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Virginia Landowner's Guide to the Carbon Market

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Over the years, scientists have concluded that our planet's atmosphere has become increasingly concentrated in greenhouse gases (GHGs). These gases help to regulate earth's temperatures and make it possible for us to live. Without GHGs, the earth's temperature would be about 60º F cooler than it is now (U.S. Environmental Protection Agency). However, too much of a good thing can become a problem. In fact, scientists have found that the concentration of these gases is higher than has ever been recorded, and many are concerned that this increase has begun to adversely affect our climate.

Why are Greenhouse Gases an Issue?

The four primary GHGs in our atmosphere are carbon dioxide, methane, nitrous oxide, and several fluorinated compounds. These gases come from both natural and human-influenced processes. The Global Warming Potential (GWP) measures the relative ability of a GHG to trap the sun's energy and warm our atmosphere. Carbon dioxide is used as a reference point to compare the GWP of different gases. Some of these gases are present in very high concentrations but have relatively low GWPs, while others are present in low concentrations but have much higher GWPs. Table 1 describes the historic concentrations and GWP for these gases in more detail.

Strategies to Deal with Climate Change: Adaptation and Mitigation

What can we do about it? Scientists, policy makers, entrepreneurs, citizen groups, and many others have tried to develop strategies to reduce the rate of climate change and lessen its effects. These strategies fall into two categories: adaptation and mitigation. Adaptation strategies consist of redesigning and restructuring locations particularly threatened by the effects of climate change. For instance, coastal communities may require new infrastructure for protection from rising seas (e.g. sea walls, etc.).

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Table 1. Main greenhouse gases: Their source, concentration, and potency

Greenhouse gas	Emission sources	Concentration in atmosphere by year[1] 1750	Concentration in atmosphere by year[1] 2006	Global Warming Potential[2]
Carbon dioxide	Burning of fossil fuels and wood	280 ppm	377 ppm	1
Methane	Coal mining, decaying organic material	730 ppb	1,847 ppb	23
Nitrous oxide	Agricultural soils and manure handling	270 ppb	319 ppb	296
Fluorinated compounds	Industrial processes	0 ppt	Varies by type 6–538 ppt	Varies widely 12–22,200

[1]Carbon dioxide concentrations are recorded in parts per million (ppm); methane and nitrous oxide concentrations are recorded in parts per billion (ppb); fluorinated compounds are recorded in parts per trillion (ppt). Year 1750 data was calculated using samples from tiny air bubbles of ancient air from ice cores. Source: Carbon Dioxide Information Analysis Center (CDIAC), 2008.
[2]Source: Intergovernmental Panel on Climate Change (IPCC), 2001.

Mitigation strategies seek to reduce the concentrations of GHGs in the atmosphere. This is done by reducing the emission of these gases in the first place or by reducing GHGs already in the atmosphere. For example, green plants store carbon as they grow, and they can reduce the concentration of atmospheric carbon dioxide through the process of photosynthesis. A variety of mitigation strategies has been proposed worldwide. Next we will take a look at a voluntary market-based mitigation strategy that is receiving considerable attention.

Greenhouse Gas Policy

While federal legislation governing GHG emissions is being debated, many states are now developing programs that would require specific industries, such as electric utilities, to "cap" or limit their GHG emissions. Beyond these binding requirements, many municipalities, companies, and even individuals are voluntarily agreeing to limit their GHG emissions. For example, in the 2007 Virginia Energy Plan the commonwealth recently announced a nonbinding goal of reducing statewide carbon dioxide emissions 30 percent by 2025.

These efforts create a demand for GHG reductions. New carbon offset marketing opportunities are emerging as people develop projects to supply the growing demand for GHG reductions. The Chicago Climate Exchange (CCX) is a private market launched in 2003. This exchange represents North America's only voluntary, but legally binding, GHG trading market where reductions are bought and sold in a manner similar to a conventional stock exchange. The CCX began as a four-year pilot program but has since been extended through 2010. Table 2 defines many of the terms used in the carbon market.

Table 2. Terms often used in the carbon market

Aggregator	Organization or company that combines carbon offsets from different landowners and trades these offsets in the carbon market.
Carbon credit	Quantitative measurement of a carbon offset expressed in metric tons of carbon dioxide equivalent.
Carbon offset	A verified project that removes carbon dioxide from the atmosphere or prevents the emission of greenhouse gases.
Carbon reserve pool	Twenty percent of the carbon offset is withheld during the life of the contract and is used to cover any catastrophic losses due to fire, wind, or disease; otherwise, the amount is refunded to the landowner at the end of the contract period.
Carbon sink	Short- or long-term storage of carbon in trees, soil, oceans, and other reservoirs.
Chicago Climate Exchange (CCX)	Voluntary market that began in 2003 to facilitate greenhouse gas emission allowance trading.
Greenhouse gases (GHGs)	Gases that regulate earth's atmosphere by trapping the sun's energy.
Global Warming Potential (GWP)	Potential of a gas to trap the sun's energy relative to carbon dioxide, with higher numbers indicating a greater heat-trapping potential.
Sequestration	Process that removes carbon dioxide gas from the atmosphere to a storable form.

What is a Carbon Offset?

A carbon offset is created by removing carbon dioxide from the atmosphere or by preventing the emission of a GHG. A carbon offset must be quantified and verified by methods approved by the CCX. Once created, the carbon offset can then be purchased by a buyer in the carbon market. The CCX quotes market prices on a dollar per metric ton of carbon dioxide equivalent.

Types of Carbon Offsets

There are a variety of ways to create a carbon offset. Basically, a carbon offset must either reduce the emission of a GHG or directly increase the amount of carbon stored through a variety of carbon sinks, such as trees and soil.

There are many ways to achieve either of these two goals, however not all methods are eligible for tradable offsets. The carbon offsets listed below are permitted by the CCX because they can be more accurately measured and verified. Table 3 lists several of the established carbon sequestration rates for projects in our region. Carbon offset projects should be performed in agreement with your forest or farm-management plan. Please contact your local Extension agent or the Virginia Department of Forestry for more information.

Forestry

As forests grow, they store carbon through the process of photosynthesis. Different forest management activities can enhance the rate at which a forest will trap—or sequester—carbon. This makes sense if we remember that carbon sequestration is directly related to tree growth. Therefore, the rate of carbon sequestration will vary from one region to another, between different tree species, and even over the life of a forest. Forestry offset projects may include establishing trees on barren land (afforestation) or a variety of sustainable forest management activities.

Soil

Agronomists estimate that about two trillion metric tons of carbon are stored in the earth's soil. This is about three times the amount currently in our atmosphere. Agricultural soils can be managed to increase their carbon content by converting from conventional tillage to conservation or no-till practices, or by converting to perennial grasses. In Virginia, the CCX has established a carbon sequestration rate of 0.6 metric tons per acre annually for conservation tillage, and a rate of 1.0 metric tons per acre for permanent grass stands.

Methane Capture and Conversion

When organic material decomposes, it has the potential to generate methane. A ton of methane has 23 times the heat-trapping potential of a ton of carbon dioxide, but there are methods to prevent methane from entering our atmosphere.

One opportunity to reduce methane emissions is within a livestock operation's manure-management system. While a variety of manure-management options exist to reduce the formation and release of methane to the atmosphere, a common offset is anaerobic digestion. Anaerobic digestion can convert manure to biogas and an effluent that can be reused as a fertilizer. The biogas consists mainly of methane, which can be burned off at the site to significantly reduce the total amount of GHG being emitted.

Table 3. Carbon sequestration look-up table

Project type[1]	Offset practice	Annual carbon sequestration rate in Virginia (metric tons/acre/year)			
Soil	Conservation tillage	0.6			
	Grassland establishment	1.0			
		Years since planting			
Forestry	Stand type	1-5	6-10	11-15	16-20
	Loblolly and shortleaf pine	2.367	2.472	2.303	2.136
	Longleaf and slash pine	1.173	1.644	1.957	2.061

[1]For reference only, contact CCX or an aggregator to verify actual rates for your specific project. Look-up table data available for a variety of forest stand types; however, these values tend to be conservative, and many forestry projects will require a stand inventory. Source: CCX, 2008.

Renewable Energy

An emerging method of preventing the emission of GHG is through the generation of renewable energy. Instead of using anaerobic digestion to create an offset by collecting the methane-based biogas (above), the biogas could also be used as an energy source. Using the recovered biogas as an energy source to replace energy currently derived from fossil fuels could generate an additional offset. Generally, the same holds true for other renewable energy projects that will displace energy used from fossil fuels, including wind, solar, and hydropower.

Mechanics of the Carbon Offset Market

The CCX requires that offset projects involving less than 10,000 metric tons of carbon dioxide equivalent be registered and sold through an offset aggregator. Therefore, most offsets in Virginia will need to be registered through an aggregator. An aggregator is a company or organization that administers multiple offset projects among different offset project owners. By combining many smaller projects, these offset aggregators enable members of the CCX to more efficiently purchase large quantities of credits with low transaction costs. The CCX works with about 60 different offset aggregators (a complete list of aggregators is available at *www.chicagoclimatex.com* within their current membership list). Table 4 lists the aggregators that expressed an interest in working in Virginia in 2008 and the types of projects in which they specialize.

Owners of offset projects sign a contract directly with an aggregator, not the CCX. The details of each contract will vary depending on the specific type of offset project (i.e., forestry, methane capture). Typically, the contract is a few pages in length with project-specific information, clauses that define the roles of the parties entering the agreement, and details concerning noncompliance issues, penalties, and other factors. Offset aggregators often post sample contracts on their websites.

If you are considering an offset contract, be sure to review the contract very thoroughly. Contract duration varies by practice and typically ranges from five years to 15 years for soil and forestry offsets. Projects that have already been implemented may still be eligible. For example, forestry projects conducted since 1990 may qualify, as may soil and methane-related projects performed since 1999. Be sure to contact an aggregator for details regarding project eligibility.

Table 4. Offset aggregators

Company name	Offset type
AgraGate Climate Credits Corp. *www.agragate.com* (866) 633-6758	V
Delta Institute *www.delta-institute.org* (312) 554-0900	F
Environmental Credit www.envcc.com (800) 770-8039	M
FORECON Inc. *www.foreconinc.com* (716) 664-5602	F
MACED *www.maced.org* (859) 986-2373	F
Farmers Union Carbon Credits Program *www.carboncredit.ndfu.org* (800) 366-8331	V

V = variety of offset types, **F** = forestry, **M** = methane

Finally, it is important to understand that the CCX is still a pilot program. In 2006, the CCX program was extended; however, this extension expires in 2010. Therefore, offset contracts that extend beyond Dec. 31, 2010, are contingent on the extension and existence of the CCX and tradable offsets—in some form. The future of these tradable carbon offsets will likely be determined by GHG legislation considered at the federal level between now and 2010.

Third-party auditors certified by the CCX must inspect 10 percent of all offset contracts annually. This process seeks to verify that the projects are functioning as designed and serves to maintain market integrity. Of course, natural events can damage projects—sometimes compromising their ability to store carbon. For example, a forest fire would affect the net amount of carbon stored in a forestry offset project due to the loss of carbon dioxide emitted back to the atmosphere from the burning trees.

To hedge against natural catastrophic events, carbon offset contracts have a carbon reserve pool. Typically, the carbon reserve pool holds 20 percent of the carbon offset as a form of insurance during the life of the contract. Events such as forest fire, disease, and land management choices that reduce an offset project's ability

to store carbon will result in an equal reduction from the carbon reserve pool. Typically, a landowner is not held liable for any losses of carbon stores due to natural events above what is held in the carbon reserve pool. However, the landowner is contractually required to forfeit all offsets that are found to be noncompliant due to mismanagement (e.g. performed conventional tillage within a no-till parcel or performed unapproved thinning of a forest stand). If nothing compromises the quality of the offset project, the carbon reserve pool is credited to the project owner at the end of the contract period.

Aggregators make money by charging service, registration, and trading fees. Typically, these fees, along with any verification costs, are deducted from the account balance prior to issuance of payment. Before selecting an aggregator, be sure to do your homework, understand the fee and payment schedules, and always exercise due diligence before signing any contract.

Doing the Math

You now have a general idea about carbon offset projects—both their benefit to the environment and their potential for financial gain. But the end goal of creating, measuring, and verifying a carbon offset is to have a product to sell. So, what's a carbon credit worth? The price fluctuates daily because the carbon market is just that—a market. Prices in this market vary due to the forces of supply and demand and are affected by such factors as uncertainty and policy changes. Since the inception of the CCX in 2003, a carbon credit has ranged in value from $1 to more than $7. The market price changes daily, and the specific value will be determined when an offset aggregator sells its aggregated shares in the market.

But is a carbon offset project worth the hassle and cost? At current prices, landowners likely wouldn't choose to do a project solely for the revenue generated from carbon credits, but the sale of carbon credits may provide an additional financial incentive to complement a project. Tables 5 and 6 contain worksheets that may be helpful tools for giving you an idea of the revenue a carbon-offset project might generate. Of course, a complete analysis would need to incorporate all costs associated with the offset project. Please see your Virginia Cooperative Extension farm business management agent to determine possible net returns from offset projects on your land. Remember that the carbon market can be volatile, and past performance is no guarantee of future results.

Summary

Be sure to fully evaluate the costs associated with participating in the carbon market—both out-of-pocket expenses as well as opportunity costs. For example, forestry offsets often require that a forest inventory be performed at the landowner's expense. There may also be unanticipated opportunity costs associated with an offset project. Opportunity cost is essentially the value of what you could have done with your resources (money, land, time) if you did not pursue the offset project but instead pursued your next best alternative. For instance, after entering a legally binding contract with an aggregator, you have committed your carbon-offset project for the full duration of that contract. Therefore, even if a new and more lucrative opportunity emerges, you have already legally committed your offset project to the original aggregator and cannot market your carbon offset in another market.

Additionally, after entering a carbon offset contract, you have wedded yourself to that land management practice for the duration of the contract (often even longer in forestry projects).

For example, after signing a five-year offset contract to convert cropland to grassland in 2007, you wish to convert back to row crops in 2010 due to rising grain prices. If you were to convert back to row crops and violate the original terms of your contract, you could incur legally enforceable financial penalties. Each project's carbon reserve pool may be enough to cover the penalties and fees assessed due to noncompliance issues; however, if the reserve is insufficient, the landowner may be subject to out-of-pocket expenses to reimburse the aggregator for the value of the carbon offset originally promised, plus various transaction costs.

For the foreseeable future, the United States and other nations will continue to debate new policies on climate change. Currently, the CCX represents one opportunity for Virginians to enter the carbon market. Economics, new policies, and research will likely continue to evolve as the world seeks innovative, effective, and practical ways to better understand and manage climate change. Virginia landowners have an opportunity to receive payments for adopting practices that increase the carbon content of their soils and of their forests—all of which is good for business.

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Resources and Selected Material for Further Information

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Table 5. Carbon credit worksheet

Farmer B.C. Kwestin has 20 acres of low-yielding cropland that he is considering converting to grassland or loblolly pine. He's heard of carbon credits and is curious how much value a carbon offset may add to either option. To estimate what his carbon credits might return, he referenced data from the CCX and averaged the market price for carbon over the previous year at $3.67. Let's see what he came up with:

Total acreage	20	*Carbon reserve pool*	20%
Contract start	Jan. 1, 2008	*Aggregator fee*	10%
Contract end	2012 or 2022	*CCX fee per ton*	$0.20
Contract length	5 or 15 years	*Verification fee per ton*	$0.15 (estimate)

Future of CCX beyond 2010?

Example: Grassland establishment				Contract year		Example: Forest establishment			
Rate[1]	**Acres**	**Annual tonnage**	**Estimated annual value[2] ($)**			**Rate[1]**	**Acres**	**Annual tonnage**	**Estimated annual value[2] ($)**
1.00	20	20.00	73.40	**2008**	**1**	2.367	20	47.34	173.74
1.00	20	20.00	73.40	**2009**	**2**	2.367	20	47.34	173.74
→ 1.00	20	20.00	73.40	**2010**	**3**	2.367	20	47.34	173.74
1.00	20	20.00	73.40	**2011**	**4**	2.367	20	47.34	173.74
1.00	20	20.00	73.40	**2012**	**5**	2.367	20	47.34	173.74
				2013	**6**	2.472	20	49.44	181.44
				2014	**7**	2.472	20	49.44	181.44
				2015	**8**	2.472	20	49.44	181.44
				2016	**9**	2.472	20	49.44	181.44
Option to sign new five-year contracts in the future				**2017**	**10**	2.472	20	49.44	181.44
				2018	**11**	2.303	20	46.06	169.04
				2019	**12**	2.303	20	46.06	169.04
				2020	**13**	2.303	20	46.06	169.04
				2021	**14**	2.303	20	46.06	169.04
				2022	**15**	2.303	20	46.06	169.04
Subtotal		**100.00**	**$ 367.00**			**Subtotal**		**714.20**	**$ 2,621.11**
Fees and deductions						***Fees and Deductions***			
20% carbon reserve pool			**73.40**			20% carbon reserve pool			**524.22**
10% aggregator fee			**36.70**			10% aggregator fee			**262.11**
Verification fee ($0.15/ton) [3]			**15.00**			Verification fee ($0.15/ton) [3]			**107.13**
CCX exchange fee ($0.20/ton)			**20.00**			CCX exchange fee ($0.20/ton)			**142.84**
Payment at end of contract period (12/31/12) [4]			**221.90**			**Payment at end of contract period (12/31/22) [4]**			**1584.81**
20% reimbursement from carbon reserve (1/1/13)			**73.40**			**20% reimbursement from carbon reserve (1/1/23)**			**524.22**
TOTAL			**$ 295.30**			**TOTAL**			**$ 2,109.03**
NORMALIZED TOTAL[5] Three consecutive contracts			**$ 885.90**						

[1]Sequestration rates are determined by project type and region; the actual values are set by CCX or via direct field measurement.
[2]Estimated annual value will vary with fluctuating market prices over time; $3.67 rate used for comparison purposes only. Future revenues have not been discounted to reflect the time value of money. Contact your farm business agent for more information
[3]Project verification cost varies among different aggregators, as does the timing and form in which these fees are assessed.
[4]Payment schedule varies among aggregators and projects; some companies pay semiannually while others pay annually.
[5]For comparison, this value assumes three consecutive five-year contracts to equal the duration of the 15-year forestry contract.

Table 6. Estimate the gross value of your carbon offset

Year	Rate[1]	Acres	Annual tonnage	Estimated annual value[2] ($)
		Subtotal		
			Fees and deductions	
			20% carbon reserve pool	
			10% aggregator fee	
			Verification fee ($0.15/ton)[3]	
			CCX exchange fee ($0.20/ton)	
			Payment at end of contract period[4]	
			20% reimbursement from carbon reserve	
			TOTAL	**$**

[1]Sequestration rates are determined by project type and region; the actual values are set by CCX or via direct field measurement.
[2]Estimated annual value will vary with fluctuating market prices over time; $3.67 rate used for comparison purposes only. Future revenues have not been discounted to reflect the time value of money. Contact your farm business agent for more information
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