Carbon Market Watch

Fossil and biological carbon: a tonne is not a tonne

Whether biological carbon credit should be traded in carbon markets is topical, with discussions ongoing in the UNFCCC, ICAO and the California Cap-and-Trade system. To date, compliance markets have rejected the eligibility of biological carbon offsets. They are right to do so. Fossil and biological carbon operate on different parts of the carbon cycle, and on very different timescales. Fossil carbon is permanent; biological carbon is potentially and frequently subject to rapid fluxes, whether natural or manmade. For these reasons, offset credits from REDD+, afforestation and reforestation or other biological systems should not be treated as fungible with fossil carbon, but should instead be addressed through other, appropriate, policy measures.

Introduction

One of the problems in addressing the climate change crisis is that there are a number of different radiative forcers involved including greenhouse gases, black carbon and aerosols, coming from a wide variety of sources, which each have different chemical and physical characteristics. A rational policymaking approach to address climate change would therefore be to put in place tailored measures to address this diversity in ways most appropriate to different forcers and sources.

The use of biological carbon offsets in carbon markets, trading it against fossil emissions, is seen by some as an opportunity to find the needed finance to address emissions from land use changes, including from deforestation and forest degradation. Other promoters see it as a political bargaining chip to overcome the resistance of vested fossil fueled interests to decarbonize in their sectors, rather than as the most effective means to address emissions from these sources. As a result of such views, there is pressure from some quarters to include credits from 'reducing emissions from deforestation and forest degradation' (REDD+) in carbon markets.

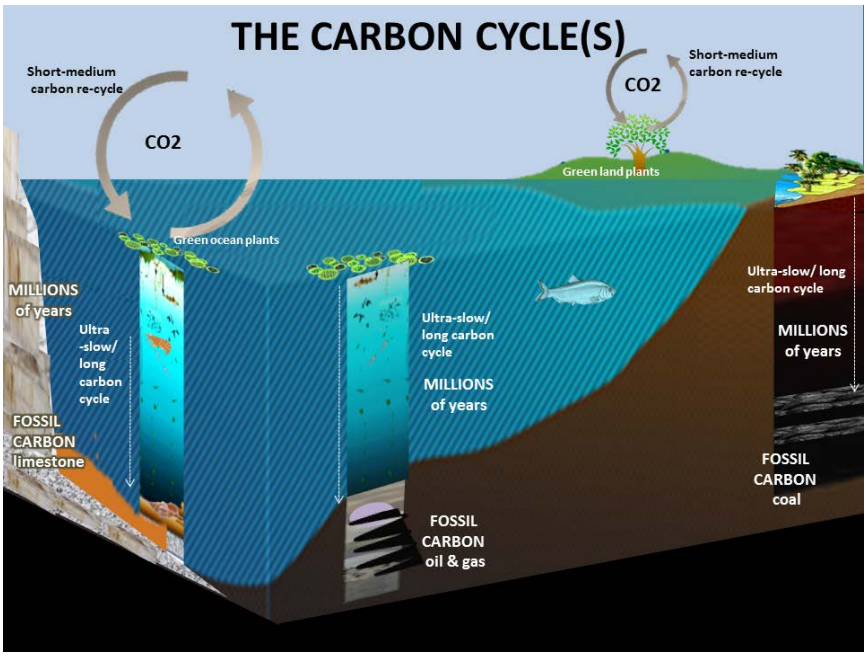
In practice, purchasers have been notably reticent to buy the few types of eligible biological carbon credits, because of some of the practical difficulties associated with, including biological carbon in the markets. In the compliance market, eligible land use credits are temporary and so have to be replaced. Biological carbon is subject to far greater concerns on permanence than fossil carbon. For example, credits from absorbing carbon through planting trees may be reversed due to insect infestation, fires or harvesting. There are also technical concerns defining realistic baselines in the land use sector against which credits can be issued. Concerns about conflicting priorities for land use, including food security are also relevant for certain types of biological carbon.

Whatever the rationale brought forward for including biological carbon in carbon markets, the assumption is made that fossil and biological carbon are indeed fungible: that one tonne of avoided emissions from not burning fossil fuels is equivalent to avoiding carbon emissions from biological stores. This, however, is not the case. This briefing outlines some key scientific differences in the carbon cycles from fossil and biological sources and sinks that makes them inherently non-fungible, and thus explains why **offset credits from REDD+, afforestation and reforestation or other biological systems should not be used to offset any use of fossil carbon.**

Why fossil and biological carbon are not fungible

Timescales

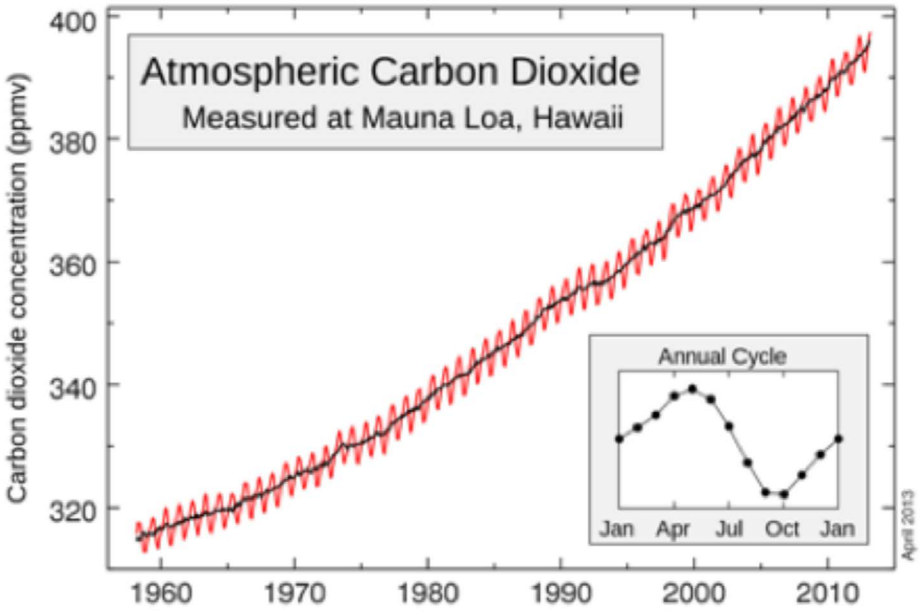
In terms of what the atmosphere sees, a tonne of greenhouse gas is indeed a tonne: the interaction of solar radiation with a tonne of a given GHG is the same regardless of its source, and this is the foundation for accounting for what is emitted into the atmosphere, or absorbed by sink. However, this is a very incomplete view of the carbon fluxes from the different sources and sinks; in particular, in ignores the timescales for fluxes in different parts of the overall carbon cycle. This is important for any consideration of fungibility between the cycles.



Biological and fossil parts of the carbon cycle operate in different cycles, on different timescales.[1]

The fossil carbon found in fossil fuels was mostly laid down in the carboniferous period 359.2 to 299 million years ago, and is only now being released through their anthropogenic use. The large scale weathering of carbon back

into the geosphere takes place also on geological time scales (thousands to millions of years).
In contrast, the fluxes of carbon through the biosphere operate over much shorter timescales than the geological ones, allowing rapid emissions - through land use changes, fires, insect attacks and reactions to rising temperatures. Photosynthesis allows uptake of CO_2 over a period of years, instead of millions of years: indeed it is the photosynthetic cycles of the northern boreal forests that does much to explain the annual fluctuations in atmospheric CO2 in the famous Moana Loa graph of atmospheric CO_2 concentration[2]:



This difference in timescales, and its policy implications, is something well recognized in earth science, but not so among climate policy makers. For instance, a recent paper[3] stated:

"We bookkeep fossil fuel and deforestation carbon separately, because the larger fossil fuel term is known more accurately and this carbon stays in the climate system for hundreds of thousands of years. Thus fossil fuel carbon is the crucial human input that must be limited".

Permanence

Because of the potentially rapid fluxes in biological carbon, relying biological carbon emission reductions to offset fossil carbon carries real risks of reversibility, so that biological carbon stocks rapidly get released to the atmosphere. A recent study[4] found that for every degree Celsius of warming, the Amazon and other tropical forests will release 53 ±17 billion tonnes of carbon. Intended Nationally-Determined Contributions pledged into the UNFCCC so far, if implemented, would imply warming of a concerning 2.7ºC. Further, another recent study[5] found that many forests won't be able to absorb as much CO_2 as previously projected, as they'll have a shortage of another vital nutrient: nitrogen. The IPCC[6] also noted "Carbon stored in terrestrial ecosystems is vulnerable to loss back to the atmosphere, resulting from increased fire frequency due to climate change and the sensitivity of ecosystem respiration to rising temperatures" Not burning fossil fuels is a permanent means of not increasing atmospheric loading of CO_2.

In the CDM, eligible land use, land use change and forestry (LULUCF) activities have tried to overcome the permanence issue by issuing temporary Certified Emissions Reduction (tCER) credits, but these have proved unpopular in the marketplace: The CDM allows the use of certain types of biological carbon, including afforestation and reforestation (A&R), to be traded as offsets. The standing approach for addressing the risk of non-permanence in LULUCF CDM projects is by issuing temporary credits (tCERs and lCERs), which expire at the end of the commitment period during which the CERs were issued. These have proven unattractive for investors: A&R projects represent 0.8% of the total number of projects to date[7]. Despite this, there is pressure to include additional types of biological carbon in the CDM, including agroforestry and silvopastoral practices, cropland and grazing land management, and wetland drainage and rewetting.

Land area limits

Other than the fundamental factor of different flux timescales, there are other, practical, biogeophysical limits to treating fossil carbon and biological carbon as fungible. There are land area limits that raise concerns for relying too heavily on biological carbon to offset fossil emissions. One study[8] found that for every gigatonne of carbon removed by tropical afforestation would require at least $7 \times 1 \quad 0^6$ ha yr^{-1} of land (roughly the area used for irrigated oil crops[9]), 0.09 Mt y^{-1} of nitrogen, and 0.2 Mt y^{-1} of phosphorous. Development agencies are increasingly raising concerns on land use decisions connected with climate mitigation and food security, which are relevant considerations for certain types of land use mitigation activities. This is not to say, of course, that ecosystem restoration on a large scale is needed: forest areas the size of Panama are lost each year[10], eroding biodiversity, impoverishing soils and affecting local and regional hydrology. Estimates vary, but deforestation and degradation account for around 10% of global greenhouse gas emissions[11]. Addressing these emissions needs to be a priority, but needs to be addressed at the same time and in parallel to ending the use of fossil fuels.

Conclusion

If CO_2 emissions from fossil fuels were offset by absorption into the biospheric carbon cycle, this would require both the biosphere to remain a stable sink and for a massive increase in the land area to be covered in high carbon biomass. It would also fundamentally misunderstand or ignore the different timescales of the carbon fluxes through the respective carbon cycles.

Action to rapidly reduce emissions from both biological and fossil sources is needed, but in parallel. Both are sources of emissions that need to be addressed in order to avoid dangerous climate change impacts, but their different characters through the whole of their respective carbon cycles means that they are not fungible with each other, and climate policy instruments need to recognize this.

Offset credits from REDD+, afforestation and reforestation or other biological systems should not be used to offset any use of fossil carbon.

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2. C. D. Keeling, S. C. Piper, R. B. Bacastow, M. Wahlen, T. P. Whorf, M. Heimann, and H. A. Meijer, Exchanges of atmospheric CO_2 and $^{13}CO_2$ with the terrestrial biosphere and oceans from 1978 to 2000. I. Global aspects, SIO Reference Series, No. 01-06, Scripps Institution of Oceanography, San Diego, 88 pages, 2001.
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6. IPCC, 2014, Working Group 2: Impacts, Adaptation and Vulnerability
7. http://www.cdmpipeline.org/cdm-projects-type.htm
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