Carbon currency, the credits and debits of carbon emissions trading

Contributed by Carbon Currency Foundation

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The Kyoto Protocol is the first step towards stabilising global emissions of carbon dioxide. But what is carbon emissions trading and will it limit the enhanced greenhouse effect?

Imagine you are a farmer in the Australian wheat belt. You need to plant trees to arrest salinity, erosion and soil acidification, but you can’t afford to – trees usually don’t earn you money for many years, if ever. Then, along comes a carbon broker. He offers to pay you money up-front to plant trees. In return, he wants a credit for the carbon such trees will store. You plant the trees and pocket the cash. As more and more farmers switch to trees, the wheat belt becomes more like a belt of living carbon. That is the dream of some Australian farmers, foresters and entrepreneurs. They believe that a system of carbon emissions trading that allows the buying and selling of carbon 'credits' will simultaneously help prevent global warming and promote the planting of trees on degraded land.

The greenhouse effect We owe our presence on Earth to carbon dioxide (CO2) and other greenhouse gases. Spewed out from below the Earth’s crust before life began, CO2 helped stabilise temperatures to levels suitable for organic life. It did this – and continues to do it – by what is known as the greenhouse effect. This occurs when heat energy from the sun passes unimpeded through the atmosphere and warms up the Earth. In turn, the Earth radiates this energy back towards space. The greenhouse gases – water vapour (the main greenhouse gas), methane, ozone, carbon monoxide, nitrous oxide and CO2 – absorb some of this energy and emit it in all directions, including back towards Earth. The Earth's surface is about 34ºC warmer as a result. Over millions of years, the Earth has managed to regulate concentrations of greenhouse gases through a system of sources and sinks. Carbon (in the form of CO2 and methane) is emitted by volcanoes and by rotting vegetation and other organic matter. But CO2 is sequestered, or absorbed, by trees (their roots, branches, trunks and leaves are about 50 per cent carbon), plankton, soils and water bodies. Indeed, scientists have become aware that increased concentrations of CO2 actually stimulate the growth of many different types of plant, including trees – this is called the

CO2 fertilisation effect. For example, a doubling of atmospheric CO2 has been shown to stimulate leaf photosynthesis rate by up to 50 per cent depending on temperature. Although some of this CO2 will be released back into the atmosphere by increased respiration, more carbon should be sequestered. So, if a series of volcanic eruptions or burning of fossil fuels emitted excess CO2, in time it would be partly ‘mopped up’ by the increased growth of forests, and partly dissolved in the oceans.

Enhanced greenhouse effect In modern times the burning of fossil fuels like coal, oil and natural gas – in which carbon has been stored for millions of years – combined with accelerated land clearance has led to unprecedented levels of greenhouse gas emissions. Carbon sinks can’t keep up, and concentrations of greenhouse gases in the atmosphere have risen dramatically leading to an enhanced greenhouse effect. Most scientists say that as concentrations of these gases continue to rise, there will be a general and very rapid warming of the world’s climate. No one is sure what effect this warming will have on the details of regional climate, but predictions include widespread ecological changes in agricultural production, and rising sea levels. While not all model predictions are so dire, the possibility of costly disruption from rapid climate change calls for greater attention and precautionary measures to be put in place.

Waking up to warming – slowly People have become increasingly concerned about the possible effects of global warming. Although the annual rate of emissions has been decreasing, the CO2 concentration in the atmosphere is still increasing. In 1992, most developed countries in the world agreed to the United Nations Framework Convention on Climate Change (UNFCCC), which is designed to impose limits on greenhouse gas emissions and thus minimise the adverse effects of climate change (Box 1: International deliberations). But experience has shown that reducing the use of fossil fuels is a slow process. In Australia, which relies heavily on coal for its power supplies, only 9 per cent of our energy comes from renewable and non-greenhouse sources; the government hopes to increase this to 11 per cent by 2010 (Box 2: Australia's policy response). Scientists predict that we need to decrease global CO2 emissions by at least 50 per cent of current levels by 2050 to stabilise global carbon dioxide levels and prevent further climate change. Are

there alternatives to cutting back on fossil fuels? For example, what if we were to grow more forests, or not cut down trees that we might otherwise have, thereby removing carbon from the atmosphere? While recognising that it is only a partial solution, negotiations conducted by all the countries that have signed the UNFCCC are paving the way for this possibility. Some people hail it as a way of simultaneously cutting concentrations of atmospheric greenhouse gases and promoting reforestation. Others see it as a tactic to delay the time when countries have to deal with the issue of burning fossil fuels – by which time the problem may be much worse.

A formula to limit emissions Under the Kyoto Protocol, developed countries such as Australia are required to limit their greenhouse gas emissions according to the following formula: actual emissions must be less than or equal to the assigned amount +/- carbon sinks and Kyoto emissions.We won’t attempt to decode this fully here; what concerns us most is the ‘carbon sinks’ part of the formula. It means that Australia can emit more than its assigned amount (which, incidentally, is 8 per cent above its emissions in 1990) if it can simultaneously sequester the equivalent amount in sinks.

Allowable carbon sinks Under the Kyoto Protocol, allowable carbon sinks include afforestation and reforestation activities undertaken since 1990. Agricultural soils and some other sources and sinks may also be included, although these are yet to be agreed to. Part of the difficulty with including these is scientific – measuring changes in soil carbon on agricultural land, for example, remains extremely problematic – demonstrating that compliance will be a problem. Geosequestration is another option being investigated as a possible sink for carbon in Australia and other countries with suitable geology.

Carbon emissions trading What does this all have to do with carbon emissions trading? Under the UNFCCC, countries are permitted to use a trading system to help meet their emissions targets. In principle, a country may allocate permits to individual companies for the emission of a certain quantity of greenhouse gases. If permits are only issued to a level equal to or below the assigned amount, then a country should meet its Kyoto commitment (assuming that the measures of its emissions are accurate). If a country is incapable of meeting its target, it can buy permits from countries that are under their targets. Similarly, companies within a country that prove more able to reduce their emissions are allowed to ‘trade’ excess permits to other, more polluting, enterprises.

Where carbon credits come in The trading system involves the issuing of carbon credits for afforestation and reforestation activities. It requires an assessment to answer questions such as: Was the forest established after 1990? How quickly is it growing? How much carbon is it sequestering? Credits are issued to the individual or company growing the forests. These credits can be sold to a carbon emitter such as a power company, using them to ‘offset’ its excessive carbon emissions.

The scientific questions Part of the reason for global warming is excessive land clearing, so is restoring vegetation cover part of the solution? Vegetation, largely forest, is already absorbing about one-third of human-induced emissions, planting more forests could increase absorption. Some caution is required because accounting for the carbon contained in forests is difficult. The amount of carbon in forest soils, forest litter and the trees themselves needs to be measured. Different types of trees store different amounts of carbon when growing on different types of soils in different climates. In addition, we might expect natural year-to-year variations in carbon stored, related to climate variations. And there is the added difficulty of monitoring the long-term fate of carbon – will the sink become a source? Consider what happens in a plantation harvested for pulp. Much of the carbon stored in the roots, leaves, bark and branches of trees is released into the atmosphere as the dead vegetation rots. The stems are turned into pulp, which is manufactured into a range of paper and wood fibre products. Many of these are used once and then discarded – they will also rot or be incinerated, returning their carbon to the atmosphere. Even trees harvested for long-term uses such as furniture and house frames will lose a large proportion of their stored carbon to the atmosphere through waste during processing. Planting trees for conservation purposes – where they are unlikely to ever be harvested – will be of more long-term benefit to the global carbon cycle than will plantings for some commercial harvesting (eg, trees for pulping). But even trees for conservation purposes may be lost in a forest fire – and most of the stored carbon would return to the atmosphere. Furthermore, a new forest acts as a sink only until it reaches maturity, at which time new growth is compensated by death and decay. To help account for carbon flow, the Australian Greenhouse Office, the CSIRO and the Australian National University have developed methods to reliably measure greenhouse gas emissions. The methods calculate emissions resulting from variables such as soil cultivation, fire management, fertiliser application, climate, different plant species and land management systems. Methods for measuring emissions are evolving and improving as a result of new research.

Carbon accounting in Australia Australia is dealing with issues of carbon accounting. Many research institutions – including the Cooperative Research Centre for Greenhouse Accounting, the Cooperative Research Centre for

Greenhouse Gas Technologies and the Australian Greenhouse Office – are developing knowledge to underpin an acceptable approach by Australia. One area of investigation is to determine the degree to which the CO2 fertilisation effect can help to sequester Australia's CO2 emissions. To explain the fertilisation effect, we need to take a quick look at photosynthesis.

Photosynthesis and the CO2 fertilisation effect The basic ingredients for photosynthesis are CO2, water and energy (in the form of sunlight). In addition, several nutrients such as nitrogen and phosphorus are required for the manufacture of essential proteins. Photosynthesis will increase if the availability of these ingredients increases. This explains the CO2 fertilisation effect – as more CO2 becomes available, more growth can take place and more carbon is sequestered. But basic plant physiology and ecosystem experiments show that the fertilisation effect of increasing concentrations of CO2 eventually reaches a saturation point. This means that other vital ingredients such as water and nutrients become limiting. Clearly, when reafforestation is used as a method for storing carbon, it can only occur when sufficient water and nutrients are available. The same applies for the CO2 fertilisation sink, except that elevated CO2 increases the efficiency of use of water and nutrients in fostering carbon sequestration.

The next phase The pros and cons of carbon credits continue to be debated by the international community. The Sydney Futures Exchange has established a carbon credits trading market and many carbon emitters are buying credits from forest growers. While forests are an important carbon sink, there is a limit to the amount of carbon that they can store. The largest carbon sink is in the fossil fuels in the ground, but we are currently using them as a major source of energy and emitting CO2 into the atmosphere as a result. A number of changes are needed to achieve a substantial decrease in emissions. It will require reduced energy demand, increased energy efficiency, using less fossil fuels and more renewable energy sources. It will also require research and development of sustainable technologies that reduce carbon emissions. If carbon emissions trading becomes a widespread phenomenon, we will probably see big changes in the Australian countryside. For 200 years we have worked hard to get rid of our trees because they hindered agriculture. Now we know that they deserve a bit more credit than that.

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