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Comments on the EC proposal for amendment of the Renewable Energy and Fuel Quality Directives

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Summary

On 17 October 2012, the European Commission presented a proposal[1] for adapting EU legislation related to biofuels (the Renewable Energy Directive (RED[2]) and the Fuel Quality Directive (FQD[3]), to also take into account the excess greenhouse gas emissions resulting from indirect land-use change (ILUC).
Our main conclusions on the proposal by the European Commission with respect to indirect land-use change (ILUC) are:

- the proposal for the amendment of the Renewable Energy Directive related to reducing ILUC emissions by implementing a cap of 5% on biofuels from agricultural crops can only be effective if the Fuel Quality Directive is also attuned to this approach – this is not the case in the current proposal for this directive;
- counting the emissions twice and four times for different types of biomass in the proposal for the Renewable Energy Directive is not effective for stimulating development and market integration of the presently expensive innovative options that have great potential in the long term, including electric and hydrogen vehicles;
- reporting on ILUC emissions that are related to biofuels can only be useful for evaluation purposes if it is based on monitoring data about global land use and agricultural developments; it is recommended that a method is developed for combining existing monitoring data and modelling results.

[1] COM(2012)595 final
[2] OJ L 140/16
[3] OJ L 140/88

Introduction

On 17 October 2012, the European Commission presented a proposal[4] for adapting EU legislation related to biofuels (the Renewable Energy Directive (RED[5]) and the Fuel Quality Directive (FQD[6]), to also take into account the excess greenhouse gas emissions resulting from indirect land-use change (ILUC). The aim of the proposal is to limit global land conversion for the purpose of biofuel production, and raise the climate benefits of biofuels used in the EU. The proposal includes the biofuel contribution to two policy targets:

1. a share of 10% renewable energy in transport by 2020 (RED);
2. a 6% reduction along the production chain (well-to-wheel balance) of fuels for transport by 2020 (FQD).

This paper discusses some of the main impacts of the proposal. There are four particular issues – elaborated in this paper – that require careful consideration:

1. a consistency in the approaches adopted in both directives;
2. the need to stimulate sustainable, advanced biofuels that have great long-term potential;
3. the opportunity offered by the amendment of these directives to stimulate zero-emission vehicles, thus bringing it into alignment with the objective of making a transition towards a low-carbon transport system
4. the need for reporting in order to evaluate actual global ILUC emissions.

Studies have shown that ILUC emissions are an important issue to consider in the environmental benefits of biofuels, although the issue is complex and by definition surrounded by uncertainty and, therefore, difficult to come to grips within a policy context (see Ros et al. (2011) for an explanation of the principles of ILUC emissions).

Consistency in approach for both Directives

The European Commission's ILUC proposal includes a cap of 5% on the contribution of biofuels produced from food crops to the transport-fuel target of 10% in the Renewable Energy Directive. The proposal does not include a cap on the contribution of such biofuels to the 6% emission-reduction target in the Fuel Quality Directive.
There are four main options for realising the 6% emission reduction along the production chain of transport fuels, as required in the Fuel Quality Directive:

1. *Application of biofuels produced from food crops*.
   If the contribution of these biofuels to the target in the Renewable Energy Directive would be limited to 5% (about the current contribution) and the average direct emission reduction would be about 50% to 60%, their contribution to the target in the Fuel Quality Directive would be between 2.5% and 3%. However, because the EC proposal, for the Fuel Quality Directive, does not foresee in a cap, the contribution of biofuels towards achieving the directive's 6% target could be higher. Moreover, the 5% cap in the Renewable Energy Directive is an administrative measure, as it does not include a ban on the production of biofuels that are based on oil, sugar or starch crops.
2. *Application of biofuels based on non-food biomass*.
   The proposal for the Renewable Energy Directive includes a list of more sustainable types of biomass (without causing indirect land-use change (ILUC)). The incentive

[4] COM(2012)595 final
[5] OJ L 140/16
[6] OJ L 140/88

to use this biomass is increased by counting their contribution to the remaining 5% of the Renewable Energy Directive target twice or even four times. Therefore, the actual contribution of these biofuels is expected to be not larger than 2%. With an average estimated emission reduction of about 75%, the contribution of these biofuels to the target of the Fuel Quality Directive is about 1.5%.

3. *Emission reduction measures for refineries*.
   The emissions from refineries contribute for about 10% to the total well-to-wheel emissions. Therefore, every 10% in emission reduction would imply a contribution of 1% to the target of the Fuel Quality Directive. Technically, there may be options to realize even more reductions, but the costs are not well-known. It is possible that this option is too expensive to compete with biofuels produced from food crops (option 1), as suggested by a representative from a Dutch refinery (pers. comm.), but there might be cheaper options, as well.
4. *Large-scale use of electric and/or fuel-cell cars*.
   In theory, this is an option to reduce the emissions from transport. However, by 2020, the share of these cars in the total European fleet is expected to be only limited. Moreover, this option's contribution to lowering emissions in actual practice, depends on the actual emissions from electricity generation. Therefore, for 2020, our estimate is that the potential of this option to achieve the target of the Fuel Quality Directive will be small.

Example of the calculation of the contribution of electric vehicles (EV) to the 6% transport target of the Fuel Quality Directive:

1. The current proposal is based on emissions per unit of energy: if 1% of the kilometers driven in a vehicle with a combustion engine would be replaced by kilometers driven in an EV, 1% of the energy in fossil fuel would be substituted by only about 0.4% (1/2.5) of electricity, because electric vehicles are more efficient.

2. To correct for this difference in efficiency, a factor 2.5 is introduced in the Directive; in this example with this factor the contribution is set to 1%.

3. The emissions related to power generation are based on the current emission level, strongly based on the emission factors of coal- and gas-fired plants. In case of an average emission of 400 g CO_2/kWh, a share of 1% of EVs would result in an emission reduction of almost 0.5% (considerably less than the same amount substituted by sustainable biofuels).

4. Alternative approach for EV: if the emissions related to power generation are assumed to be zero, the contribution of EVs would be 1%. This assumption would be based on close-to-zero emissions from power generation in the future, which is an important argument to stimulate EVs in the first place. Such an approach would be a good example of transition policy.

The proposed administrative cap in the Renewable Energy Directive of 5% for biofuels produced from food crops is not a restriction to the application of these biofuels to achieve the target in the Fuel Quality Directive. Therefore, by considering the above mentioned options, a contribution of 4% to 4.5% of food-crop-based biofuels to the emission target in the Fuel Quality Directive cannot be excluded, and would equal a renewable energy share in fuels of up to 8% or 9%. If an approach to limit ILUC emissions similar to one proposed by the European Commission in the Renewable Energy Directive would be applied in the Fuel Quality Directive,

this would result in a cap of about 3% (half of the target) for the contribution of food-crop-based biofuels to achieve the target of the Fuel Quality Directive. In case cheaper emission reduction measures would be feasible for refineries, such a cap would be a 'no regret' measure. In case, measures applied to refineries would be more expensive, such a cap would be essential to restrict ILUC-emissions.
In its proposal, the European Commission has chosen for a cap instead of addressing ILUC-related factors in order to limit emissions from ILUC in the Renewable Energy Directive. Since these factors are not constant values but the result of the dynamic interaction between new biofuel production and the global physical economic system (Ros et al., 2011), the EC's approach is a simple and efficient alternative.
The target in the Fuel Quality Directive is one of emission reduction and it would seem only logical to also include emissions from indirect land-use change (ILUC). However, including emissions from ILUC in combination with an overall 6% well-to-wheel emission reduction target has certain disadvantages:

a. There would be a shift from oil crops because of the relatively high ILUC emission-factor in the proposal (even negative net emission reductions can be expected) towards (some) starch and sugar crops with a relatively low ILUC emission-factor. This would mean that investments, especially in biodiesel production will not be recovered.
b. In case emission reductions per MJ of biofuel are lowered due to the inclusion of ILUC emissions, the application of biofuel would need to be increased, in order to meet the reduction target.
c. Because of the uncertainties in the real effects of ILUC emissions (which can be quite different from the proposed ILUC emission factors), a) and b) may still lead to undesirable or even increasing indirect land-use change effects.

A reconsideration of the greenhouse gas emission reduction target in the Fuel Quality Directive seems justified. Aiming for an emission reduction without including ILUC emissions is just a reduction on paper and ignores the real-world impact of biofuel production. The aim to stimulate innovation and market entrance of more sustainable biofuels – something that is necessary to realise a low-carbon energy system in the future – has already been dealt with in the Renewable Energy Directive, and the emission reduction target in the Fuel Quality Directve does not seem to add anything to that. Although this reduction target could indeed be an incentive for emission reductions at refineries, these emissions are already part of the EU Emissions Trading System (EU ETS). In conclusion, the following policy options can be distinguished for the Fuel Quality Directive:

1) No emission reduction target (as the Renewable Energy Directive stimulates the use and production of advanced biofuels, and the EU ETS stimulates emission reductions at refineries);
2) An emission reduction target of 3%, excluding biofuels based on food crops;
3) An emission reduction target of 6% with a cap of 3% for the contribution of biofuels based on food crops (ILUC emissions not included).

Extra incentive for sustainable biomass

The European Commission's proposal regarding indirect land-use change (ILUC) intends to stimulate the use of more sustainable types of biomass for biofuel production. For that purpose, a list of feedstocks other than food crops[7] is included. The contribution of biofuels produced from these feedstocks to the 10% renewable energy target for transport is increased by a factor

[7] Cereals and other starch-rich crops, sugars and oil crops

or 2 to 4 in the EC's proposal. This double or four double counting can be regarded as an extra stimulation for the production of advanced biofuels. However, because of the cap of 5% on the share of food-crop-based biofuels, which is about equal to the current share, the other 5% have to be realized mainly with those more sustainable biofuels. So, main purpose of this double and four double counting is to achieve the 10% renewable energy target, on paper. In fact, the EC's proposal shows that the development of technologies and new production capacity based on sustainable biomass is considered to be of greater importance than achieving a volume of 10% by 2020.
The following three general categories of biofuels can be distinguished (see also Annex 1 for indicative assessments):

1. biofuels produced using relatively simple, established technologies based on food crops that have been cultivated on arable land – this is likely to involve relatively large amounts of emissions from indirect land-use change;
2. biofuels produced by relatively simple, established technologies based on waste and residues with limited potential for future supply;
3. biofuels and other transport fuels produced by advanced, more complex technologies that are still in development, based on residues with substantial potential for future supply.

The volume of biofuels in Category (1) is restricted by the EC's proposal because of the related and possible large amount of ILUC emissions. The biofuels in Category (2) are available in the short term to contribute to achieving the general emission reduction and renewable energy targets, but due to their limited volume they can only play a relatively small role in any long-term solution. The biofuels in Category (3) could play an important role in a sustainable, low-carbon energy system in the long term, but their realisation depends on the progress made in RD&D. In the short term, their price–performance ratio is unfavourable to compete with the options in Categories (1) and (2).
In case further development of the techniques in Category (3) would require large-scale demonstration plants or new substantial niche markets, additional and specific stimulus would perhaps be an effective instrument to increase their contribution to the 10% targets. To achieve this, the Renewable Energy Directive could set conditions to – at least in part – favour them over the biofuels in Categories (1) and (2). However, the distinction made in the EC's proposal between counting emissions twice or even four times does not appear to be based on considerations that relate to these three categories.

Additional incentive for zero-emission vehicles

The long-term aim of the EU is to achieve a low-carbon transport system. Biofuels contribute to this aim, but electric and hydrogen[8] vehicles play a significant role, as well. These last two types of energy are interesting options, because they potentially would generate no emissions and are therefore important technologies in the transition towards a low-carbon energy system. Moreover, electric and hydrogen vehicles are options to prevent the effects from emissions related to indirect land-use change. The current proposal by the European Commission ignores zero-emission vehicles, while their importance in the long term is large.
Zero-emission vehicles – whether electric or hydrogen – constitute a complex system option in the transition towards a low-carbon transport system, because this would require simultaneous innovations in various components of the system. The contribution of this option to a low-carbon transport system would depend on the size of the share of electric or hydrogen vehicles as well as on the availability of low-carbon power generation. Both transitions are likely to take many decades to achieve. If stimulation of large-scale deployment of zero-emission vehicles

[8] Hydrogen can be produced using electricity

would not start until clean electricity is readily available valuable time will be lost – since the technological development of zero-emission vehicles will also take time to reach market maturity. More effective, from a system innovation perspective, would be to stimulate both clean power generation and zero-emission vehicles, simultaneously.
The Renewable Energy and Fuel Quality Directives offer the possibility of stimulating innovations related to zero-emission vehicles by introducing new impetus to increase the use of electricity in transport. By introducing such an impetus, a specific incentive is introduced for an innovation that looks promising for the long term and is not associated with indirect land-use change. The Renewable Energy Directive already includes measures to achieve a factor 2.5 increase in electric vehicle use, but this is a correction factor rather than an additional stimulus; electric vehicles use 2.5 times less energy per kilometer compared with vehicles powered by combustion engines. Therefore, on the assumption that future electricity production will be (almost) free of emissions, an incentive towards electric and hydrogen vehicles would be more effective if these technologies could be regarded as 100% renewable, thus justifying counting their effect on emissions fourfold in the Renewable Energy Directive and considering these related emissions to be zero in the Fuel Quality Directive (see boxes).

Example of the calculation of the contribution of electric vehicles (EVs) to the 10% renewable energy target in transport in the Renewable Energy Directive:

1. The current proposal is based on emissions per unit of energy: if 1% of the kilometers driven in a vehicle with a combustion engine would be replaced by kilometers driven in an EV, 1% of the energy in fossil fuel would be substituted by only about 0.4% (1/2.5) of electricity, because electric vehicles are more efficient.

2. To correct for this difference in efficiency, a factor 2.5 is introduced; in this example with this factor the contribution is set to 1%.

3. At this moment, the share of renewable electricity is limited to about 30%. Therefore, the actual contribution to the target will be 0.3%. There is no additional double counting or more for this electric driving.

4. Alternative approach for EV: if electricity is regarded as 100% renewable and it's contribution to the Renewable Energy Directive target could be considered to counts four times, it would contribute 4% to the target. It would be an alternative transition policy approach to compensate for a missing electrification target.

5. For comparison with the current proposal for sustainable biofuels: if 1% of fossil fuels is substituted by sustainable biofuels it contributes 4% to the target.

Reporting on emissions from indirect land-use change

The proposed amendments to the Renewable Energy and Fuel Quality Directives include the requirement to report on emissions from indirect land-use change (ILUC). For that purpose, ILUC emission factors are introduced for groups of biofuels or more specifically for types of feedstock. However, the added value of this type of reporting based on fixed factors seems to be very limited. It would be much more informative to report on actual ILUC emissions. However, they cannot be monitored directly.
As explained earlier (Ros et al., 2011) an ILUC emission factor is not a fixed characteristic of a biofuel/crop combination, they represent the interaction between additional demand for biofuel

and the global physical economic system. Developments, especially in global land use, land-use change, food consumption and agricultural productivity, are related to the effects of indirect land-use change. Existing monitoring systems (e.g. that of the FAO) deliver data on these issues. It would therefore be more interesting to combine these data with biofuel-production data (including data on land use and by-products).
Which leaves the question of how these data could be combined in a meaningful way. The insights obtained from models and model calculations are helpful in this respect. A first attempt to develop such a method is presented by Overmars et al. (2011). For the Netherlands, this type of method has been applied to report on the emission effects of biofuel use, also taking the substantial uncertainties into consideration (PBL's Assessment of the Human Environment 2012). An evaluation based on this kind of analysis could be helpful for a better assessment of the actual ILUC effects, and be used in future amendments to the EU Directives.

Conclusions and recommendations

Our main conclusions on the proposal by the European Commission with respect to indirect land-use change (ILUC) are:

- the proposal for the amendment of the Renewable Energy Directive related to reducing ILUC emissions by implementing a cap of 5% on biofuels from agricultural crops can only be effective if the Fuel Quality Directive is also attuned to this approach – this is not the case in the current proposal for this directive;
- counting the emissions twice and four times for different types of biomass in the proposal for the Renewable Energy Directive is not effective for stimulating development and market integration of the presently expensive innovative options that have great potential in the long term, including electric and hydrogen vehicles;
- reporting on ILUC emissions that are related to biofuels can only be useful for evaluation purposes if it is based on monitoring data about global land use and agricultural developments; it is recommended that a method is developed for combining existing monitoring data and modelling results.

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Annex 1

The table below presents a concise analysis of the more sustainable types of biomass, gives an indication of their long-term potential to contribute substantially to a low-carbon system, and discusses the status of the production technology of the biomass and conversion technologies.

Type of biomass	**Multi-plica-tion factor**	**Potential long term supply (indica-tive)**	**Source of biomass**	**Technology of conversion into biofuels**
Renewable liquid and gaseous fuels of non-biological origin	4	+++	Not based on biomass; The most common origin is electricity produced from renewable energy (wind, solar, water, geothermal); the potential to produce low-carbon electricity in future is high (with a large share of renewables)	Production of hydrogen by electrolysis is well-known, but large-scale application might stimulate further cost reduction; fuel-cell vehicles require further development to improve the price–performance ratio (in the phase of first niches) New development is the synthesis of liquid fuels or methane from hydrogen and carbon dioxide (from biomass or fossil)
Renewable electricity	1	++/+++	Electricity can be produced from renewable energy source such as biomass, wind, solar, water, geothermal	For transport, electricity storage (batteries) is the real challenge; the price–performance ratio of batteries has to be improved; partly in the phase of R&D but also moving from incidental demonstrations to niche markets or small shares of the global market
Algae	4	o / ++	Short-term, low potential (expensive), but for the long term possibly quite high, depending on future costs of the production process, which is still in the phase of fundamental research and small-scale demonstrations (at this moment only profitable for the production of specific chemicals);	Technologically not the most critical step; if drying is included in this step the energy needed is the main point of attention; in the present situation the energy input–energy output ratio is very unfavourable
Biomass fraction of mixed municipal waste	4	+	Waste stream (probably not the organic fraction which can be composted or specific fractions such as paper or plastics)	In the present situation in land filling (with the potential of methane production, mostly for local use) or incinerated (with the potential of electricity and heat production); production of liquid fuels unlikely
Straw	4	++	In the short term, a reasonable option, and in the long term even quite substantial. It depends on the need to add straw to the agricultural soil for quality reasons. It needs new infrastructure and the use of developed	Technology to produce biofuel from straw is in the phase of demonstration plants: • Advanced fermentation to produce ethanol; straw is already used in some production plants

			pretreatment processes. There are different types of straw with very different qualities.	• Gasification to produce syngas; by Fischer-Tropsch synthesis (a well-known process) biodiesel, methanol, ethanol, DME can be produced. Straw is not used yet in pilot gasification plants
Animal manure	4	o	The energy content of animal manure is quite low (because the animals have used most of it), but there are differences between the manure of different animals	Biogas is produced by digestion, a well-known process in practice. Because the biogas energy produced is of the same order of magnitude as the energy needed for the digestion, this technology should be regarded as emission control (no methane emissions from the manure) rather than as energy production
Sewage sludge	4	o/+	The production of sludge will grow with increased global water treatment	Well-known technology
Palm oil mill effluent and empty palm fruit bunches	4	o	Non-tradable waste stream from palm oil production (not in Europe)	Production of biogas for local use is the most likely application
Tall oil pitch	4	+	By-product of wood pulp production	Well-known technology (comparable to esterification of vegetable oils)
Crude glycerine	4	o	Related to biofuel production by esterification based on oil crops; of limited supply in the short term, and for the longer term, probably even smaller supply because of restrictions for biodiesel based on oil crops	Production of biomethanol has been recently developed (in the Netherlands) Glycerin is also added in the co-digestion of manure to produce biogas; this is a well-known technology
Bagasse	4	+/++	By-product of the production of sugar or ethanol from sugar cane; without further stimulus of sugar-cane ethanol, its future potential will be reduced. In the present situation bagasse is mainly used for process energy (heat and electricity) in sugar or ethanol production	It needs an advanced fermentation process to produce ethanol from bagasse. In case bagasse is used for the production of biofuel, it cannot be used for process energy; the impact on the greenhouse gas balance of sugar-cane ethanol is a point of attention
Grape marcs and wine lees	4	o	Related to wine production (or developments on the wine market, overproduction)	Fermentation to produce ethanol or biogas production by digestion
Nut shells	4	+	Related to several food products	(It probably requires advanced technologies; see straw)
Husks	4	+	Related to several food products	Biogas is produced by digestion

Cobs	4	++	Residu of maize	(It probably requires advanced technologies; see straw)
Bark, branches, leaves, saw dust and cutter shavings	4	+/++	The challenge is the organisation and infrastructure for the collection and transport. The potential also depends on the benefits for biodiversity of leaving some of it in the forest	See straw
Used cooking oil (UCO)	2	+	Waste product; the risk of promoting used cooking oil for biofuels is the attractiveness of selling it before it should be regarded as waste; In case UCO was used as animal feed there is also a relationship with ILUC	Well-known technology (after pretreatment the same as for other vegetable oils)
Animal fats **	2	+(?)	Waste product	See UCO
Non-food cellulosic material (1)	2	+/+++	Production of timber; sustainability criteria needed; ILUC effects have to be studied; Time dependency in the GHG balance is a point of attention (it takes many years to grow)	See straw; In gasification, wood is the first type of biomass used for further development of the technology
Non-food cellulosic material cultivated on degraded land	2	+/++	Production of perennial crops on degraded land. Only in recent years there has been more research to optimise yields. However, the real barrier is the unattractive business case (relatively low yields, no infrastructure, unattractive locations). In case these energy crops are cultivated on agricultural land significant amounts of ILUC emissions may occur	See straw
Ligno-cellulosic material except saw logs and veneer logs	2	+/++	Waste from wood consumption	See straw; In gasification, wood is the first type of biomass used for further development of the technology