Bioenergy

a carbon accounting time bomb

BirdLife International

European Environmental Bureau

Transport & Environment

Background: a carbon accounting time bomb

The European Union (EU) established a 20% target for renewable energy use by 2020 and a 10% target for renewables in the transport sector by 2020. Bioenergy, including solid biomass and waste, is expected to represent 60% of the EU's renewable energy use and biofuels is expected to cover most of the 10% renewable energy use in transport. Widely perceived as carbon neutral, new studies reveal that these policies could be increasing emissions compared to fossil fuels.

Two studies commissioned by BirdLife International, EEB, and T&E show that Europe has a major carbon accounting problem, threatening the credibility of two flagship EU environmental policies: the Renewable Energy Directive (RED) and the Emissions Trading Scheme. Under EU accounting rules, burning bioenergy is considered to be "carbon neutral" despite the release of significant greenhouse gas (GHG) emissions in the short-medium term, turning bioenergy into a misguided policy tool for achieving emissions reductions. The best available scientific evidence shows that the carbon costs of many bioenergy options are high. Bioenergy causes losses of carbon to the atmosphere from vegetation and soils when biomass is harvested. And biofuels cause losses of carbon to the atmosphere when land is converted - either directly or indirectly - to meet the increased demand for agricultural crops.

Two principle gaps exist in the current accounting scheme for GHG emissions from bioenergy and biofuels, one temporal and one spatial in nature:

> **Carbon debt.** Harvesting forest biomass and associated management changes and conversion of land, releases immediate and significant GHG emissions - creating a carbon debt - that can take decades or even centuries to repay through recapture in soils and vegetation. The time element is ignored under EU law, which means that carbon reductions on paper in 2020 do not correspond to what is happening in reality.
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> **Carbon laundering.** For the purpose of reporting under the UNFCCC, emissions from burning biomass are allocated to the "land use, land use change and forestry" (LULUCF) sector, not the energy sector. Those emissions, however, are not always accounted for in countries' reduction obligations since countries can opt not to include emissions from "forest management." In addition, the accounting system under the Kyoto Protocol counts only those emissions occurring in Annex 1 countries[1], allowing emissions from a decrease in forest stocks in non Annex-I countries to be excluded. This means that when non-Annex 1 countries export biomass to Annex 1 countries, not only are the emissions from harvesting not accounted for, but neither are the emissions that occur when the biomass is burned. This accounting gap is only partially solved by the RED sustainability criteria which only calculate the emissions related to direct land use change. Indirect land use change (ILUC) is still being ignored.

While both studies presented here concentrate on carbon, it must be noted that other environmental impacts, such as loss of biodiversity and ecosystem services, are also significant and must be considered in policy decisions on bioenergy and biofuels.

1. Annex 1 countries are those that have an emission reduction obligation under the Kyoto Protocol (i.e. "the industrialized countries") .

Carbon debt
of woody biomass

The carbon debt created when woody biomass is burned takes centuries to pay off. The result is that biomass can be more harmful to the climate than the fossil fuel it replaces.

This study suggests that while recovering waste biomass can have short term emission reduction benefits, increasing the harvesting of standing forests will mostly lead to worsening of the climate crisis- and that is before even starting to look at other impacts such as biodiversity loss or increased erosion.

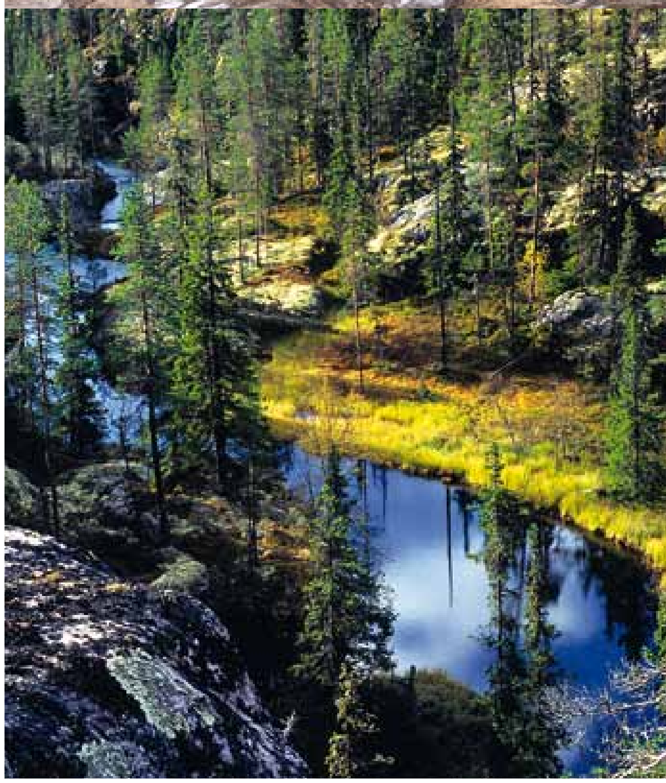
This section is based on the following report: "Bird N., Pena N. & Zanchi J., The upfront carbon debt of bioenergy, Graz, Joanneum Research, June 2010". An electronic version of the report can be found at: http://www.birdlife.org/eu/EU_policy/Biofuels/carbon_bomb.html

The European Commission - DG Energy - estimates that bioenergy demand in 2020 will require 195 Mtoe[2] of biomass. Energy generation from solid biomass and biowaste will be 58% of the total renewable energy generation in 2020 (140 Mtoe of 240 Mtoe), covering 12% of the gross energy demand. Although quantifying emissions is scientifically possible, no full assessment was performed to determine the GHG implications of the EU-RED policy. This study focuses on filling a critical gap in these assessments.

In this study, emissions are quantified through a so-called Carbon Neutrality (CN) factor. The factor is defined as the ratio between the net reduction or increase of carbon emissions in the bioenergy system and the carbon emissions from the substituted fossil fuel system - the fossil fuel comparator - over a period of time. Because initial emissions from bioenergy and biofuels can be higher than those from fossil fuels due to lower efficiency and land-based carbon stocks changes, bioenergy only starts to deliver atmospheric benefits after the passage of time. The turning point occurs when recovery of carbon stocks equals the cumulative fossil fuel emissions avoided by use of biomass. The study looks at the carbon stock emissions, addressing an area that has been largely ignored in previous studies. It does not examine other sources of emissions, such as transport and processing, because those impacts have been analysed and quantified elsewhere.

The study revealed that biomass for bioenergy can have variable climate mitigation potentials, depending on the timeframe considered and the source of the biomass. This can be calculated by assessing the development of the carbon neutrality factor (CNC) over time:

- Additional logging for bioenergy can produce a decrease of the overall carbon stock in managed forests, which will significantly affect the GHG balance of the bioenergy system. In the short-medium term (20-50 years), additional felling[3] could emit more



2. Million tons of oil equivalent
3. Calculation based on additional harvesting taking place in a rotation forest in Austria of 60 ha. In a 60 year rotation period, 1 ha of forest is cut each year.

carbon than a fossil-fuel system (CN<0). In such a case, the biomass would only begin to produce benefits after 2-3 centuries (see Figure 1).

- Harvested residues are often discarded on the forest floor. When extracted for bioenergy, there is a loss in the amount of dead wood, litter and organic material in the soil, leading to a carbon loss. It is estimated that the GHGs are reduced by such bioenergy material in a 20-year timeframe by 60-90 % (CN=0.6-0.9) which is however still significantly different than carbon neutrality.

- Land conversion causes carbon stock changes - by removing vegetation and ploughing the soils to grow bio-energy feedstocks - leading to GHG emissions. If there is an initial carbon loss, such as conversion from a mature forest into fast growing plantations, the biomass will only produce climatic benefit after 150-200 years. However, when the carbon stock change is zero or positive, such as when cropland is converted into forest, the biomass system can be carbon neutral[4].

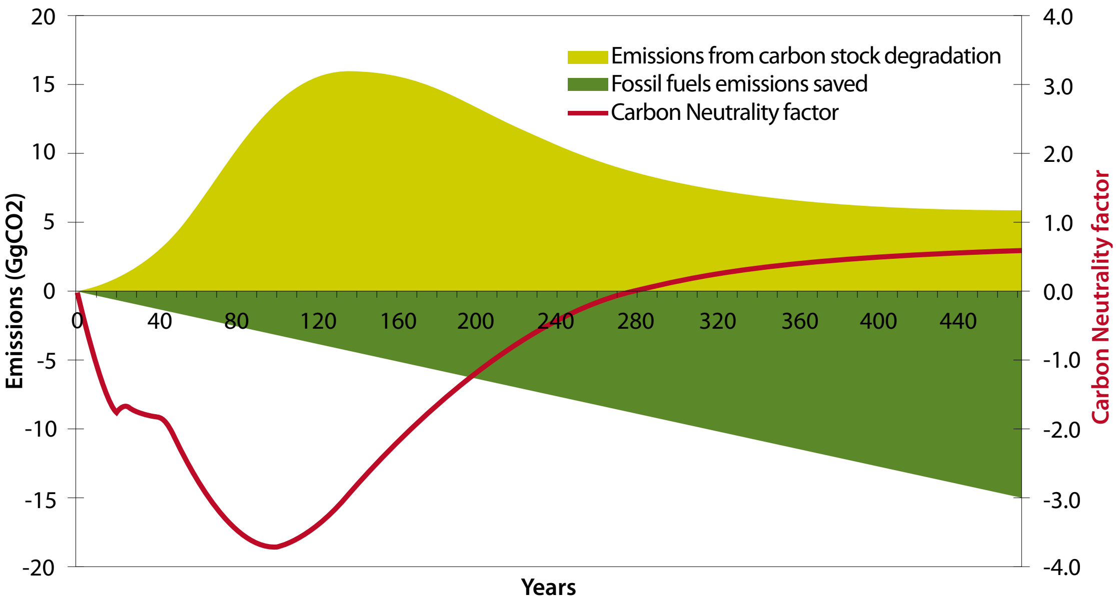


Figure 1: Graph showing the interplay of emissions from harvesting and burning biomass versus savings from fossil fuel replacement in the case of additional felling in a typical European managed forest, with wood used to replace coal in power generation. The red line shows the evolution of the carbon neutrality factor: biomass use in this case leads to increased emissions for the first two and a half centuries. Note that in the emissions ('green") graph, positive values mean emissions while negative mean emission savings. Conversely, in the case of the carbon neutrality factor ('red graph'), negative values mean net emissions while positive values mean net savings.

4. Although this study did not assess the indirect land use change impacts of for example converting cropland into forest, the study by CE Delft -presented later in this paper- shows that this impact can be very significant.

Carbon laundering

biofuels and indirect land use change

Growing biofuels on agricultural land results in the conversion of forests and other natural areas into cropland to replace those agricultural lands lost to biofuels production. This results in related emissions that can completely negate any climate benefits.

The scientific evidence is growing that most current biofuels have very poor greenhouse gas performance and the majority are actually worse for the climate than the fossil fuels they replace.

This section is based on the following report: "Bergsma G. C., Croezen H. J., Otten M. B. J. & van Valkengoed M.P.J., Biofuels: indirect land use change and climate impact, Delft, CE Delft, June 2010". An electronic version of the report can be found at: http://www.birdlife.org/eu/EU_policy/Biofuels/carbon_bomb.html

The conventional thinking is that biofuels have a carbon benefit, displacing fossil fuels and associated emissions. Biofuels and fossil fuels used in vehicles have, however, comparable tailpipe emissions. Any carbon savings therefore come from the assumption that biofuels feedstocks are carbon neutral: emitting the same amount of carbon as was sequestered during cultivation. This assumption overlooks the fact that carbon would have been absorbed by vegetation on the land. This is exacerbated by the conversion of forests and other natural areas into agricultural land, leading to a reduction in its carbon stock – from forest to cornfield, for example. Forests and natural areas also absorb and accumulate carbon over time, which annual or perennial cropping does not. Therefore, to assess GHG implications from transitioning from fossil fuels to biofuels, it is essential to account for land use and land conversion. Land use changes can be both direct when a forest itself is converted to cropland for biofuels feedstocks, and indirect when current agricultural land is used for biofuels production, which means that existing crop production moves into natural areas. See Figure 2.

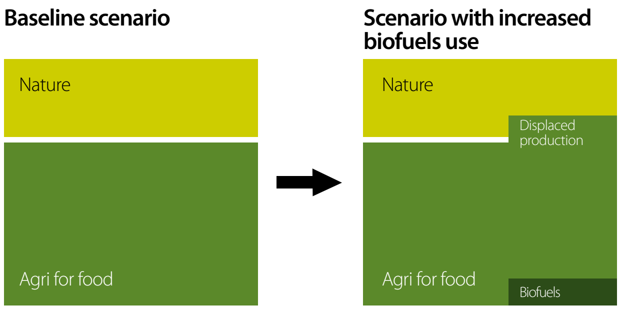


Figure 2: Schematic representation of indirect land use change mechanism. Agricultural land currently used for food production is taken for biofuels feedstock and food production is displaced into newly cleared land. When natural habitats such as forests and grasslands are converted to agriculture, their carbon stock is lost. These emissions can often be greater than those caused by burning fossil fuel. Thus producing the same amount of energy as the biofuels triggering the displacement.

Indirect land-use change (ILUC) has been the subject of a significant number of studies. Some of these studies have estimated emissions on the basis of agro-economic models, whilst others have taken a risk based approach, which serve as a worst-case scenario. A review by CE Delft shows that, under a risk-based approach, the estimated 70 million tonnes of CO_2 reductions under EU's biofuel policy are dwarfed by the 270 million tonnes of CO_2 emissions from land-use change. Even under more conservative agro-economic models, ILUC would result in 70 million tonnes of CO_2 emissions, resulting in no net carbon benefit.

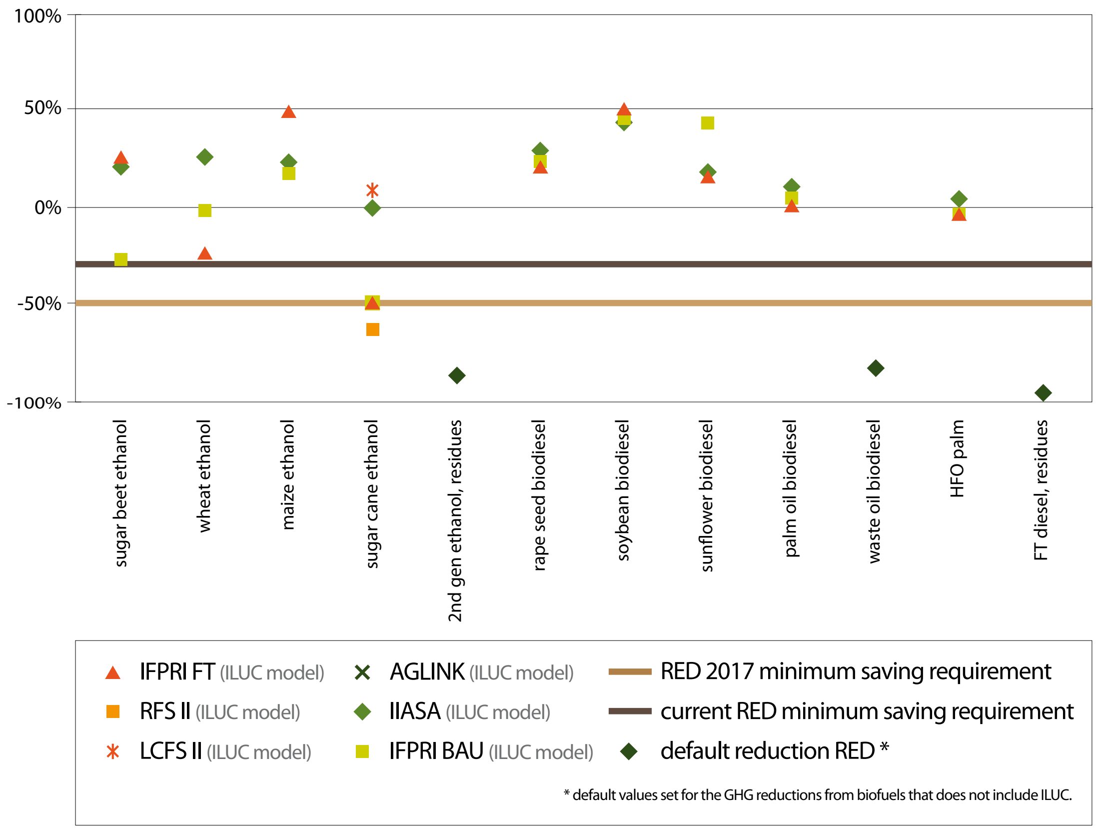


Figure 3 The graph shows the results of different ILUC models and how their results for emissions from biofuels compare to the thresholds set by the Renewable Energy Directive. The graph demonstrates that, when indirect land use change effects have been added to the default GHG savings of biofuels, only sugar cane ethanol and waste biofuels still meet the 35% and 50% thresholds for GHG reductions from biofuels use that apply under the Renewable Energy Directive (RED). Other biofuels result either in no GHG savings or even in net emissions increase compared to petrol and diesel.'

According to the study, ILUC effects can be partially mitigated by ensuring additional carbon growth, such as increasing yields or increasing productivity of abandoned or degraded lands in a sustainable way without damaging biodiversity. It can also be avoided by using waste products as biofuels where no land is required to produce it and it does not conflict with more efficient uses, such as a soil improver. Strong policies are needed, however, in order to guide the right decisions of the companies.

Conclusions and solutions

Bioenergy and biofuels can still contribute to climate change mitigation, but only if we use technologies and feedstocks that truly deliver timely savings. Honest accounting is the critical first step.

The financial crisis has taught us that basing policy on rigged accounting is not a good idea; this is as true for carbon accounting as for financial accounting.

These two studies have revealed that unless a number of urgent measures are taken, the EU's renewable energy policy, an EU flagship policy to combat climate change, is very likely to lead to an increase in carbon emissions. For it to remain a flagship of EU climate policy, a growth in renewable capacities will need to be coupled with strong policies to increase energy efficiency and reduce demand. The development of renewable energy capacities will need to take full account of the physical limits the environment poses.

At present, the European Commission is preparing an assessment of the ILUC effect of biofuels policy and a proposal for tackling the problem. Without proper accounting of ILUC emissions, the use of biofuels is likely to undermine the EU's efforts to tackle climate change.

In the short term, according to the study, the only viable policy measure to ensure emission savings is the application of an ILUC factor. Such an ILUC factor would correct the overestimated climate benefits for biofuels, taking into account all land-use-based emissions, including those caused by displacement. The actual values are already calculable for most common feedstocks, and others may rely upon a default factor of 60 g CO_2/MJ until actual values can be determined. The default value can be reduced or removed when evidence is provided that the feedstock does not use land - waste and residues - or results from increased crop yields.

The situation regarding biomass for energy is more problematic because the European Commission has recently decided against developing legally binding sustainability criteria before 2011 at the very earliest. It is vital that the European Commission reverses this decision and puts in place robust mandatory sustainability standards including minimum thresholds for greenhouse gas savings.

Given the urgent need to reduce GHG emissions in the short-term i.e. the next 10 to 40 years, only biomass that delivers positive GHG gains compared to fossil fuels over a 20-year period should be allowed to qualify for meeting the 20% renewables target. In practical terms, this means limiting bioenergy to certain feedstocks, such as certain waste streams where this does not compete with other uses, new plantations on abandoned land with little biodiversity value, or carefully managed systems in which proven increased growth is stimulated by forest management.

Getting the carbon accounting right is absolutely crucial. However, it is far from the full story. Bio-energy production can have very severe impacts on biodiversity, water and other natural resources and on vulnerable human populations. Comprehensive, watertight, legally binding and well implemented sustainability standards are absolutely vital in order to ensure that bio-energy can truly live up to its promise of being "green energy".

BirdLife International
BirdLife International is a global Partnership of conservation organizations that strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources. The BirdLife Partnership operates in more than 100 countries and territories worldwide. BirdLife International is represented in 42 countries in Europe and is active in all EU Member States.

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European Environmental Bureau – EEB
The EEB is a federation of more than 140 environmental citizens' organisations based in all EU Member States and most Accession Countries, as well as in a few neighbouring countries. These organisations range from local and national, to European and international. The aim of the EEB is to protect and improve the environment of Europe and to enable the citizens of Europe to play their part in achieving that goal.

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Transport Environment – T&E
T&E is an independent pan-European association with scientific and educational aims, with no party political affiliation and devoid of any profit making motive. T&E's mission is to promote a policy of transport and accessibility, based on the principles of sustainable development, which minimises negative impacts on the environment and health, use of energy and land and all economic and social costs, maximises safety, and guarantees sufficient access for all. Established in 1990, T&E represents around 50 organisations across Europe, mostly environmental groups and sustainable transport campaigners.

E-mail: info@transportenvironment.org - http://www.transportenvironment.org

Studies used as basis for this report:

- Bird N., Pena N. & Zanchi J., The upfront carbon debt of bioenergy, Graz, Joanneum Research, June 2010 can be found at: http://www.birdlife.org/eu/EU_policy/Biofuels/carbon_bomb.html
- Bergsma G. C., Croezen H. J., Otten M. B. J. & van Valkengoed M.P.J., Biofuels: indirect land use change and climate impact, Delft, CE Delft, June 2010 can be found at: http://www.birdlife.org/eu/EU_policy/Biofuels/carbon_bomb.html

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