



Science
Societies

Voluntary versus state-based compliance carbon markets

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Photo by Tyler Thompson.

The following article is a portion of a larger document containing a glossary, responses to frequent questions, and a list opportunities and requirements of selected volunteer carbon markets that can be viewed at <https://bit.ly/2X6UvqJ>. Its purpose is to provide useful information about the voluntary and compliance carbon markets.

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What Is a Carbon Credit?



Carbon storage in soil can generally be increased by many practices, including planting cover crops and growing plants that produce a large

A carbon credit is a generic term for any tradable certificate or permit representing the right to emit 1 metric ton of carbon dioxide or the equivalent amount of a

amount of plant material (i.e., corn, grain sorghum, and perennial plants). Photo by Philip Needham.

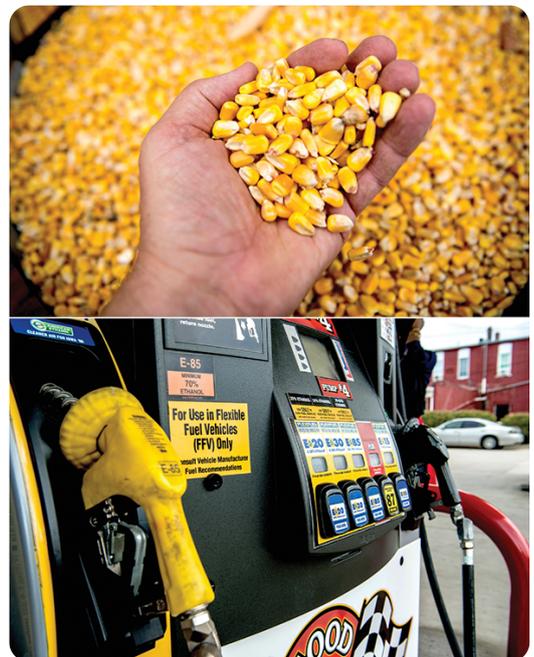
different greenhouse gas (tCO₂e) (Wikipedia, 2021). Agriculture can produce tradable carbon credits by increasing the amount of carbon stored in the soil or decreasing the amount of greenhouse gas (GHG) emissions attributed to the production of food, fiber, and energy products. In agriculture, important GHGs include carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄). Both on-farm (N₂O from soil) and embedded emissions (e.g., diesel and fertilizer manufacturing) should be counted. Sustainable farming practices may reduce net GHG emissions by building soil organic carbon stocks. Carbon storage in soil can generally be increased by many practices including:

- Planting cover crops,
- Returning the crop residues,
- Growing plants that produce a large amount of plant material (i.e., corn, grain sorghum, and perennial plants), and
- Minimizing soil disturbance.

Once the credits have been generated and verified, they can be sold to buyers through voluntary and compliance markets. Since changes in farming practices (e.g., cover crop) may require additional fuel and material input and thus higher upstream GHG emissions, carbon credits should be calculated using life-cycle analysis tools to determine the net GHG reduction benefits (i.e., soil carbon increases less additional GHG emissions).

Selling Carbon Credits

When considering selling carbon credits to a voluntary or a state-based compliance carbon program, there are several important factors that should be considered. **First**, in a voluntary market, the rules (generally called “pathways”) are created through a negotiation among the project developer or company, protocol developer, assessor and verifiers, and buyers. In contrast, state-based compliance market pathways are based on government legislation. **Second**, depending on carbon credit price, buyers can choose to participate, whereas in a state-based compliance market, the buyers may be legally obligated to purchase credits. The difference between the voluntary and compliance market purchasing requirements may be responsible for lower selling prices in the voluntary markets compared with compliance markets. For example, many voluntary markets are paying between \$10 to \$20 per metric ton. In the California Low Carbon Fuels Standard, carbon credits are currently trading for \$200 per metric ton. **Third**, for a seller to market credits, pathways must exist. These pathways are still being developed and involve discussion among the project developers, protocol developers, assessor and verifiers, and buyers.



Voluntary Markets

- Do not have a fixed number of credits for trading.
- Depend on a contract between the buyer and the seller to set credit prices.
- Are managed by a coalition of companies that may be a company or a non-profit organization.
- Are often driven by corporate sustainability reporting (CSR), financial regulatory disclosure, or environmental, social, and governance (ESG) investing.
- Are complex in that each program has slightly different protocols developed (most generally follow [IPCC 2019 guidelines](#)).
- Can include offsets and inset/emission factors depending on the source or scope of the emissions (see Glossary section in the full presentation here: <https://bit.ly/2X6UvqJ>).
- Can be sold to a third-party entity.
- Are optional (not required by law) for the credit generator (i.e., farmer) or buyer (i.e., industry).
- May require adoption of new practices (additionality) or the purchase of a commercial product.
- Often vary in permanence requirements (10 to 100 years) for long-term soil carbon sequestration.
- Include pathways for payment or compensation for soil organic carbon storage, GHG emission abatement, water quality improvement, and biodiversity enhancements.
- May provide pathways to obtain payments for storing carbon in soil.

The U.S. federal government influences renewable fuel production through the Renewable Fuel Standard (RFS), which has contributed to increasing the amount of ethanol blended into the nation's fuel supply. Photo by Dennis Schroeder/NREL.

Compliance Markets

- Are made in response to government legislation.
- Have a fixed number of credits for trading that are based on the regulatory requirements.
- May require the purchasing of credits for specific industries and manufacturers (buyers).
- Allow farmers choose whether to participate.
- Have been formed in 12 states and will be soon in other states as laws are passed.
- Are (as of April 2021) in the midst of discussions about options for providing payments in the California Low Carbon Fuel Standard (LCFS) program for storing carbon in soil.
 - Research is being conducted to determine an inexpensive and accurate pathway to measure/predict C storage.
 - Select or modify an existing pathway (method) to fit their needs. For example, the **LCFS** is an active market:
 - The goal of this program is to reduce the carbon intensity of petroleum-based fuels 20% by 2030 and 80% by 2050.
 - Payments have been made to liquid fuel producers that help achieve these goals.
 - Farm practices can further reduce GHG emissions. However, before farmers can receive payments, a pathway (method for measuring and validating the reduction) must be approved.
 - Currently, the California (and **Oregon**) markets calculate carbon intensities using a modified form of the U.S. Department of Energy (DOE) **GREET** model.

Summary

Voluntary and compliance markets have similarities and differences. Similarities include that sellers can choose to participate and farmers may receive payments for participating. A difference is that in voluntary markets, buyers can choose to participate, whereas in compliance markets, buyers may be required to participate. In addition, all markets have different pathways/protocols for determining offsets.

Role of the Federal Government

The U.S. federal government influences renewable fuel production through the Renewable Fuel Standard (RFS). The RFS program is a national policy that requires a certain volume of renewable fuel to replace or reduce the quantity of petroleum-based transportation fuel, heating oil, or jet fuel. The RFS, combined with other subsidies and mandates from both state and federal governments, has increased the amount of ethanol blended into the nation's fuel supply beyond what would occur in a free market. Under the law, the USEPA sets annual quotas for conventional renewable fuel (usually corn-based ethanol), advanced ethanol alternatives made from non-edible material, and biodiesel. These quotas are then translated into blending requirements for individual refiners. Companies that do not meet their blending mandates must buy Renewable Identification Numbers (RINs) to cover the difference, unless they are a small refinery that qualifies for a hardship waiver. In this program, the four fuel categories are biomass diesel, cellulosic biofuel, advanced biofuel, and total renewable fuel. A full description of the RFS is beyond the scope of this fact sheet, and additional information is available at <https://bit.ly/3y7Xlml>.

At some time, the federal government may choose to regulate voluntary markets and the state-based compliance carbon-trading programs. To date, there has been no federal movement on voluntary and state markets.

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