

Calvin College Carbon Emissions Trading Simulation (CETS)

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BIOL354b and ENGR333a
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One way in which governments are attempting to meet Greenhouse Gas (GHG) emissions requirements of the Kyoto protocol is by creating markets in which GHG emissions are traded for sequestration and emission reduction projects worldwide. These markets create incentives for developing clean energy technologies and establish a price on GHG emissions. When the price of GHG emissions is built into products and services, consumers are encouraged by their own enlightened self-interest to pursue activities that emit less GHGs. As stated by Bayon, et. al. (p. 3)

The theory is that carbon markets are able to achieve this magic because they help channel resources toward the most cost effective means of reducing GHG emissions. At the same time, they punish (monetarily) those who emit more than an established quota, and reward (again, monetarily) those who emit less. In so doing, they encourage people to emit less and change the economics of energy technologies, making technologies that emit less carbon more competitive vis-à-vis their carbon-intensive counterparts.

There is other magic at work as well: By turning units of pollution into units of property, the system makes it possible to exchange pollution from Cape Town with pollution from Cape Cod. If business managers find reducing their company's emissions too costly, they can buy excess reductions from a facility where reductions are less expensive. The bigger the market, the theory goes, the greater the likelihood that efficiencies will be found.

In a carbon market, *carbon credits* are traded, each credit representing the reduction of GHGs equal to one metric ton of CO₂ (tCO₂e). Several GHGs are normally traded, including CO₂, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons (like R134a), and perfluorocarbons. Each GHG is traded at its global warming potential (GWP). So, for example, methane has a GWP of 23, because it is 23 times more potent for global warming over a 100-year period. One ton of methane emitted is equivalent to 23 tons of CO₂ emitted in terms of its effect on global temperatures. When an individual or an organization emits CO₂, their credits are "retired" or "consumed."

CO₂ emissions trading credits can be generated by project-based transactions or awarded outright to market players as an annual allowance. Project-based credits are the result of a carbon reduction project undertaken by an organization or an individual. For example, a large company could improve the energy efficiency of its factories and prove that the changes have reduced energy use. By reducing energy usage, fewer tons of CO₂ are emitted at a power plant. If those reductions are verified, the company earns carbon credits that it can sell on the carbon market. If the income earned by the company from selling the credits exceeds the cost required to implement the energy savings at its factories, the company is a net winner in the carbon market.

Allowance-based markets usually trade credits in a cap-and-trade market system. In a cap-and-trade market, carbon credits are issued to companies by regulators. Only a certain amount of credits are available. Market participants who emit less than their allowance are free to sell their credits to those who expect to emit more than their allowance. The price of the credits on the market fluctuates according to supply and demand, and regulatory agencies can purchase and retire credits (without their corresponding emissions ever actually happening) to reduce overall emissions from the market and, probably, drive up the price of credits on the market because the supply of carbon credits is now tighter.

There are both voluntary and regulatory (compliance) carbon markets. Voluntary markets usually utilize project-based credits. Compliance markets usually utilize allowance-based transactions.

During this 2-part simulation, you will participate in a small and simulated carbon market consisting of students in BIOL354b and ENGR333 and the professors of the two classes. You will track your carbon emission behavior during the simulation and trade credits amongst yourselves. Use the accounting sheet to track your market behavior (retiring, buying, and selling credits). You must report your activity and submit your retired credits to your professor at the beginning of every class period using the CETS v1 transaction reporting form. Market reports will be provided each weekday during the simulation at <http://www.calvin.edu/~mkh2/cets/>. (An RSS feed is available on that URL.)

This simulation will employ features of both regulatory and voluntary markets.

CETS v1

The first version of the simulation will last 2 weeks (from Tuesday 4 September to Tuesday 18 September). During the first version of the simulation, carbon emission credits will be activity based rather than mass based. The following table shows the carbon credit equivalence of various activities.

Table 1. Carbon Credit Equivalence of Market Participant Activities.

Credits	Activity
2	Ride in a car on a one-way trip anywhere: to Calvin, to the store, home, etc. (Two people the same car retires one credit per person.)
1	Watch TV for an hour. (Two people watching the same TV retires 0.5 credits per person.)
6	Operate air-conditioning in your house for a day. (No pro-rating for housemates.)
4	Operate the furnace in your house for a day. (No pro-rating for housemates.)
1	Eat a piece of fruit grown outside Michigan
1	Use or leave a computer on for 2 hours

The market for CETS v1 will be based on a cap-and-trade system using allowance-based transactions. You will be issued 110 carbon emission credits each on the first day in the form of Monopoly money. Each Monopoly dollar equals one carbon emission credit.

Compliance markets work on the basis of a regulatory system where penalties for under-reporting carbon equivalent emissions are harsher than purchasing the credits on the market. The only penalty for illegal market behavior during this simulation is your grade. Thus, the Christian virtue of honesty (Plantinga, p. 231) will be required from all of us to make this simulation successful.

You must use your own money to purchase credits on the market should you need them. Each student is required to submit an accounting of your activities and the money you spent (to buy credits) or earned (from selling credits) in the market. Those market participants with positive cash flow for the simulation will be required to buy a pizza lunch for the class on 18 September 2007.

Between CETS v1 and CETS v2

Between v1 and v2, the students involved with the simulation are required to develop an updated version of the simulation. Changes that must be made in the simulation are:

- Carbon credits must be mass based rather than activity based. You, as a class, could decide that one carbon emission credit should be equivalent to 1 tCO₂e, for example. Then, the activities in the list would have their credits adjusted. The credits for taking a car ride must then be based on the CO₂ emitted during the trip. You are encouraged to use your knowledge of carbon emissions from the Calvin College Carbon Neutrality project to develop a system for assigning mass-based credit values to activities.
- Additional activities must be added to the credit equivalence table.
- Project based transactions must be included. Thus, you will be able to do simple household projects to generate credits that can be sold on the market. (An example could be installing low-energy lights in your house or apartment.) Credits can be generated only by doing a project that will allow you to do the same activity with less carbon-equivalent emission.
- A verification scheme for the projects (to be implemented by the profs) must be developed.
- Forms for personal emissions credit and monetary logging must be improved.

The above list is required, not exhaustive or restrictive. Other improvements may be included as well.

Instructions for the improved simulation must be handed in to the professors by 2 October 2007.

CETS v2

Version 2 of the simulation will run from 9 October through 20 November (first day of final presentations for the Calvin College Carbon Neutrality project). Again, the monetary winners will be responsible for providing pizza lunch to the market participants on 20 November. So, save the money that you accrue in the market.

Every transaction must be recorded with Prof. Heun or Prof. Warners using the improved CETS v2 transaction reporting form. Daily reports of market conditions will be provided by the professors at <http://www.calvin.edu/~mkh2/cets/>.

References:

Bayon, R., A. Hawn, & K. Hamilton. 2007. *Voluntary Carbon Markets*. Earthscan, Sterling, VA.

Plantinga, C. 2002. *Engaging God's World: A Reformed Vision of Faith, Learning, and Living*. Eerdmans, Grand Rapids, Michigan.