who-we-are/our-history/.

The Michigan State Forest System

GEOGRAPHY OF THE MICHIGAN STATE FOREST SYSTEM

Michigan's climate and geography was formed by receding ice sheets and the disappearance of ancient glacial lakes. Once land was settled and taken for agricultural use; pollution, soil erosion, and forest fragmentation were extensive around the state. Eventually, the state of Michigan inherited large portions of cleared land that was determined unusable for farming. In 1899, the state established a Forestry Commission, which designed the first state forest reserve on 34,000 acres. This was the start of the present-day state forest system.[5]

Today, the Michigan Department of Natural Resources (DNR) manages the largest state-owned forest system in the U.S. at around 4 million acres of state forest land in the upper and lower peninsulas. Michigan's forest system is made up of four regions that are distinct in aspects such as vegetation, climate, and soils. These regional designations are used to develop maintenance plans and projections for the future of water and land resources. Appendix A contains a map of publicly owned land in the state of Michigan. Current state forests are comprised of secondary growth which provide the DNR with various management choices. The carbon sink potential can be quite large for secondary forests and can be an important factor in the storage of carbon.[6]

CURRENT MANAGEMENT POLICIES FOR THE STATE FOREST SYSTEM

The Michigan DNR develops and modifies forest management plans based on input from inventory specialists and goals set forth by the State. The DNR divided the state forests into 15 units according to county lines and these units are divided further into compartments of 1000 acres.[7] The department inventories each compartment every 10 years so that every year, one tenth of the total state forest land is inventoried. During inventories that typically occur in the winter, forest inventory specialists conduct aerial surveys and walk-throughs to identify species and relative abundance. Age data is also collected from harvests or tree cores. Specialists review inventory data to assess the availability of the forest for harvest and determine future management strategies for each unit. These practices go into effect one year after management decisions are made. Wall to wall review of the entirety of the forest system occurs every 10 years once all units have been surveyed.[8]

Michigan forests contain some of the highest quality red oak and hard maple timber in the world, of which the state can harvest a portion.[9] Twenty percent of the raw material from the forest products industry in Michigan originates from the state forest system. Logging and trucking firms, primary manufacturers (sawmills, pulp and paper mills, etc.), and secondary manufacturers (finished wood products) provide 96,000 jobs to Michiganders. Forest products contribute $20 billion per year to Michigan's economy and the state expects that timber will remain an important resource contributing to the social and economic livelihood of Michiganders.[10]

5 Michigan Department of Natural Resources. (2008). Michigan State Forest Management Plan. Lansing.

6 Pugh, T. A., Lindeskog, M., Smith, B., Poulter, B., Arneth, A., Haverd, V., & Calle, L. (2019, March). Role of forest regrowth in global carbon sink dynamics. Proceedings of the National Academy of Sciences, 116(10), 4382-4387. doi:10.1073/pnas.1810512116

7 Michigan Department of Natural Resources. (2008). Michigan State Forest Management Plan. Lansing.

8 (2019, July 25). State Forest Inventory Specialist, Michigan Department of Natural Resources. (K. Swaroop, Interviewer)

9 Michigan Department of Natural Resources. (n.d.). Forest Products Industry. Retrieved from The Department of Natural Resources: https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80943---,00.html

10 Michigan Department of Natural Resources. (n.d.). Commercial Timber Sales. Retrieved from The Department of Natural Resources: https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80912---,00.html

Methods

Methods to compile the knowledge and recommendations outlined in this report include primary and secondary research.

Due to the attributes of the emerging carbon sequestration industry and the lack of standardized public oversight; the state of carbon markets, the mechanisms of transactions, and the financial outcomes are not well-publicized or understood. The team spent significant time and effort pursuing and reading existing literature on this topic. The literature review provided the team with a baseline of knowledge on carbon offsets markets and projects. The desk research portion of this project dominated the first three months of work, although it continued through the entire project duration as the team's knowledge grew. However, as with many emerging industries, the most up-to-date information is held by individuals who work in carbon markets. The team quickly concluded that primary research with these individuals was essential to completing an accurate report.

Informed by desk research and advisor guidance, the team identified several relevant organizations and was able to arrange ten interviews with individuals representing multiple facets of the carbon offset industry, ranging from public officials within and outside of Michigan, those who have established local offset projects, and those which help others set them up. The interviewee affiliations and topics covered can be found in Appendix B. Conversations ranged in length from 30 minutes to 1 hour.

The team also worked closely with two advisors: Michael Kay, formerly with The Dow Chemical Company and with expertise related to the subject matter as well as the Dow Sustainability Fellowship project structure; and Dr. Michael Moore, Associate Dean and Professor at the University of Michigan School for Environment and Sustainability, with expertise in environmental economics. Advisors provided valuable guidance and input as the team worked its way through the often confusing subtleties of the carbon offset markets. The client, Richard Bowman of the Nature Conservancy, also served a vital role in determining and maintaining the direction of research. Bowman's regular visits to Ann Arbor and conversations with the team provided valuable guidance. Contact information for these key stakeholders and advisors is in Appendix C.

This research has allowed the team to gain a more sophisticated understanding of the industry and how other buyers and sellers of carbon offsets operate. Using learnings about the system as well as market participants' successes and challenges, the team was equipped to make strategy recommendations.

About Carbon Sequestration Markets

WHAT ARE THEY?

Carbon sequestration markets serve to create a monetary value of carbon sequestration. An offset is an intangible product that represents a quantity of carbon that has been sequestered. Traditionally, sequestered carbon has had no monetary value in capital markets; carbon offset markets change this. This approach provides a flexible and market driven solution to reduce atmospheric CO2 levels, rather than traditional command-and-control governmental regulations such as emissions standards or taxes. A key driver of the rise in carbon dioxide emissions are human activities, including the burning of fossil fuels and changes to land use. Carbon sequestration markets seek to curb these anthropogenic levels of CO2 while allowing the market to allocate resources in the most efficient way. Companies and individuals can buy offsets to counteract CO2 emissions, enabling them to continue emitting CO2 but still reducing their overall emissions contributions. Companies seeking to counteract their CO2 emissions can purchase offsets directly from companies who generate offsets through improving their practices to reduce emissions. Over time, carbon offset credits are retired so the supply dwindles, gradually forcing reductions in polluting practices.[11]

11 Carbon Trading & Sequestration. (n.d.). Retrieved from https://enviroliteracy.org/environment-society/environmental-resource-economics/carbon-trading-sequestration/.

WHY ARE THEY VALUABLE?

Carbon sequestration markets help correct a market failure. Typically, the carbon emitted from burning fossil fuels in industry and private use is a negative externality; the detrimental consequences to the environmental and health not captured in the economic transaction. While those burning fossil fuels benefit from its use, they and others are harmed by lower air quality and increasing global temperatures from greenhouse gasses (GHGs) emitted into the environment. This cost to the environment is not captured in the cost of the goods being produced and services rendered in industries supported by fossil fuels. Carbon sequestration offsets attempt to correct this externality by incorporating the cost of CO2 emissions into the market. They place a value on sequestered carbon - carbon taken from the air and fixed in natural formations like forests, grasslands and wetlands - which gives people an incentive to preserve trees and keep the carbon bound to the earth rather than the atmosphere. Carbon markets help companies and countries limit their greenhouse gas emissions and allow them to balance out their emissions by purchasing credits for the carbon that they must emit.[12] As policies and ethics are encouraging people, corporations, and other organizations to reduce their carbon footprint, carbon markets are an effective way for people to transition and reduce their environmental impact.

This captured value benefits both the producers and consumers of offsets. The producers of offsets, the entities that sequester carbon, are incentivized to change their practices to make them more environmentally friendly. Though some organizations are motivated to improve sustainability practices through non-monetary means, carbon offsets provide an additional economic incentive to sequester carbon. For consumers of offsets, purchasing offsets allows them to lower their overall carbon emissions without investing in emissions reductive technology. For industrial companies, reducing site emissions could mean a large investment in equipment, and carbon offsets may provide them a lower cost avenue to accomplish a similar goal.

RISKS AND CONTROVERSIES

Although carbon offsets are generally viewed as a positive step in the direction of decarbonizing modern life, they are not without controversy. Some argue that allowing companies to purchase offsets in lieu of lowering emissions from their operations only delays the inevitable. Ultimately, to get to a zero or negative carbon economy, emissions must be lowered at the pollution site, and a carbon offset market does nothing to encourage the kind of drastic action and changes to the status quo that this would require. In fact, the presence of offsets weakens the producers' incentives to cut emissions.[13]

Many of the offsets today are generated in developing economies through avoided deforestation. This is the promise that forest area scheduled to be cut down will instead stay as is, and therefore sequester more Carbon than would have been sequestered otherwise. Much of the value of these offsets have been called into question. An investigation by ProPublica revealed in many cases of avoided deforestation, logging activity is simply moved to other areas of nearby or even remote forest, and therefore logging is not actually avoided.[14] Although this particular example is not as relevant in developed countries where massive clearcutting is less common, it is important to remain aware of the counterarguments of a policy which may bear the state of Michigan's approval.

12 White Paper. (n.d.). Retrieved from https://nori.com/resources.

13 Anderson, K. (2012, April 4). The inconvenient truth of carbon offsets. Retrieved October 24, 2019, from https://www.nature.com/news/the-inconvenient-truth-of-carbon-offsets-1.10373.

14 Song, L. (2019, May 22). An (Even More) Inconvenient Truth: Why Carbon Credits For Forest Preservation May Be Worse Than Nothing. Retrieved May 22, 2019, from https://features.propublica.org/brazil-carbon-offsets/inconvenient-truth-carbon-credits-dont-work-deforestation-redd-acre-cambodia/.

COMPLIANCE MARKETS

Compliance markets are those in which emitters are forced to conform to limits on their carbon emissions. In compliance markets, industrial emission sources are legally required to reduce their GHG emissions to a specified level. These sources must also retire carbon allowances or offset credits equal to their reported GHG emissions.[15] After a carbon credit is retired it can no longer be used in commerce, thus forcing industries to reduce their emissions further over time or else incur large penalties. There are already two models of Emissions Trading System (ETS) markets in the U.S.: Regional Greenhouse Gas Initiative (RGGI) and California's ETS. Through conversations with industry experts, we learned that many compliance markets are moving towards more restricted boundaries, particularly that many prioritize offsets generated without their own participating states. Therefore, compliance markets are not a good fit for the state of Michigan to enter.

RGGI CAP AND TRADE

The Regional Greenhouse Gas Initiative (RGGI) is comprised of 9 states: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. RGGI is a collective effort to cap and curb carbon emissions from the power sector. These states sell emission allowances through auctions and use the proceeds to further reduce CO2 by investing in energy efficiency, renewable energy, and consumer benefit programs. This system promotes innovation in clean energy and creates green jobs in these states.[16] RGGI is not awarding offset allowances to projects outside of the RGGI region at this time.[17]

CALIFORNIA'S CAP AND TRADE PROGRAM

California's Cap and Trade program was launched in 2013 as one piece of their goal of lowering emissions in the state. The program is the fourth largest of its kind in the world, after European Union, the Republic of Korea, and the Chinese province of Guangdong. California's program will drive emissions cuts to one of the largest economies in the world. The emissions trading system is expected to decrease greenhouse gas emissions from regulated entities by over 16 percent between 2013 and 2020, and by an additional 40 percent by 2030. The cap-and-trade rule pertains to large electric power plants, large industrial plants, and fuel distributors which includes 450 businesses which are responsible for about 85 percent of California's total greenhouse gas emissions. Furthermore, California has joined forces with the Canadian provinces of Ontario and Quebec so that businesses from one jurisdiction can trade emissions allowances in another. This increases the number of businesses participating which leads to additional economic efficiencies.[18]

GLOBAL ETS

Though there are additional trading systems throughout the globe, like the U.S., each come with specific rules and many are domestically focused. Therefore, we will not explore international compliance markets in the scope of this report.

VOLUNTARY MARKETS

Many businesses and consumers want to know that the commerce they are engaging in is carbon neutral. For this reason, companies and individuals are purchasing carbon offsets on the voluntary market purely by choice. The voluntary market consists of all transactions of carbon offsets that are not purchased with the aim of conceding them to an active regulated carbon market. It does include offsets that are purchased to resell or retire in order to meet carbon neutral or environmental claims.[19] In 2016, $74.2 Million worth of voluntary forest Carbon offsets were transacted, representing a volume of 14.3 Million tons CO2 equivalent (MtCO2e).[20] To provide context, this trading volume is less than the entire amount of carbon currently sequestered across all of Michigan's state forests, which we detail in the next section. There are many carbon registries in which one can purchase these credits - a process which we will discuss later in this paper.

15 White Paper. (n.d.). Retrieved from https://nori.com/resources.

16 RGGI, Inc. (n.d.). Retrieved from https://www.rggi.org/rggi-inc/contact.

17 (2019, June 11). RGGI, Inc. (M. Jaruzel, Interviewer)

18 California Cap and Trade. (2018, March 16). Retrieved from https://www.c2es.org/content/california-cap-and-trade/.

19 Carbon Market: Overview. (n.d.). Retrieved from https://www.ecosystemmarketplace.com/marketwatch/carbon.

20 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

Carbon Sequestration in the Michigan State Forests

This section contains an overview of how carbon sequestration values can be obtained as well as a monetary estimate of the carbon sequestration potential in the Michigan State Forest System.

CURRENT AMOUNT OF CARBON SEQUESTERED

Carbon sequestration amounts for forests can vary greatly. Trees typically have high sequestration rates when first planted and these rates can increase exponentially in the early stages of growth before stabilizing and then eventually decreasing. All of this can depend on the species of tree, location, and management among other variables. A typical forest in the upper Midwest can achieve an average CO2 capture rate of 3-4 metric tons per acre per year.[21]

21 Central Minnesota Regional Sustainable Development Partnership. (n.d.). A Landowner's Guide to Carbon Sequestration Credits. Retrieved from http://www.myminnesotawoods.umn.edu/wp-content/uploads/2009/10/landowner-guide-carbon-seq1-5-12.pdf

If we take into account the full area of the Michigan State Forest system (4 million acres), we can calculate a very generalized rate of CO2 sequestration for the entirety of the forest.

$$\frac{3.5\ metric\ tons\ CO_2}{acre * yr} * \frac{1.102\ US\ ton}{1\ metric\ ton} * 4{,}000{,}000\ acres = 15{,}428{,}000\ ton\ CO_2/yr$$

The World Bank estimates carbon pricing to be around $10/tCO2e[22] (this price is aligned with a 2016 survey that found North American average price to be $9.2/tCO2e)[23] so the potential monetary value from carbon sequestration of the entire Michigan State Forest system is as follows:

$$15{,}428{,}000\ ton\frac{CO_2}{yr} * \frac{\$10}{ton\ CO_2} = \$154{,}280{,}000/year$$

However, there are various challenges involved with determining the exact value of carbon from Michigan forests that can be sold on the market. This would require setting an accurate baseline carbon stock value and determining steps to reduce emissions further from that baseline. As mentioned above, the rate of carbon storage from trees is dependent on a number of variables. including but not limited to, type and age of trees, amount of dead wood, management practices, and harvest lengths. Complex modeling of various scenarios is needed in order to understand the amount of sequestered carbon that can be monetized. Various methodologies are available for calculation of the amount of carbon available to sell into a market. Offset Project Registries are used to "help facilitate the listing, reporting, and verification of offset projects."[24] These registries develop specific methodologies that can be third party verified in order to comply with either compliance or voluntary markets. The amount of emissions reduction for a project is taken into account by calculating the amount above a specific baseline reduction. Baseline is usually defined as "business as usual" if the offset project did not take place. In this case, the full $154 million would not be able to be put on the market. The total project value would only be determined based on the improved management practices the state forest system implements to increase reductions compared to baseline or "business as usual." Regarding the earlier mention that the entire voluntary carbon market is slightly smaller than the total amount of carbon sequestered in the Michigan State Forests, we should not expect a dramatic shift the market, because the quantity of Carbon offsets that Michigan will sell will likely be much smaller than this quantity. This is due to the aforementioned requirement to improve above the baseline sequestration value.

22 The World Bank. (2017, December 1). Carbon Pricing. Retrieved from The World Bank: https://www.worldbank.org/en/results/2017/12/01/carbon-pricing

23 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

24 California Air Resources Board. (2018, February 15). Offset Project Registries. Retrieved from CA.gov: https://ww3.arb.ca.gov/cc/capandtrade/offsets/registries/registries.htm

All registries have different methods to quantify emissions reductions for various scoped projects. Methodology for Improved Forestry Management (IFM) practices is most applicable to the Michigan State Forest System. These methodologies outline rules and applicability associated with the project, including the need for adequate additionality for the emissions reduction project. In many cases, projects can be considered adequately additional if the project passes a three-pronged test; to meet the requirements of additionality and the quality for offsets, the project must exceed current laws and regulations in place that would mandate the project activity, go beyond common practices and technology implemented in the industry, and face a barrier (financial, technical, or institutional) that hinders the implementation of the project.[25] Once the project is adequately qualified, the IFM methodology details calculations of carbon pools and sources to establish a baseline and quantify the emissions reductions resulting from the project at different points in time. In order to do this, forest plots must be inventoried and monitored regularly throughout the life of the project. A commitment to these projects is required, usually between 40-100 years.[26]

SOCIO-ECONOMIC ADVANTAGES OF CARBON SEQUESTRATION

Changes in forest management are an important consideration when attempting to maximize the carbon offset of forests. Even slight changes in how forests are maintained can result in carbon capture improvements. Two practices that have been used to demonstrate change from baseline conditions have been stimulation of fast-growing species and fertilization. A number of projects that enter into carbon markets increase their delta from baseline by extending time between harvests of their trees for timber. Although both the lower and upper peninsulas have shifted away from strict timber-based economies to the inclusion of more diversified industries such as recreation and agricultural resources, timber is still an important element of Michigan's economic structure. Understanding this structure can help provide guidance in developing a long-term plan if the state chooses to enter a market. Although timber is important, the carbon storage impacts from delaying harvests can potentially be an even greater source of revenue for the State. As discussed later in this paper, the revenue generated from the state forest system's entrance into a carbon market can be invested back into Michigan infrastructure to provide more equitable benefits for residents.

All registries have different methods to quantify emissions reductions for various scoped projects. Methodology for Improved Forestry Management (IFM) practices is most applicable to the Michigan State Forest System.

25 American Carbon Registry (2019). The American Carbon Registry Standard, version 6.0., Winrock International, Little Rock, Arkansas.

26 The American Carbon Registry. (2018). Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal U.S. Forestlands.

Michigan's Opportunities in Carbon Registries

Just four registries that certified **93%** of all forestry and land use voluntary Carbon offsets in 2016

Carbon Registries are the bodies that certify carbon offsets, and while there are no laws mandating their use in voluntary markets, our interviews and research indicate that verification by a reputable registry is necessary to find buyers for offsets.

Just four registries that certified 93% of all forestry and land use voluntary Carbon offsets in 2016: Verified Carbon Standard (VCS), American Carbon Registry (ACR), The Gold Standard, and Plan Vivo. The remainder of offsets were unverified, used the Australian Carbon Farming Initiative, or used another unspecified system.[27] In this section, we'll focus specifically on registries that cater to forestry and land-use offsets.

The Gold Standard and Plan Vivo together only made up 6% of offset verification, and these registries cater primarily to small rural communities in low income countries. VCS verified by far the largest quantity of offsets, capturing 82% of all forestry offset transactions in 2016. VCS has global reach and covers a variety of projects types, but the most common projects verified are Reducing Emissions from Deforestation and Forest Degradation (REDD), which are primarily located in low to middle-income countries where the majority of deforestation is taking place. The American Carbon Registry made up the second largest share of the market at 5%. Although small compared to VCS, ACR is focused on improved forest management which is more common in developed countries and is the type offset project that this report is recommending for Michigan. Additionally, ACR offsets are primarily located in the United States and cater to the U.S. market.[28] For these reasons, as well as its endorsement by multiple of interviewees, we recommend that the state of Michigan pursue using the ACR registry to verify offsets.

27 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

28 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

Business Model and Sales Strategy

THE VALUE CHAIN[29]

In voluntary markets, there are many entities that make up the value chain. These entities are briefly defined below.

Offset generator/project developer: The organization that generates offsets through improved forest management, or other means, and receives monetary compensation for these offsets. In this report, the Michigan State Forest System is the assumed generator.

Aggregator (optional): A seller of carbon offsets can work with an aggregator to bundle supply and demand of carbon offsets across multiple projects to streamline the project development and sales process. Among other things, an aggregator can support landowners in the development of a carbon offset project, assist with inventory and growth modeling, monitor the project over its life cycle, prepare project documentation, and manage project financing and credit sales.

Broker (optional): An offset generator can work with a broker to find buyers for the sale; however the broker does not buy the offsets and the generator does not get paid until an end buyer purchases the offset.

Retailer (optional): An intermediary buyer who, from the point of view of the generator, acts as a final buyer. The retailer will re-sell the offsets either to another retailer or to the end user who will retire the offsets.

End Buyer: The end buyer will purchase offsets with the intention of retiring them, essentially "using up" their carbon credit. The end buyer is where the offset ends its journey.

Figure 1 shows the relationship among these entities:

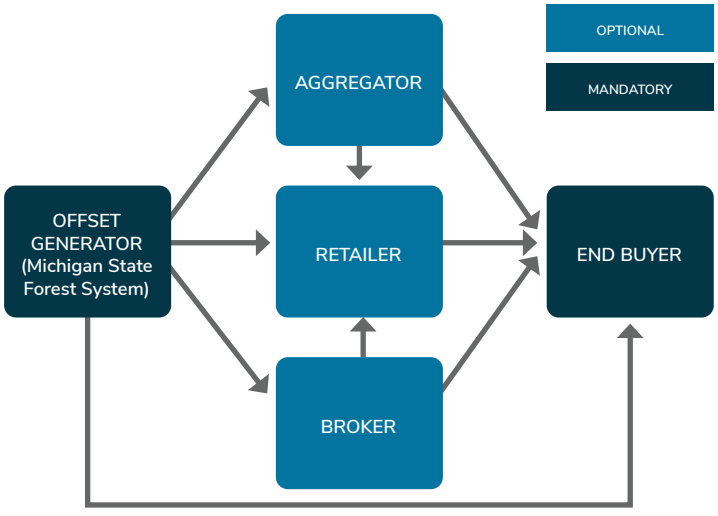


Figure 1

29 #

In addition to the direct value chain entities, third party verifiers are often a mandatory participant when selling to voluntary markets. Many registries' standards, including ACR's, require third-party verification, both at the implementation of the project and at certain time intervals during the life of the project.[30] Therefore once the standard is chosen, these are often non-negotiable costs built into the project.

BUSINESS MODEL RECOMMENDATIONS

We recommend that the state of Michigan bypass working with an aggregator, broker, or retailer strictly for the services previously described. An aggregator will not be needed because these services provide the most value for numerous small projects, which seems unlikely to be needed should the state forest system manage and sell their own carbon offsets, assuming the forest system sells improved forest management offsets for a large swath of land. A broker may be useful in helping identify buyers, however with the reputation and name of the Michigan State Forest System, and relationships that the state government has with industry in Michigan and the Midwest, a broker is unlikely to add much value. Further details on sales strategy are discussed later in this report. A retailer will dramatically reduce the price that Michigan receives for carbon offsets. In 2016, the average price of carbon offsets from improved forest management sold at $6 per ton CO2 equivalent (MTCO2e). When selling directly to the end user, the project developer receives this entire dollar amount. However, when offsets were sold to a retailer, the project developer only received an average of $3.9 per MTCO2e. Both brokers and retailers help find an end user, but at a steep cost.[31]

Our first recommendation is that the MDNR contract with a reputable consulting service in the field. Consulting services were mentioned in interviews with two publicly set up voluntary offset projects in Astoria, Oregon and Hawaii. The managers of these projects hired consultants to help them navigate the complexities of choosing appropriate registries, and more importantly, to help them through the registries in-depth requirements. While this report lays out the foundation of voluntary carbon offset markets and provides recommendations, detailed implementation steps and processes are out of scope of this project. Also, throughout the course of this research, it has become clear that there is still much uncertainty and ambiguity around carbon offset markets. Firms that have experience in helping large organizations establish offset projects will be very valuable in this same capacity for the Michigan State Forest System. BlueSource is one such consulting firm that was interviewed for this research. They not only help their clients navigate the verification and standards process, but also help the clients find buyers. Though all of their offered services may not be necessary, we recommend, at a minimum, a conversation with various offset consulting agencies to better understand what value they provide when looking to enter the carbon offset market.

FINANCIAL CONSIDERATIONS

Though discussed in other areas of this paper, this section serves to summarize the financial considerations of initiating a carbon offset project. Costs are numerous and unable to be fully captured at this early stage of analysis. First, there are startup costs associated with research and conversations, both internally and externally, to better understand carbon offsets and project implementation. We aim for this report to provide some of this, however there will still be labor (writing legislation, working with governing bodies and other human capital-intensive planning and implementation) and potentially travel costs associated with this work. Moving past the soft costs of labor are more concrete costs. Costs associated with a registry may include accreditation fees and costs for third party verification. Choosing to hire a consulting service to aid in this process would be an additional cost,

30 #

31 #

The expected revenue from carbon offsets is simply the revenue generated by offset sales. This is less complex than costs; however, revenue from voluntary markets is unpredictable due to the lack of governance supporting the market.

although BlueSource (and likely other firms) receive payment only from offset revenue rather than charging an up-front fee.[32] Another significant cost is the avoided revenue of improved forest management practices. Improved forest management as the source of carbon offsets is dominant in developed countries such as the United States.[33] One common method of implementing this is through extending the harvest rotation longer than typical, thereby creating additional carbon stock. Astoria, Oregon is using this offset generating mechanism.[34] Other costs include that of customer acquisition and any fees associated with the transfer of credits to customers. As with any complex program, there are likely many more costs that aren't captured here, however these listed provide a baseline consideration set.

The expected revenue from carbon offsets is simply the revenue generated by offset sales. This is less complex than costs; however, revenue from voluntary markets is unpredictable due to the lack of governance supporting the market. For example, we learned through interviews that voluntary markets tend to shrink locally as more compliance markets come online and pay a higher price for offsets for those project developers that are eligible to participate in the compliance market. Compliance markets generally pay higher prices for offsets than voluntary markets.[35] The average paid price for voluntary offsets generated from improved forest management in 2016 was $6 per ton CO2 equivalent (tCO2e). However, when considering only the offsets registered with ACR, the price rises to $8.9 per tCO2. Even more specifically, improved forest management offset prices averaged $9.5 per tCO2. Given that ACR's offsets are primarily in the United States where the costs of improving forest management are higher than the costs of generating other types of offsets elsewhere, this indicates that prices are reflective of costs.[36]

These macro-scale trends regarding costs and revenue are helpful to frame the conversation and understand what questions to ask, but ultimately much more detailed and specific analysis of the Michigan State Forest System's offset project must be done to determine the profitability of the project. Additionally, one should take away from this section that voluntary offsets are not guaranteed to sell, and difficult to predict the price of, making a marketing and sales strategy a large component of what drives revenue and profit.

MARKETING AND SALES

Marketing and sales strategies are important aspects of the overall business model when selling carbon offsets to the voluntary market. Unlike a compliance market, there is no guaranteed buyer, so sellers must differentiate themselves on marketing strategy. Significant thought and effort should be put into the marketing strategy of Michigan State Forest Offsets through branding, customer targeting, and co-benefits.

Branding is essential to capture buyers in a voluntary market. Customers looking to buy offsets in a voluntary market are free to purchase offsets from any generating project anywhere in the world. The Michigan State Forest Carbon Offsets therefore must find a way to brand their offsets to capture buyers. One potential idea is to consider using the already established and well known "Pure Michigan" brand. This helps consumers visualize what these offsets help support and which communities are benefitting.

32 (2019, July 16). Vice President, Bluesource. (K. Swaroop, Interviewer)

33 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

34 L&C Carbon LLC. (n.d.). Bear Creek Watershed Forest Carbon Project. Bear Creek Watershed Forest Carbon Project. Astoria, OR: City of Astoria.

35 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

36 #

Customer targeting is the second prong of the marketing strategy. Continuing with the example of the "Pure Michigan" brand, the Michigan State Forest system may find that its target customers are those within the Midwest who value a "local" emphasis on the ecological services that they are supporting. Additionally, offset sales can choose to focus on either lower volume, higher price customers, or higher volume, lower price customers. In 2016, prices of voluntary forest carbon offsets displayed clusters around both low and high prices (approx. $1-2 vs. $9 per tCO2), indicating that the buyers are split between low and high volume. This data however does not capture disaggregation by country or other factors, so one should not take away that Michigan can only sell in small quantities to obtain high prices. As discussed earlier, there is nuance by geography and offset type.[37] Given the quantity of expected, these include offsets generated, high volume customers may make sense as primary customers. Specifically, Michigan corporations with Michigan or Midwest ties, and with incentive to purchase offsets, such as DTE.

Co-benefits is the third identified highly important factor when considering sales strategy. Of buyers surveyed in 2016, 46% purchased voluntary forest carbon offsets to meet GHG targets, however co-benefits influenced 92% of buyers when deciding which offsets to purchase. Co-benefits are the secondary, non-carbon related benefits that stem from the offset project. Community benefits most commonly motivated buyers, followed by biodiversity, then adaptation.[38] In developing the carbon offset plan, it's important to keep co-benefits in mind and analyze how potential buyers may prioritize some co-benefits over others. Though some co-benefits will be tied in with the forest management and difficult to change, revenue allocation is an area where the project developer has complete control over co-benefits. Careful consideration and intentional decisions about how the offset revenue is spent could create additional co-benefits and serve to increase the sales of the offsets through marketing that appeals to buyers' values.

37 Hamrick, K., & Gallant, M. (2017). Fertile Ground: State of Forest Carbon Finance 2017. Fertile Ground: State of Forest Carbon Finance 2017. Washington, D.C.: Ecosystem Marketplace.

38 #

Policy Challenges and Recommendations

INTRODUCTION

During our research we discovered two government entities that had developed carbon projects on public land and were able to interview employees familiar with each project. One project is located in Hawaii and is managed by the state Department of Land and Natural Resources.[39]

The second project is managed by the City of Astoria, Oregon and is a small forest management project that is presently operational.[40] We also found that Michigan's Department of Natural Resources is similarly exploring the potential of carbon offset projects.[41]

Hawaii's Department of Land and Natural Resources is currently developing a carbon offset program based on reforestation of grasslands. The program is working with the voluntary market Verra Carbon and is contracting for assistance navigating the verification process.[42] Presently, no work has been done with an aggregator. This carbon project provides some insight into policy problems that Michigan could experience. Hawaii's carbon offset program is operated by the Department of Land and Natural Resources and their oversight council is responsible for entering into the agreement with Verra Carbon.[43] However, the legality of the council's ability to enter into this agreement may be challenged in the future.[44] As Michigan explores a carbon project, a similar challenge will be determining the proper authority to create a carbon project that survives the policy life-cycle.

In Michigan, one option for achieving additionality is to extend the length of the harvest cycles so the forest can sequester more carbon than it presently does.[45] For example, a section of forest would be harvested every 30 years, instead of 25, giving trees 5 more years to absorb carbon. This is challenging for Michigan because of the pre-existing agreements with logging companies and the need for lumber.[46] Additionally, shorter rotations provide habitat for endangered species that prefer younger trees.[47]

39 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
40 (2019, July 22). Springboard Forestry LLC. (M. Jaruzel, Interviewer)
41 (2019, July 19). Michigan Department of Natural Resources. (M. Jaruzel, Interviewer)
42 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
43 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
44 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
45 (2019, April 18). Compass Land Consultants LLC. (K. Swaroop, Interviewer)
46 (2019, July 1). Michigan Department of Natural Resources. (M. Jaruzel, Interviewer)
47 (2019, July 1). Michigan Department of Natural Resources. (M. Jaruzel, Interviewer)

THE POLICY LIFE-CYCLE

The policy life-cycle is a series of hurdles that a program must survive in order to endure long term. The first hurdle is the formation and adoption of a policy. Lasting policies must be thoroughly researched and developed but must also have political support to be adopted. "Compelling policy ideas do not automatically or necessarily translate into politically feasible or sustainable policies."[48] The second challenge for a policy is a successful launch and implementation. A policy that is adopted may fail due to poor implementation methods.[49] Additionally, when the reality of the policy becomes clear, opposition may form against the policy. These first years after launch are when the policy may be quickly reversed.[50]

The third challenge is surviving the first change of leadership to another political party. "Elections can often become a referendum on a policy adopted during an incumbent's term in office."[51] Dissatisfaction with a leader who championed the policy or resistance from industry and bureaucracy can undo a policy during the election cycle. One study found that 42% of policies were "fully or partially overturned or modified subsequently,"[52] the majority of which began within one election cycle of adoption.[53] Lastly, a policy must have successful management that is capable of adjusting to challenges and road bumps 10 to 15 years down the road.[54] If a policy does not have the capacity to adjust to challenges, then it may be overturned or functionally dead.

POLICY CHALLENGES

Operating a carbon offset project on public lands can be a straightforward endeavor, however there will still be challenges that must be overcome in order for a carbon project to be successful. The project will need to gather political support, account for stakeholder interests, create a strong agreement using the proper authority, determine the use of revenue, and survive the policy life-cycle.

The primary policy challenge for a carbon project is gathering the political will to take on the project and commit to the project's timeline. Because contractors are equipped to manage the carbon project, if utilized, there is little work for the state to do other than authorize the carbon project and check in periodically.[55] This of course requires political leaders to support the project. Although revenue is being generated, a carbon project does commit a parcel of state forest land to a management plan for a period of time. Sometimes this may be challenging for leaders to agree on, however, the opportunity to generate revenue from forest land is an influential factor.

Stakeholders are the next potential challenge that must be considered. Identifying how the forest is being used presently, and who has a vested interest can highlight potential opposition to the carbon project. In Michigan, harvest rotations would likely need to be extended in order to achieve additionality.[56] Because harvesting is a revenue generator for the State, a carbon project would have to bring in more revenue than what is lost by extending the harvest rotation. However, simply using a different method of additionality could then impact a different stakeholder group in other ways.

48 Rabe, B. (2018). Can We Price Carbon?
49 Rabe, B. (2018). Can We Price Carbon?
50 Rabe, B. (2018). Can We Price Carbon?
51 Rabe, B. (2018). Can We Price Carbon?
52 Beam, D., Posner, P., & Conlan, T. (2017). Pathways of Power.
53 Rabe, B. (2018). Can We Price Carbon?
54 Rabe, B. (2018). Can We Price Carbon?
55 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)
56 (2019, April 18). Compass Land Consultants LLC. (K. Swaroop, Interviewer)

> To ensure the success of a carbon project in Michigan, it is important to ensure proper authority and take into consideration the impacts of the project on stakeholders.

Government entities have not attempted a large carbon project on public land.[57] Because carbon offsets from public lands are a new endeavor there is confusion on who can authorize the project. In Astoria, Oregon, the city council voted to allow the mayor to enter into an agreement for a carbon project.[58] But in Hawaii, the oversight council for the Department of Land and Natural Resources were the entity who entered into their agreement. However, it is unclear whether that will be challenged down the road.[59] Failing to create a properly authorized carbon project could lead to a reversal in the second or third challenge of the policy life-cycle.

The revenue generated by a carbon project may create a strong argument to undertake the project. But it could also create a roadblock for the project. Governments always need more revenue to fund their projects and Michigan is no different. If a significant division exists over how to spend the offset revenue, then the project may end up being blocked politically. Currently, Michigan is going through a budgetary battle over funding for infrastructure and education. A project generating revenue could easily be swept up into the controversy.

It is possible that in the future an entirely new group of leaders could come into State government and want to withdraw from the carbon project. The state of Michigan would still have to provide the carbon offsets that it had already sold.[60] This would have to be done by purchasing other offsets on the market to fulfill the commitment.[61] The cost of this would be significant, but if the land was needed immediately for a project that would generate significant revenue, it could happen.

RECOMMENDATIONS

To ensure the success of a carbon project in Michigan, it is important to ensure proper authority and take into consideration the impacts of the project on stakeholders. These steps will pay off later as the program faces each challenge of the policy life-cycle.

A project can require minimal management by the state if contractors are utilized, which will be further discussed in the next section. The real question in Michigan is whether there is political support for a carbon offset project, which is the first hurdle in the policy life-cycle. Regardless of the method of additionality, if a stakeholder is expected to be impacted by a change to the state forest management, then that stakeholder will likely oppose the carbon project. If this opposition is substantial, then the carbon project may never gain political support. However, if opposition remains minimal and the carbon project shows positive revenue even with a change in forest management, then a strong argument exists for adoption of the project. For these reasons, it is important to engage with stakeholders and minimize the impact a carbon project will have on their interests.

Apart from political will, the other challenge is ensuring the carbon project is created with authorization from the proper authority. In Hawaii, the oversight council entered into an agreement that may be challenged in court later.[62] A stronger method would be to follow the example of Astoria, Oregon. In Astoria the legislature voted to give the executive the authority to enter into an agreement.[63] This broad support is also important politically later to ensure the carbon project survives the third policy life-cycle challenge. Unilateral actions by the executive can be viewed as heavy handed and targeted for reversal after leadership changes.[64]

57 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)
58 (2019, July 22). Springboard Forestry LLC. (M. Jaruzel, Interviewer)
59 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
60 (2019, July 22). Springboard Forestry LLC. (M. Jaruzel, Interviewer)
61 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)
62 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
63 (2019, July 22). Springboard Forestry LLC. (M. Jaruzel, Interviewer)
64 Surowiecki, J. (2016). The Perils of Executive Action. The New Yorker.

In addition to carbon offset projects, cap and trade programs also provide agreement examples. The California Air Resources Board (CARB), took on the role of regulating carbon through Assembly Bill 32, the Global Warming Solutions Act of 2006.[65] Alternatively, the Regional Greenhouse Gas Initiative (RGGI) was created using a Memorandum of Understanding (MOU) signed by the governor of each state.[66] A bill passed through the Michigan Legislature would be the strongest method of authorizing a carbon offset project. However, as RGGI has demonstrated, executive action by the Governor may survive the policy life-cycle as well.

Deadlock over how to utilize revenue from the carbon project could also prevent the adoption of the project. As this paper will outline, it is our recommendation that Michigan use the offset revenue to fund sustainability projects. In this way, rather than simply offsetting pollution, the carbon project will work to reduce or eliminate an emission source permanently. Unless this objective is articulated from the beginning, the political process may quickly use this offset revenue to plug other holes in the state budget.

The second hurdle in the policy life-cycle is implementation and a successful launch. The challenges that a carbon project may initially face after the program launch are creating additionality and generating revenue on a carbon market without a significant impact on stakeholders, as well as unforeseen circumstances such as wildfires.[67] If the project is able to generate revenue without seriously disrupting stakeholders in the state forest lands, then the project may not be immediately reversed.

Similar to gaining political support for adoption, a carbon project can survive a change of political leadership if it is shown to generate revenue. Surviving a change of leadership, especially from different political parties, is the next challenge in the policy life-cycle. Again, it is important that project opposition is kept minimal by managing the impact that creating additionality has on stakeholders. For example, extending the harvest rotations by 5 years creates additionality but is less impactful on the lumber industry than extending the rotations by 20 years. Managing this impact and opposition will help the carbon project survive the third hurdle in the policy life-cycle.

Finally, the carbon project will need to have the capacity to adjust to changes 10 to 15 or more years into operation. A wildfire or a change in the price of carbon offsets may require the project to significantly adjust in order to remain revenue positive. Year to year management changes should be easily made by the contractor or department managing the project. However, a significant change to the project, such as incorporating more forest land to maintain profitability, may require additional political support from the Governor and the Michigan Legislature.[68]

65 History. (2019, October). Retrieved from California Air Resources Board: https://ww2.arb.ca.gov/about/history

66 Bifera, L. (2019, October). RGGI Brief. Retrieved from Center for Climate and Energy Solutions: https://www.c2es.org/site/assets/uploads/2013/12/rggi-brief.pdf

67 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)

68 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)

> It is our recommendation that Michigan use the offset revenue to fund sustainability projects. In this way, rather than simply offsetting pollution, the carbon project will work to reduce or eliminate an emission source permanently.

POLICY LIFE-CYCLE CHALLENGE Figure 2

	DESCRIPTION	PRIMARY CHALLENGE	RECOMMENDATION
1	**FORMATION & ADOPTION**	Political Will	Engage with Stakeholders
2	**LAUNCH & IMPLEMENTATION**	Good Management	Utilize Contractor or DNR Staff
3	**CHANGE OF LEADERSHIP**	Authority & Good Management	Authorize Project Through Michigan Legislature & Engage with Stakeholders
4	**SUCCESSFUL MANAGEMENT**	Authority & Good Management	Authorize Project through Michigan Legislature

Governance Structure

In addition to accessing feasibility and creating models of a potential carbon offset program, it is also important to outline how the program will fit into the overall governmental structure of Michigan. This section will explore which department should manage the carbon program and describe what the staff requirements may be.

Third party companies handle the majority of the workload associated with a carbon project.[69] They model the forest as well as collect data from inventory plots. Additionally, the third parties navigate the verification process and promote the sale of credits.[70] Depending on the company, it is possible for the state to step in at various points in the process and take over management. One consultant, BlueSource, will manage a project for 10 years and then prepare staff of the state to take over.[71]

The resources required for improved forest management depends on the type of additionality that is best for Michigan. If the project is based on extending the harvest rotations, then there is little that needs to be done besides delaying harvesting. However, if methods such as thinning trees or replanting deforested areas, staff and equipment or contractors are needed to carry out these activities. The number of staff will depend on the size of Michigan's carbon project.

Staff will also need to oversee the carbon program. A small pilot project that relies on an aggregator may have one or two staff members who manage the project part time.[72] A large project may require more, particularly if inventory data collection is required. In Hawaii, staff members assigned to oversee the carbon project spend about 15% of their time managing the present project.[73] The task of management requires monitoring the status and progress of the carbon project as well as checking in with the contractors.

In Michigan, the logical home within Michigan's government is the Department of Natural Resources. The Forest Resources Division presently manages the harvest of timber on State forest land.[74] Considering that additionality will likely be based on extending the harvest rotation, a carbon offset program fits easily within this division. Housing this carbon offset program within the DNR's Forest Resources Division would capitalize on the efficiencies of staff working within the same office as their counterparts. Additionally, the program staff would have access to the knowledge base and data this division has developed on Michigan's forests. If the state of Michigan decided that it wanted to manage the data collection from inventory plots, the DNR is presently collecting similar data. The only requirement would be hiring additional staff to manage the increased workload.

The state of Michigan recently restructured its Department of Environmental Quality into the Department of Environment, Great Lakes, and Energy (EGLE). Considering the nature of a carbon program, EGLE could take a management position for this project. Carbon sequestration is important because of the problems with emissions and climate change. EGLE has an Office of Climate and Energy and an Office of Environmental Justice Advocate, which fits with the climate change mitigation aspect of carbon offsets. However, because true management of a carbon program requires forest data collection and forest management, a carbon program fits in better with the responsibilities that the DNR already has.[75]

69 (2019, April 18). Compass Land Consultants LLC. (K. Swaroop, Interviewer)
70 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)
71 (2019, July 16). Bluesource. (K. Swaroop, Interviewer)
72 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
73 (2019, July 9). Hawaii Department of Land and Natural Resources. (M. Jaruzel, Interviewer)
74 (2019, July 1). Michigan Department of Natural Resources. (M. Jaruzel, Interviewer)
75 (2019, July 1). Michigan Department of Natural Resources. (M. Jaruzel, Interviewer)

Potential Strategies for Revenue Expenditure

Selling sequestered carbon from Michigan forests can help Michigan meet its environmental goals. The revenues from this carbon sequestration program could be re-invested to lower Michigan's dependence on fossil fuels across the board. It could even be put towards projects which are already in motion.

For instance, RGGI invests their profits in programs such as energy efficiency, clean and renewable energy, greenhouse gas abatement and direct bill assistance.[76]

According to a report released in October, 2019, the lifetime benefits of RGGI investments from 2017 include:

$1.4 billion
in lifetime energy bill savings

13.9 million MWh
of electricity use avoided

22.6 million MMBtu
of fossil fuel use avoided

8.3 million short tons
of CO2 emissions avoided

Another option is for Michigan to use the revenue to weatherize its housing stock in an effort to reduce energy demands. According to the Department of Energy, with improvements and upgrades like those undertaken in their weatherization program, households save on average $283 or more every year.[77] A program like this in Michigan could especially help low income communities who may not otherwise be able to afford weatherization and for whom energy bills take up a larger percentage of their income.

Other ideas include subsidizing more public and mass transit to lower emissions from travel. Michigan has created a plan for 2020 that calls for an expansion of express service along the main travel corridors from Detroit. They have also proposed a commuter service that would be used during rush hour along 13 regional routes. Finally, there is a commuter rail service proposed between Ann Arbor and Detroit, an airport express line and bus rapid transit along Woodward Avenue.[78] These enhancements and additions to mass transit could reduce on single occupancy vehicles commuting throughout Michigan. This would lower the number of vehicle miles traveled which in turn reduces the amount of gasoline and resulting air pollution from commuter travel. The project revenue could be re-invested into this transportation plan and in turn help the environment.

> The investment of these profits has the power to propel Michigan towards its goal of becoming more environmentally sustainable while sequestering the carbon that has already been emitted.

76 Investments of Proceeds. (n.d.). Retrieved from https://www.rggi.org/investments/proceeds-investments.

77 Weatherization Assistance Program. (n.d.). Retrieved from https://www.energy.gov/eere/wipo/weatherization-assistance-program.

78 Mondry, A. (2019, July 15). RTA updates its transit plan for Southeast Michigan. Retrieved from https://detroit.curbed.com/2019/7/15/20694714/rta-regional-transit-plan-southeast-michigan-detroit.

Summary and Next Steps

The Dow Fellowship team conducted a thorough literature review and various interviews with experts and stakeholders in order to develop strategic recommendations for the state of Michigan, concerning a carbon offset project on Michigan State Forest lands. Our research showed a clear potential for economic and social benefits for Michigan, and we recommend further exploration of the carbon offset program potential for the state forest system. Guidance on different facets of the project scope are outlined in the following table.

ISSUE	RECOMMENDATION
MARKET TYPE	Voluntary
REGISTRY	American Carbon Registry
INTERMEDIARY	Consultant
MARKETING AND SALES	Work with "Pure Michigan" campaign branding and consider co-benefits
POLICY	Engage stakeholders early
GOVERNANCE STRUCTURE	House program within Michigan DNR Forest Resources Division
REVENUE EXPENDITURE	Invest in energy efficiency and public transit

Future Dow Fellows could partner with the DNR to further develop a carbon project in the Michigan State Forest System. We found that data to model carbon sequestration is difficult to obtain without hiring a contractor. The DNR could create this connection with a contractor while Dow Fellows further develop the business plan and political assessment of Michigan cementing the carbon project with a statute from the legislature.

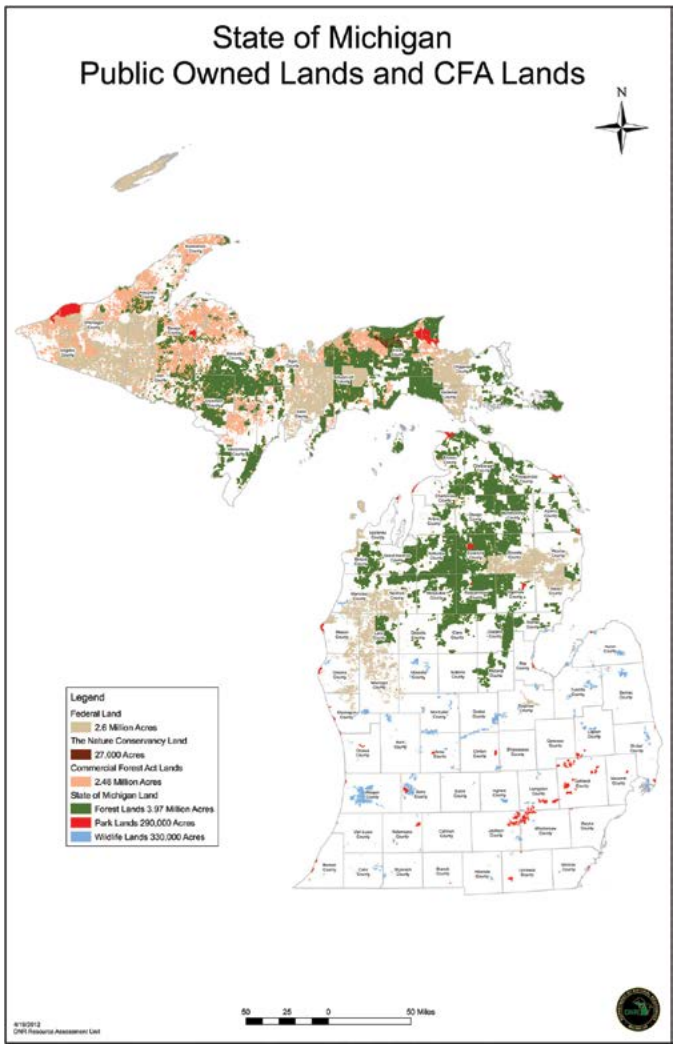
The most important area for further exploration by future Dow Fellows is sustainability-oriented use of the revenue.

Working with Michigan's Office of Climate and Energy, the fellows could identify the optimal projects through cost-effectiveness analysis of the most greenhouse gas reductions per dollar. Environmental justice aspects of the investments should be considered as well. This work will significantly benefit from the modeling results that can be provided by third-party contractors. Once revenue is estimated, it will be easier to identify which sustainability projects are within the scale of the revenue generated.

APPENDIX

Appendix A

FIGURE A1. STATE OF MICHIGAN PUBLIC OWNED LANDS[79]



79 Alexander, J. (2012, August 23). Interview with Senator Casperson: 'A primary objective should be to return land to private ownership'. Retrieved from MLive: https://www.mlive.com/politics/2012/08/interview_with_senator_caspers.html

Appendix B

TABLE B1. A SUMMARY OF INTERVIEWS

DATE OF INTERVIEW	ORGANIZATION	SUMMARY
4/3/19	**Delta Institute**	Overview of potential carbon registries and avenues for state market entry.
4/18/19	**Compass Land Consultants**	Potential carbon registries, aggregators, and baseline calculations.
6/27/19	**Michigan DNR**	Current work being done by DNR in carbon markets area.
7/1/19	**Michigan DNR**	Broad view of DNR management, potential policy issues, and processes.
7/9/19	**Hawaii Division of Forest and Wildlife**	Details about Hawaii's carbon offset program and challenges in process.
7/12/19	**Emergi**	Conversation on Emergi which helps offset carbon footprints and conversions to renewable energy.
7/16/19	**Blue Source**	Overview of aggregator role and how it would assist Michigan DNR.
7/19/19	**Michigan DNR**	Origin of carbon market work by Michigan DNR and future plans for proceeding.
7/22/19	**Springboard Forestry LLC**	Astoria, Oregon's entrance into voluntary carbon market.
7/25/19	**Michigan DNR**	Michigan DNR forest inventory practices.

Appendix C

TABLE C1. KEY STAKEHOLDERS

Richard Bowman	Client	The Nature Conservancy
Mike Kay	Consultant	Dow
Michael Moore	Faculty Advisor	University of Michigan

DOW SUSTAINABILITY FELLOWS
UNIVERSITY OF MICHIGAN

The Nature Conservancy