Climate Change Policy Partnership

Center on Global Change
Nicholas Institute for Environmental Policy Solutions
Nicholas School of the Environment and Earth Sciences

Harnessing Farms and Forests
Domestic Greenhouse Gas Offsets for a Federal Cap and Trade Policy
FAQs

The following is a living document; we are happy to accept comments and questions and will continue to update this as we receive input. Contacts: Lydia.Olander@duke.edu or Christopher.Galik@duke.edu

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What is a cap and trade system?
Cap and trade regulatory schemes attempt to combine traditional regulatory tools with the power of market incentives. Unlike many other regulatory programs that prescribe technologies to lower pollution cap and trade programs set a target level for pollution, commonly referred to as a cap, and allow the emitters to determine how to meet the cap. The cap is divided into allowances that permit the holder to emit a specified amount of pollution. Firms must hold allowances at least equal to the amount of emissions they produce. Once the cap is set and allowances are created and allocated, the flexibility of the regulatory mechanism comes into play. Cap and trade programs allow regulated parties to buy and sell allocated allowances as they see fit. In this way, a market for the allowances emerges. Variation in emission levels and reduction strategies among firms creates economic efficiency gains because the exchange of allowances is advantageous for both potential buyers and sellers and compliance is generally achieved at a lower cost than without trading.

What is an allowance?
In most current climate policy proposals an allowance is a unit of measurement equal to one metric ton of carbon dioxide or a carbon dioxide equivalent.

What is an offset and how does it work?
Under a cap and trade system some sectors or emitters might not be included under the cap. This is the case in most current proposals, where small emitters and the dispersed forest and agricultural sectors are not capped. However, these uncapped entities can make reductions in greenhouse gas emissions or sequester the greenhouse gas carbon, which can then become a commodity in a cap and trade system. An uncapped entity may voluntarily choose to produce offset allowances, but once those allowances are registered and sold, there will be certain requirements to maintain the value.

An offset system would allow a capped entity (e.g., a coal fired power plant) to buy allowances stemming from greenhouse gas reductions achieved by an uncapped entity (e.g., a farmer). For example – a coal-fired utility can emit 100 extra tons of carbon dioxide from its generating plant and still meet its emission target by purchasing 100 offset allowances from a farm that is sequestering the equivalent of 100 extra tons of carbon dioxide in its soil. A capped entity may want to purchase offset allowances if they are having difficulty meeting the required reductions under the cap, or if the offset allowances are less expensive than making the reductions internally. Estimates suggest that many types of offset reductions are likely to be less expensive than those from entities under the cap. Their use therefore will help constrain costs of compliance.

An offset, does just that, it offsets the emissions reductions that should be made by one entity by reductions made by another. An offset should not change the total level of reduction reached under a cap; the reduction is just met in a different sector and location. This works because the climate is only affected by the total greenhouse gas burden, not where it comes from.

What are the benefits of allowing domestic farm and forest offsets in a cap and trade system?

When included as part of a larger cap and trade program, agricultural and forestry offsets emerge as relatively low-cost mitigation options, reducing the overall costs of emission reduction efforts and providing a bridge until new emission reduction technologies can be developed. Offsets can also provide new business opportunities to farmers and forest owners while helping U.S. energy and industrial sectors meet mandated emissions reductions. In many cases, offset projects also produce other environmental benefits beside greenhouse gas reductions, including habitat and water quality improvement.

What about other types of offsets?

A domestic forestry and agricultural offsets program can be part of a broader offsets program that may include, for instance, efficiency investments in the residential sector or reduced emissions for small businesses or other entities that are not directly covered in a cap and trade program. International offsets are also possible and can encourage other countries to do their part to address climate change. Offsets from tropical forest nations for reductions in emissions from deforestation (currently responsible for 20% of global emissions) are a promising possibility.

What types of farming and forestry activities could be included in a domestic offsets program?

There are four general types of farming and forestry activities that can be used to generate offsets, (1) activities that increase or avoid losses in the amount of carbon stored in biomass (e.g., trees), (2) activities that increase the amount of carbon stored in soil, (3) activities that reduce methane and nitrous oxide emissions from farming, and (4) activities that reduce methane emissions from manure processing and disposal.

Common activities to increase the amount of carbon stored in biomass include establishing new trees, allowing existing trees to grow larger, increasing carbon stored in harvested wood products and wood waste, and decreasing loss of existing forested land. Increasing the amount of carbon stored in soil can be accomplished by decreasing soil disturbance through altered tillage practices such as no till or conservation tillage, winter cover cropping and other means to increase biomass returned to soil. Reductions in nitrous oxide emissions can be achieved by reducing the use of nitrogen fertilizer and from manure management, and methane emissions from manure can be reduced through waste aeration or methane capture and combustion.

How do biofuels fit into a farms and forests offsets program?

The production and use of some biofuels may release fewer greenhouse gas emissions than traditional fossil fuels, placing these biofuels at a competitive advantage in meeting emission reduction targets. That said, the particular treatment of biofuels under a farms and forests offsets program depends somewhat on the scope of the cap-and-trade system, especially whether fuels are regulated upstream (e.g., refineries), downstream (e.g., power plants or vehicles), or by a low carbon content fuel standard. Any greenhouse gas emissions reductions achieved by biofuels as compared to fossil fuels should not be "double-counted," (credited for the same emission reductions more than once). If fossil fuels are regulated under a cap, then there will be an incentive to use lower-emission biofuels, an incentive that will be translated into increased demand for biofuel feedstocks.

How much greenhouse gas mitigation can be expected from a domestic farms and forests offsets program?

The greenhouse gas mitigation potential of a domestic farms and forests offsets program is depends on the price of carbon. The type of offset activities undertaken, as well as the location of these activities, will also change depending on the carbon price.

A 2005 report by the U.S. Environmental Protection Agency (EPA) found that year 2015 mitigation potential at a carbon price of $1 per ton CO_2e (carbon dioxide equivalents) was 121 Tg CO_2e per year; at a price of $50 per ton CO_2e, year 2015 mitigation potential jumps to approximately 1,500 Tg CO_2e per year.[1] These mitigation potentials translate to roughly 2 and 22 percent, respectively, of 2003 total U.S. greenhouse gas emissions. The EPA report further notes that, at the lower end of the price spectrum, soil carbon sequestration and forest management are expected to dominate the offsets market, while afforestation dominates at higher prices. Regionally, the Midwestern and South-central portions of the United States display high mitigation potential at all carbon prices. The relative potential of Great Lake states declines at higher carbon prices. An additional consideration is the timing of potential activities and offsets. In the early years of a domestic farms and forests offsets program, agricultural soil sequestration and forest management practices are expected to dominate, with afforestation contributing more up to 2050.

How can we be assured that an offset is real or valid?

To ensure the integrity of an offsets program, mechanisms must be established for measuring and verifying offsets. Clear standards must be established for what type of projects are eligible for participation in an offsets program, how to ensure that the reductions made are additional to those that would have been made anyway, how to account for any induced affects ("leakage") that may occur outside of a particular project, and how to account for any release or reversal - a problem particular to offset projects which are storing greenhouse gases in plants or soils.

[1] U.S. Environmental Protection Agency. 2005. Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture. EPA 430-R-05-006. Washington, D.C. 154pp.

How are offsets measured? What type of accounting is required?
The best, most accurate way, to measure and account for greenhouse gas reductions or carbon sequestration is through carefully designed and orchestrated field sampling. *Harnessing Farms and Forest in the Low-Carbon Economy*, a book recently published by Duke University, has pulled together details on how a land owner or project developer can design and carry out effective measurement and accounting for different kinds of forest and farm offsets projects.[2]

Minimizing the cost and difficulty of participating in an offsets market will be important to encourage participation. To reduce the difficulty and expense of measurement for land owners and project developers that might otherwise prevent them from participating in an offsets program, existing standard models, equations, look up tables, and internet tools can be used for measurement and accounting. Alternatively, new models, tools, equations or tables could be developed by the U.S. Department of Agriculture (USDA) or Environmental Protection Agency (EPA) for such a purpose. Tools which use existing data are likely to have greater uncertainty than direct field measurements. This uncertainty will need to be accounted for in the value of the total amount of offsets generated by the project; either with a conservative estimate or a relatively high discount.

The use of general tools and tables can also provide the officials in charge of approving projects a way to assess whether the offsets reported by a project with field measurement are within a reasonable range and to help reduce errors. Examples of existing tools and look up tables which could be adapted for use by a national offsets program include:

- A tool for determining carbon sequestered or emitted from tillage practices developed in cooperation with the USDA. http://www.cometvr.colostate.edu/
- A tool for afforestation and reforestation that calculates carbon sequestered and includes discounting for additionality and leakage developed in cooperation with the EPA. http://ecoserver.env.duke.edu/rapcoev1/

The project information required for land owners and project developers to use these tools should be readily available or inexpensively obtained.

It may also be beneficial to provide additional funding and guidance to the USDA and EPA for collecting additional data and for continuing to improve existing methods and tools using the new offsets projects. Tools which use existing data are likely to have greater uncertainty than direct field measurements. This uncertainty will need to be accounted for in the value of the total amount of offsets generated by the project.

Landowners or project developers should have the choice of methods for measurement, as long as uncertainty is measured and then discounted from the total credits expected.

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[2] Harnessing Farms and Forests in the Low-Carbon Economy: How to create, measure, and verify greenhouse gas offsets. 2007. Eds. Zach Willey and Bill Chameides. Published by The Nicholas Institute for Environmental Policy Solutions, Duke University Press.

How do we ensure that allowances from offset projects represent an equivalent emission reduction?

The environmental and economic integrity of the offsets program requires that each offset allowance is the same as any other allowance. Specifically, an offset allowance for 1 ton CO_2e of greenhouse gas emissions must represent a full 1 ton of CO2e of greenhouse gas emissions avoided or carbon sequestered. Any factor with the potential to reduce or misrepresent the actual amount of emission reductions or carbon sequestration achieved by an offsets project must be accounted for when determining the total number of allowances to be awarded. At a minimum, total emission reductions or carbon sequestration should be "discounted" to account for the following:

(1) the business-as-usual baseline for similar project types in that geographical area to insure that only additional reductions or sequestration are counted,
(2) where applicable, the leakage calculated for that project type in that area, and
(3) where applicable, the uncertainty associated with the methods and input data used.

How can we ensure that offset allowances result in an overall reduction in greenhouse gas emissions and do not include activities that would occur anyway? (How do we ensure that offset allowances are additional?)

Since an offset allowance can be purchased to allow an entity to emit greenhouse gases above their cap, the offset must represent a real reduction in emissions or an increase in sequestration comparable to the increase in emissions by the capped entity. A key first step in determining whether or not an offset achieves this reduction is to compare any increase in sequestration or reduction in emissions to what would have occurred in the absence of the project. This concept is termed "additionality," and is determined by comparing the project activities against a baseline of background or business-as-usual trends in that project type under similar conditions (forest or crop type and regional policies).[3]

For example:

(1) For a facility such as a methane digester which captures greenhouse gas emissions, measurements of emissions in the absence of the digester (before the project began) can serve as the baseline.
(2) For afforestation/reforestation projects, background rates of afforestation and reforestation will be strongly influenced by local conditions and policies. As a result, a regional baseline is appropriate to use for these project types. (See RAPCOE tool).

[3] More information on additionality can be found in Harnessing Farms and Forests in the Low-Carbon Economy: How to create, measure, and verify greenhouse gas offsets. 2007. Eds. Zach Willey and Bill Chameides. Published by The Nicholas Institute for Environmental Policy Solutions, Duke University Press.

What is a baseline?
A baseline is the net greenhouse gas emissions or carbon sequestration on a project's lands or facilities that would have occurred in the absence of the project.

Under many accounting protocols, the change in greenhouse emissions or sequestration in a project above those in the baseline are additional, and count for the project's credited allowances.

What happens if an offsets project inadvertently leads to an increase in greenhouse gas emissions elsewhere in the economy?
"Leakage" is the shifting of activities that generate emissions to areas not included in the measured area of an offsets project. This can result in a smaller net reduction in overall emissions than expected. Accounting for leakage in an offsets program, and adjusting credits accordingly, maintains the environmental and market (value) integrity of offsets.

Leakage usually occurs when an offset project reduces the supply of a good, displacing production – and thus greenhouse gas emissions- to another location. Leakage is likely to be a problem where the offsets market reduces the availability of forest land for another market commodity (such as timber harvesting, harvesting feedstock for biofuels, and clearing for agriculture or urban development) causing scarcity. For example, when a landowner decides to generate offsets by switching to longer timber rotations, one effect is that the availability of timber is reduced, creating scarcity in the market, and raising demand for timber grown outside of the project area. This increased demand may lead to an increased rate of timber harvest outside of the project area, diminishing any net gains in sequestration.

However, the more inclusive the offsets program is, the less leakage there is likely to be. If only afforestation is counted in a national offsets program, economic models suggest leakage of around 24%; however, if forest management, despite its more complicated accounting, is included as well, net leakage essentially disappears. National models show leakage from changes in tillage may be around 6%.[4]

How do we account for inadvertent or leaked emissions?
Leakage, where a project simply shifts emissions to some other unregulated source, can result in a smaller net gain in emissions reductions than are expected. As a result, an offset allowance for those types of projects that have leakage cannot be traded 1 for 1 with a ton of CO_2 emitted by a facility covered by a cap. This issue can be dealt with by calculating leakage and discounting the farm or forest offset by the amount of leakage for that project type in that region.

For a national offsets system with multiple types of forest and agricultural projects included, leakage may best be addressed by a national modeling effort to determine

[4] U.S. Environmental Protection Agency. 2005. Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture. EPA 430-R-05-006. Washington, D.C. 154pp.

annual leakage discounts for each project type in each region, which would be updated periodically.

How can uncertainty be addressed?
For some project types there will be uncertainty associated with the field data collected, as well as the methods used to determine baseline and additional greenhouse gas reductions and leakage. In those cases the methods and tools developed need to include estimates of uncertainty.

To be conservative in maintaining environmental and economic integrity for offsets, a project's offsets should be discounted by the uncertainty inherent in the methods used and the input data provided. One way to discount would be to accept the most conservative estimate within an accepted statistical confidence interval, if such data are available.

A range of methods for measurement and accounting exist, from those that require less data (less effort) but have greater uncertainty to those requiring more site specific data (more effort) and have less uncertainty. Discounting that is scaled to increase with uncertainty will allow the market to settle on the ideal mix of effort and certainty. In this fashion, a landowner may consider measurement and accounting practices of increasing stringency up to the point where the increased costs and effort becomes greater than the benefit gained from a reduced discount.

How can we address the fact that carbon sequestration may not be permanent?
Projects that sequester carbon are subject to the loss of this carbon, whether through intentional management decisions (harvesting or tillage) or unexpected natural occurrences (fire, infestation, etc.).

Sequestration projects produce allowances that can be sold for profit when they are gaining carbon. However, when a reversal occurs and carbon is released from a sequestration project, the project developer must either sequester additional carbon to make up for the loss or buy a number of allowances equivalent to the loss.

Project developers will need to report their annual sequestration as well as any project reversals so net allowances can be balanced. Projects developers can also set up their projects as short term "rental" agreements whereby they expect to pay back the balance in 20 years when they harvest or shift management.

Unfortunately natural occurrences, such as storms or fires, can also result in reversals, damaging not only the forest or farm, but also releasing sequestered carbon. Mechanisms need to be in place to manage this risk, such as establishing carbon reserve buffers or otherwise insuring risks.

How would forest management be addressed?
Various forest management practices can enhance the rate of carbon sequestration, such as increasing rotation length, increasing density in under-stocked stands, or intensifying fertilization. To generate offsets through forest management activities, carbon must be sequestered above some baseline level. While the issue of forest management baselines is not completely resolved at this time, evolving protocols suggest the baseline could reflect the amount of carbon sequestered under business-as-usual management practices. In forest stands, this baseline level of carbon sequestration would take into account common management practices being used by similar landowners in the area, as well as any voluntary compensation program or regulatory requirements.

As in other offset projects, the total number of offsets generated by the project will be equal to the amount of carbon sequestered in the forest minus the baseline and any other applicable discounts.

How would forest products be addressed?
The harvesting of timber can be viewed as a net emission of sequestered carbon, and a landowner participating in an offsets program will need to account for this. However, not all of the carbon stored in the harvested timber will be instantly lost to the atmosphere. Depending on the end-use of the timber, a great deal of carbon could remain stored in forest products for a very long time.

There are a number of methods for tracking the carbon sequestered in forest products. One method tracks the disposal or decay of forest products over time, and accounts for any loss of stored carbon the year in which it is actually lost. A second method estimates the total amount of carbon left in forest products after 100 years, assumes that this amount is "permanently" sequestered, and accounts for such at the time of harvest. Tracking the actual amount of carbon lost in any given year could provide the most accurate account of the forest product carbon pool, but reporting and documenting the connection between a project's harvested output and its specific destination in the product pool could be prohibitively complicated. The 100-year method relies on the calculation and application of accurate decay curves, but can be easily applied as an upfront discount at the time of harvest, avoiding the need for further tracking or accounting. The choice of accounting system will likely be based in part on who owns the forest product offset. For example, landowners may prefer the simplicity of the 100-year method despite that this might underestimate the lifespan and resultant size of the forest product offset.

How can we mitigate the risk that natural occurrences pose to offset projects?
Given the potential for natural occurrences (fire, storms, etc.) to release sequestered carbon from offset projects, mechanisms are needed to mitigate risk.

In a system that requires environmental certainty[5] both sequestration and release need to be accounted for - where a reversal occurs the project must either provide additional carbon storage or purchase allowances to make up for the losses. As a result, a reversal event (e.g., fire) can result in the loss of both property (e.g., timber) and its sequestered carbon. The increasing financial value of an offset carries with it additional financial exposure.

All else equal, it is better to have the risk/liability tied to the project and not the purchaser because the incentive to avoid reversals and maintain carbon storage remains with the party in control of the project.

There are different ways to address environmental certainty while managing financial risk for the project owner. Each approach can have different economic costs for the project owner, affecting the likelihood of riskier projects being developed and being brought to the greenhouse gas market. These approaches pool the reversal risks of individual projects assessing a risk premium on each project. Pooling reduces the landowner's individual risk of financial loss from accidental reversal. Several approaches could be considered, defined by who bears the risk.

1) **Project developer:** Projects could be conservatively discounted based on risk. In other words, the project landowner would receive less than a one-to-one credit from the developer for each ton sequestered or reduced, but then the risk and liability is transferred to the project developer. This approach to risk management works better when projects are aggregated in a diverse portfolio, because it allows the developer or an aggregator to pool risk across projects more efficiently. Project aggregation will likely be the norm for agricultural sequestration, due to the relatively small amounts of carbon at stake on a per acre or per project basis.
2) **Private third party:** Risk-pooling could be extended further by involving third parties who manage risks through insurance contracts, financial instruments, reserve requirements, or other well-established vehicles used to manage risks from other commodities. These mechanisms will ultimately impose some sort of premium or discount as described above which will reduce the net payment to the landowner, but sustains the expectation that full losses will be covered.
3) **Public shared liability plan**. A shared liability system where every allowance at risk of reversal pays a small percentage (at a level related to expected risk) into a national or regional shared liability fund that will be available to all project developers when they are subject to a reversal caused by an act of nature.

[5] We assume that environmental certainty is required. There are a number of programs where this is not the case, which could be considered. For example:

- Reversals caused by acts of nature can be exempt from compensation or repayment requirements.
- An assurance program could be established related to expected risk that is banked and available for each project to help cover losses (like the Chicago Climate Exchange).

How will existing projects or offset-eligible activities (i.e. early actors) be included?
As farm and forest offsets are already part of numerous current and impending greenhouse gas reporting and registration programs, it is important to consider how offsets reported or registered under other programs will be credited under a federal offsets program. A key principle to remember is that offsets cannot be double-counted; offsets may be registered under multiple programs or registries, but may only be cancelled, dissolved, or retired once.

Another important point to consider is that, should outside offsets projects be allowed to transition into a federal cap-and-trade program, provisions must be set up to ensure that program integrity remains intact. For those projects where a reporting or registration mechanism has allowed for changes in carbon flux or stock to be tracked over time, a determination must be made as to the stringency, accuracy, and certainty of the other program. It may be necessary to adjust offsets prior to transitioning into the federal program to account for any discrepancies. For those projects or activities that have not been subject to past reporting or registration, it may be impossible or impractical to credit past sequestration or emission reductions because no record of actual changes in carbon stocks or fluxes exists. However, other mechanisms outside of the offsets program can be used to reward early actors in these latter situations, such as incentives to encourage the maintenance of good practices.

How can the program avoid being defrauded?
By creating a tradable, saleable commodity, a farms and forests offsets program also creates the incentive to "play" the system for individual advantage. Since the total amount of offsets generated by a project will depend on the amount of greenhouse gas emissions reduced or sequestered in comparison to some baseline, individuals may be tempted to either inflate the amount of reduction/sequestration or to deflate the baseline.

An independent and certified verification process paired with transparent and thorough measurement and reporting can minimize the ability of project developers to inflate emission reductions or sequestration artificially. The same measurement, independent verification, and reporting process can be helpful in preventing the artificial deflating of the baseline. Independent verification and auditing, ranging in intensity from simple document review to site visitation to independent measurement and analysis, can serve an important role in ensuring the accuracy and transparency of the offset generation process.

A much more complicated issue, however, is how to prevent individuals from seeking a favorable baseline by intentionally increasing emissions before joining the offsets program. An example of this would be a landowner who clears his forested land just before beginning an offsets project. The landowner would then appear to begin the offsets project with a very low baseline. In reality, though, carbon sequestered as part of the offsets project cannot be said to be additional, as it is merely replacing carbon that was already sequestered onsite prior to clearing. To prevent such behavior, an offsets program could require an estimate of carbon stock or flux for a set number of years prior to project initiation. In this way, any anomalies in stock or flux can be identified and corrected for. But even identification of emission anomalies may not be enough, as there will be outstanding issues of cause (e.g. fire, pest infestation, intentional clearing) and intent (e.g. responding to changing market conditions, etc.).