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Short analysis of the RED 2009, the iLUC Directive 2015 and the 2016 RED proposal regarding implications for nature protection

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Summary of main findings

The present study examined the current proposal for the amendment of the EU Renewable Energy Directive (RED). From a nature protection perspective, the RED proposal shows several shortcomings and gaps:

- Minimum target for energy from advanced biofuels in transport may cause a “lock-in” effect for these fuel types, thus effectively preventing increased use of, e.g., renewable electricity in transport.
- The proposed plant size thresholds for solid and gaseous biomass are very high so that most biomass fuels would be exempt from meeting the RED sustainability criteria. Furthermore, a criterion referring to the size of economic operators along the production chain might be more suitable.
- The proposed Art. 26.5 addressing criteria for forest biomass fails to address a number of concerns:
  - Direct land use change effects (e.g. conversion of highly biodiverse grassland to forest plantations, conversion of primary forests, conversion of highly biodiverse forests, conversion of protected areas) are not included.
  - No reference date to allow an assessment of direct land-use change effects is defined.
  - Areas of high conservation value are highlighted but not defined.
  - Additional nature protection-related criteria, e.g. biodiversity-relevant habitat structures, protection against invasive species, and protection and development of a native and site-adapted species composition are absent.
  - More detailed criteria for the protection of soils are missing.
- The RED proposal strongly downgrades the risk mitigation measures for highly biodiverse grassland compared to the existing RED criteria.
- Sustainability of agricultural production is no longer covered.

The paper closes with a discussion of challenges associated with extending the RED focusing on closing identified gaps and addressing the highlighted shortcomings. The paper documents work in progress and does not represent a complete analysis.

1. Introduction

1.1. Background

There are limits to an increased use of biomass for energy and material purposes. In addition to biophysical limits, there are competing uses that reduce the available biomass potentials. So-called advanced biofuels are biofuels produced from biomass raw materials that are supposed to not compete with food crops, to have a low impact on other land uses, and to achieve high greenhouse gas (GHG) emission reductions.

The existing RED (Renewable Energy Directive) 2009 includes sustainability requirements in Art. 17 that aim to mitigate main negative impacts from biofuels on biodiversity and climate change. In November 2016, sustainability requirements were revised and extended to also include solid and gaseous biomass in a proposal tabled by the Commission (RED proposal) – alongside with new incentive structures (which might, e.g. include an increased usage of forest biomass): the use of advanced biofuels in transport shall increase from 0.5% in 2021 to 3.6% in 2030 and renewable energy for heating and cooling shall increase annually by one percentage point.

Incentives set out in the RED proposal will result in an increased use of biomass resources like round wood, forest residues and straw, which might be relevant for nature protection. It includes several changes that address the mitigation of negative impacts on biodiversity and GHG emissions. We have analysed potential nature protection impacts of the proposed amendments like requirements for forestry, plant size and changes for highly biodiverse grassland areas. In an expert workshop we aim to raise awareness for nature protection issues and to stimulate the debate on how these aspects may be covered in the design of the RED recast.

As a background document for the workshop, this report briefly analyses the existing legislation (RED 2009 and iLUC Directive) and the RED proposal regarding the coverage of sustainability criteria (Sections 2 and 3). It also highlights challenges for criteria development that aims to take into account nature conservation concerns associated with plant size, sustainability criteria and agricultural production.

2. Sustainability aspects and advanced biofuels in the course of EU energy policy

2.1. Which sustainability criteria were covered by the RED 2009?

The RED of 2009 includes sustainability requirements in Art. 17 that aim to mitigate main negative impacts of the production and use of biofuels on biodiversity and climate change (Table 2-1). Biodiversity and mitigation of climate change are considered as global subjects of protection under the WTO regulations, and it is in principle allowed to set up regulations within the EU that affect production conditions in third countries. Sustainability requirements for other environmental issues (water, soil, air) and for social issues (land use rights, labour rights, food security), however, are mainly local or regional subjects of protection. Their regulation in third countries by the EU is not compatible with WTO regulations, thus they have been excluded from the RED.

It is important to notice that the RED aims to mitigate main negative effects resulting from the **utilisation of biofuels** on biodiversity and GHG emissions. It does not aim to comprehensively address or regulate protection of biodiversity or the atmosphere. This is a fundamental difference to, e.g. nature conservation legislation.

However, the RED 2009 shows clear gaps, especially when considering solid fuels:

- Protection of highly biodiverse forests that are not primary forests is not covered by the RED;
- Sustainability requirements for forest management are absent;
- Sustainability requirements for agricultural production within the EU are rather weak (cross-compliance rules only) and they are absent outside of the EU.

Table 2-1: Sustainability criteria covered in RED 2009 and the RED revision proposal

Topic	RED 2009	RED proposal 2016	Intention
Greenhouse gas emission saving	All biomass; Art. 17.2	Art. 26.7	GHG emission reduction
Land with high biodiversity value (primary forests, protection areas, highly biodiverse grassland)	All biomass; Art. 17.3	Agricultural biomass; Art. 26.2	Mitigation of risks on biodiversity caused by land use change
Land with high carbon stock (wetlands, forest with high and low tree cover)	All biomass; Art. 17.4	Agricultural biomass; Art. 26.3	Mitigation of risks on carbon stock caused by land use change
Peatland	All biomass; Art. 17.5	Agricultural biomass; Art. 26.4	Mitigation of loss of peat caused by land use change and/or land use
Production of agricultural biomass	All biomass; Art. 17.6	--	Sustainable agricultural production in the EU
Production of forest biomass	--	Forest biomass; Art. 26.5	Sustainable forest management
Meeting LULUCF requirements	--	Art. 26.6	Protection of carbon stock by means of LULUCF requirements

Source: own presentation on the basis of the RED proposal.

2.2. What were the main changes introduced by the iLUC Directive?

The iLUC Directive in 2015 introduced a cap for food-based biofuels as well as further incentives for advanced renewable fuels. Both aspects shall reduce the risk of iLUC and foster the transition towards the deployment of advanced renewable fuels (see Table 2-2).

Table 2-2: Renewable energy sources in transport, restrictions and iLUC risks

Renewable energy in transport from…	Restriction	iLUC risk
… biofuels produced from cereal and other starch-rich crops, sugars and oil crops	Cap of 7 % points of the 10% target	High
… biofuels produced from crops primarily grown for energy purposes on agricultural land, other than cereal and other starch-rich crops, sugars and oil crops	Depending on the application in Member States: No cap or included in the 7% cap	High
… biofuels produced from biomass cultivated on degraded land	No cap.	Low
… advanced biofuels listed in Annex IX	No cap, minimum of 0.5% proposed as reference value. Target has to be defined by each Member State.	Low
… other renewable energy	No cap.	Low

Source: own illustration based on iLUC Directive.

The occurrence of iLUC is mainly triggered by competition for land that also depends on the type of crop grown (Valin et al. 2016). Member States may exclude “crops primarily grown for energy purposes on agricultural land, other than cereal and other starch-rich crops, sugars and oil crops” from the cap of 7% at maximum. In case energy crops are excluded from the cap, they would not contribute to iLUC mitigation. However, a lowering of the cap of 7% is allowed that would strengthen mitigation. Assuming a 0.5% target for advanced biofuels, 9.5% percentage points may still come from agricultural land associated with high iLUC risks in case no other renewable options (e.g. e-mobility) are available for accounting.

2.3. Definition of advanced biofuels

Advanced biofuels listed in Annex IX of the iLUC Directive (see Table A-2 in the Annex of this report) are expected to have low risks for indirect effects, low competition with food crops and low GHG emissions. Due to these positive characteristics, advanced biofuels can be counted twice their energy content under national biofuel support systems, supposed national biofuel targets are in place. Seven out of the listed advanced biofuels in Annex IX are linked to land use, and risks for biodiversity may exist (compare Table A-2).

When looking in more detail at the definition given in the iLUC Directive for the seven advanced biofuel feedstocks, it is apparent that the categories “Non-food cellulosic material” (p in Annex IX) and “Ligno-cellulosic material” (q in Annex IX) are rather broad, and they overlap strongly with the categories “Straw” (e), “Nut shells” (l), “Husks” (m) and “Cobs cleaned of kernels of corn” (n) (compare Table A-1 and Table A-2). Table 2-3 gives an overview of the categories that structure the feedstocks into agriculture and forestry sectors avoiding redundancies and further indicates their relevance for biodiversity.

Table 2-3: Proposed biomass categories for the analysis of biomass potentials and impacts on biodiversity related to advanced biofuels

Category detail	RED-category (Annex IX)	Primary / residue / waste	Agriculture / Forestry	Biodiv. relev.?
Food and feed crop residues				
Straw	Non-food cellulosic material	Production residue	Agriculture	high
Nut shells				high
Husks				high
Cobs cleaned of kernels of corn				high
Other food and feed crop residues				high
Woody and grassy energy crops				
Grassy energy crops	Non-food cellulosic material	Primary	Agriculture	high
Woody energy crops	Ligno-cellulosic material			high
Wood from forests				
Residues from forestry	Biomass fraction of wastes and residues from forestry and forest-based industries	Production residue	Forestry	high
Roundwood from forests	Ligno-cellulosic material	Primary	Forestry	high
Others				
Landscape management materials	Non-food cellulosic material / Ligno-cellulosic material	Primary	Forestry / agriculture / others	high
Other residue and wastes				
Other residue and wastes (non-wood)	Non-food cellulosic material	Industrial resuidue, waste	Agriculture	low
Other residue and wastes (wood)	Ligno-cellulosic material		Forestry	low

Source: Own illustration based on Annex IX of iLUC Directive

3. What are the main nature protection aspects of the RED proposal?

On 30th November 2016, the European Commission published a proposal for a recast of the RED (including changes regarding the iLUC Directive). In preparation of the RED proposal, the Commission carried out an assessment of the impact of different policy options on the bioenergy sector and the environment. From a nature protection perspective, the following aspects of the RED proposal are relevant:

- the type of bioenergy produced and utilised;
- how bioenergy is contributing to heating and cooling supply;
- how bioenergy is contributing to the transport sector; and
- which criteria apply for assessing GHG emissions savings and other sustainability aspects?

A central goal of the RED proposal is to extend the RED (2009) in a manner that all biomass used for transport, electricity and heating and cooling are included. EC (2016) evaluated different options for several topics of RED (2009) that need modification. Regarding "Options to strengthen the EU sustainability framework for bioenergy", the Commission prefers option 3 that builds on option 2 (see EC 2016, page 19):

– "*(Option 2) **Extend existing** sustainability and greenhouse gas saving criteria for biofuels in transport to encompass solid and gaseous biomass in heat and electricity*";[1]

– "*(Option 3) Building on option 2, further develop sustainability requirements for forest biomass alongside a requirement to include LULUCF emissions in national commitments under the Paris agreement*"

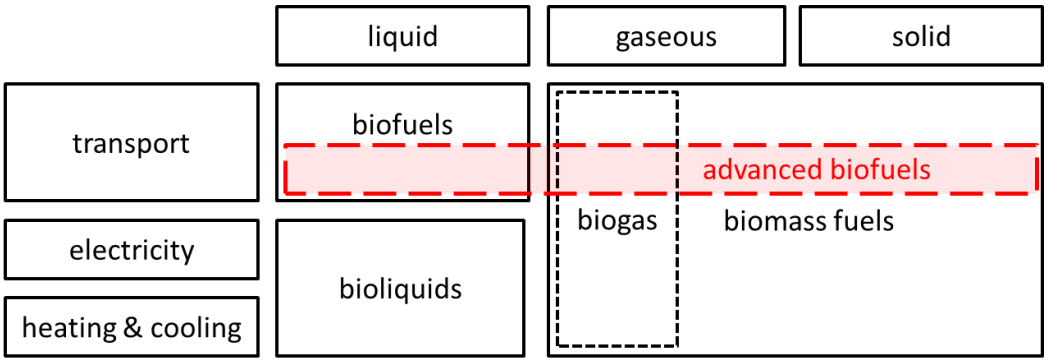
Option 2 implies that criteria for heat and electricity from **solid and gaseous biomass** should build on existing criteria given in Art. 17.2 to 17.6 of RED (2009). Furthermore, additional criteria for LULUCF shall be developed (Option 3).

3.1. Extending the coverage of bioenergy types

Several bioenergy types are referred to in the RED proposal, extending those covered in the earlier regulations. Figure 3-1 illustrates their relation to physical characteristics (liquid, gaseous, solid) and energy sectors (transport, electricity, heating and cooling). The proposal distinguishes biofuels (e.g. biodiesel, bioethanol), bioliquids (e.g. palm oil use in combined heat and power plants), and biomass fuels (e.g. wood, straw, biogas). Advanced biofuels in Figure 3-1 are included as biofuels, bioliquids and biomass fuels covering all bioenergy types in the transport sector.

[1] This preference is in line with EC (2010): "The Commission recommends that Member States that either have, or who introduce, national sustainability schemes for solid and gaseous biomass used in electricity, heating and cooling, ensure that these in almost all respects are the same as those laid down in the Renewable Energy Directive."

Figure 3-1: Illustration of bioenergy types given in the RED Proposal



Source: COM 2016, own presentation.

However, it is important to notice that the bioenergy categories illustrated in Figure 3-1 do not distinguish between raw materials from agriculture and forestry.

The RED (2009) applies to biofuels (including biogas[2]) used for transport and to bioliquids used for electricity and heating and cooling. Most biofuels and bioliquids currently used originate from agricultural production systems, but forest biomass is also included. This is especially true for advanced biofuels – a category of biofuels that explicitly includes wood from forests (except saw logs and veneer logs; see Annex IX of the iLUC Directive).

The RED (2009) thus explicitly addressed agricultural and forestry biomass, and sustainability criteria related to land use change listed in Art. 17.2 to 17.5 apply to both, agriculture and forestry production systems (see Figure 3-2a). Art. 17.6 of RED (2009) gives criteria for the agricultural production in EU Member States. Criteria referring to the forestry production were, however, missing in RED (2009) (compare Figure 3-2a).

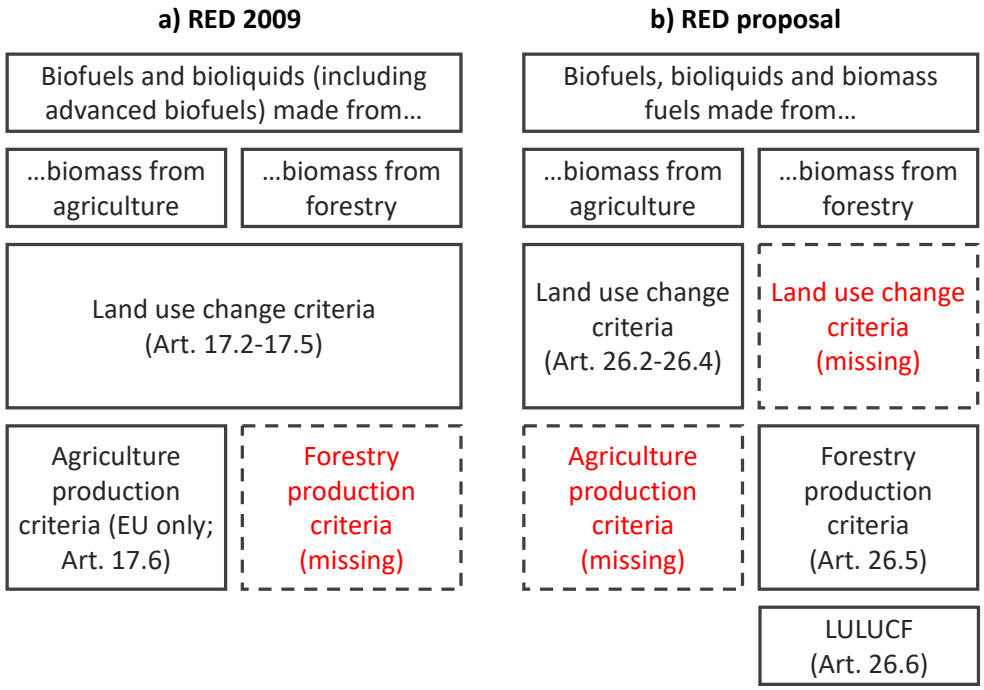
The RED proposal has been extended to include all biomass, but it also proposes fundamental changes of the architecture of the existing sustainability requirements of the RED (2009) (see Figure 3-2b):

- Criteria related to land use change shall only apply to biomass from agriculture and no longer to biomass from forestry;
- New sustainability criteria for forestry production are proposed, but they do not address risks from land use change;
- Criteria related to sustainable agricultural production are deleted;
- LULUCF criteria are added for forestry production.

In summary, the RED proposal does not extend the entire RED (2009) to solid and gaseous biomass in electricity and heating and cooling alone. Instead, it proposes a new systematic differentiation between agricultural and forestry biomass production. It clearly lowers the ambition level for sustainability criteria for forestry production systems.

[2] According to the definition of biofuels given in RED 2009.

Figure 3-2: Comparison of bioenergy sustainability requirements in the RED proposal



Source: RED (2009) and COM 2016, own presentation.

3.2. Increasing bioenergy in the heating and cooling supply

In Art. 23.1, the RED proposal stipulates that each Member State shall endeavour to increase the share of renewable energy supplied for heating and cooling by at least 1 percentage point every year. This target aims to facilitate the penetration of renewable energy in the heating and cooling sector.

Due to the fact that bioliquids and biomass fuels are a major renewable energy source in the heating and cooling sector today and presumably also until 2030, this target is likely to induce an increase of biomass mobilisation – in addition to solar heat and near-surface geothermal energy – for heating and cooling. Biomass raw materials utilised in the plants addressed by the Directive (see *plant size* in Art. 26.1; Section 3.4) will have to comply with sustainability requirements set up in Art. 26.2 to 26.7 of the RED proposal. The cap on biofuels, bioliquids and biomass fuels in the transport sector (see Art. 25; Section 3.3) does not apply to the heating and cooling sector (Art. 23).

3.3. Increasing bioenergy in the transport sector

For the transport sector, the RED proposal obliges Member States to require fuel suppliers to meet two binding targets, including trajectories from 2021 until 2030 (Art. 25.1):

1. A minimum target for energy from (1) advanced biofuels and other biofuels and biogas produced from feedstocks listed in Annex IX [part A and B], (2) renewable liquid and gaseous transport fuels of non-biological origin, (3) waste-based fossil fuels or (4) from renewable electricity (Art. 25.1). According to Annex X, part B, the minimum share shall be 1.5% in 2021 and 6.8% in 2030.

2. A minimum target for energy from advanced biofuels and other biofuels and biogas produced from feedstocks listed in part A of Annex IX (Art. 25.2). According to Annex X, part C, the minimum share shall be 0.5% in 2021 and 3.6% in 2030. This is a sub-target of point 1.

However, biofuels and biogas produced from feedstocks listed in part B of Annex IX ((a) used cooking oil, (b) animal fat, and – proposed by the Commission – (c) molasse) shall be limited to a share of 1.7% (Art. 25.1 (b)). This limit is similar to the cap for food and feed biofuels.

The mandatory target of 10% for renewable energy in the transport sector for each Member State was deleted from the RED proposal. However, Member States shall collectively ensure that the share of energy from renewable sources in the Union's gross final consumption of energy in 2030 is at least 27% (Art. 3.1). Without further regulations, e.g. GHG reduction obligations for the transport sector under the Fuel Quality Directive, there is no longer a European target or instrument that fosters the use of biofuels based on crops for food and feed.

3.4. Sustainability criteria for biofuels, bioliquids and biomass fuels

Art. 26 outlines sustainability and GHG emission-saving criteria. Compared to Art. 17 of the RED 2009, the Commission proposes several changes for a revision of the RED that may have strong implications for nature protection.

3.4.1. Plant size

The Commission proposes that biomass fuels are required to meet the sustainability and GHG emissions-saving criteria set out in Art.26.2 to 26.7 (see below and Table 2-1) only if

- an installation using solid biomass is ≥ 20 MW fuel capacity (electricity, heating and cooling or fuels);
- an installation using gaseous biomass fuels is ≥ 0.5 MW electrical capacity (electricity only).

Member States may apply the sustainability and GHG emission saving criteria to installations with lower fuel capacity (compare Art. 26.1).

3.4.2. Risks from land use change

The RED 2009 addressed risks that may occur from direct land use change with regard to nature protection (Art. 17.3), carbon stock (Art. 17.4), and peatland (Art. 17.5). It is important to notice that related criteria had to be applied to all biomass types, including agricultural and forest biomass, and that the land use situation in or after January 2008 had to be considered. According to the RED proposal, the criteria in Art. 26.2 to 26.4 shall now apply only to agricultural biomass. Forest biomass production shall follow separate criteria outlined in Art. 26.5 and 26.6. However, these criteria do not refer to the reference year 2008. This proposal strongly contradicts the self-set commitment of the Commission (Section 3 and EC 2016) to **extend** existing sustainability criteria for biofuels in transport to include solid and gaseous biomass in heat and electricity. In fact, constraining these criteria to the application to agricultural biomass only and excluding especially forest biomass means a reduction of sustainability requirements that already existed in the RED 2009.

3.4.3. Highly biodiverse forest

Highly biodiverse forests that are not primary forests are neither covered by the RED 2009 nor by the RED proposal despite the fact that new risks may occur from the use of solid biomass. For example, the conversion of highly biodiverse secondary tropical rainforest to a teak plantation would comply with the current RED sustainability requirements.

3.4.4. Highly biodiverse grassland

The Commission proposes two very critical changes. Highly biodiverse grassland shall span more than one ha. The RED 2009 did not have any minimum constraints. Furthermore, non-natural highly biodiverse grassland shall be identified as being highly biodiverse by the relevant competent authority. This proposal undermines the precautionary principle of the RED 2009.

3.4.5. Peatland

Land that was peatland in 2008 shall not be used as raw material for the production of biofuels, bioliquids and biomass fuels. The specification on the drainage status introduced by the RED 2009 does not exist in the RED proposal. Peatland would therefore be handled as a “no-go area” for agricultural production of biofuels. However, forested peatlands located in EU Member States and third countries would not be covered.

3.4.6. Agricultural production

The Commission proposes to delete Art. 17.6 of the RED 2009 that deals with sustainable agricultural production in the EU. This means that minimum standards agreed on under the Common Agricultural Policy and its financing mechanisms would not apply.

3.4.7. Forestry production

The Commission proposes to apply criteria for sustainable forest management (Art. 26.5) for addressing impacts of the production and use of biofuels, bioliquids and biomass fuels on the environment. It distinguishes between criteria related to the application of existing national and subnational laws and existing management systems (see Table 3-1). Forest management systems shall ensure that “areas of high conservation value, including peatlands and wetlands, are identified and protected” (point iii under (b) in Table 3-1). In general, management systems can help implementing sustainability criteria on specific forest areas. The identification of specific areas is critical. In case of applied national laws, an identification of areas is not required. Thus, the effectiveness of the RED proposal is substantially reduced.

Table 3-1: Criteria for a sustainable forest management in case of applicable laws or existing management systems (Art. 26.5 of the RED proposal)

(a) National and/or sub-national laws applicable in the area of harvest as well as monitoring and enforcement systems in place ensuring that:	**(b) Management systems are in place at forest holding level to ensure that:**
i) harvesting is carried out in accordance to the conditions of the harvesting permit within legally gazetted boundaries;	i) the forest biomass has been harvested according to a legal permit;
ii) forest regeneration of harvested areas takes place;	ii) forest regeneration of harvested areas takes place;
iii) areas of high conservation value, including wetlands and peatlands, **are protected**;	iii) areas of high conservation value, including peatlands and wetlands, **are identified and protected**;
iv) the impacts of forest harvesting on soil quality and biodiversity are minimised; and	(iv) impacts of forest harvesting on soil quality and biodiversity are minimised;
v) harvesting does not exceed the long-term production capacity of the forest;	(v) harvesting does not exceed the long-term production capacity of the forest.

Source: COM 2016, own presentation.

3.4.8. LULUCF requirements

The RED proposal acknowledges close linkages between the RED and the LULUCF Regulation proposed in July 2016 that are needed to ensure environmental integrity of the EU 2030 GHG emission reduction target and renewable energy targets. Three additional LULUCF requirements are outlined that shall be met at country level or by regional economic integration organisation of origin of the forest biomass (Art. 26.6):

1. the country shall be a Party to, and have ratified, the Paris agreement;
2. the country shall have submitted a Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC). This needs to include emissions and removals from agriculture, forestry and land use in a way that changes in carbon stock associated with biomass harvest are accounted towards the country's commitment;
3. the country shall have a national system in place for reporting GHG emissions and removals from land use including forestry and agriculture, which is in accordance with the requirements set out in decisions adopted under the UNFCCC and the Paris Agreement.

3.4.9. GHG emission reduction requirements

Art. 26.7 of the proposal requires that biofuels, bioliquids and biomass fuels achieve a certain GHG emission reduction depending on the date of start of the production (see Table 3-2).

Table 3-2: Proposed GHG emission reductions for biofuels, bioliquids and biomass fuels

	Installation started production before 5.10.2015	Installation started production after 5.10.2015	Installation started production after 1.1.2021	Installation started production after 1.1.2026
Biofuels and bioliquids	50%	60%	70%	70%
Biomass fuels (gaseous, solid)	--	--	80%	85%

Source: COM 2016, own presentation.

4. Analysis of main challenges for extending the RED

In the sections above, the RED proposal was analysed with a focus on aspects of nature protection. The analysis revealed, however, that the self-set commitment of the Commission (see Section 3 and EC 2016) to build the extension for solid and gaseous biomass on existing criteria given in Art. 17.2 to 17.6 of RED (2009) is only partly met. The aim of the following sections is to highlight challenges when extending the RED and focuses on closing identified gaps.

4.1. Increasing bioenergy in transport and heating and cooling sectors

The aimed increase of renewable energy in transport (Art. 25) and heating and cooling (Art. 23) is expressed in oil equivalents and wood equivalents in Table 4-1. Assuming that all additional renewable energy initiated by Art. 23 and 25 is generated from wood residues would require 295 Mm³ for heating and cooling and 204 Mm³ for transport. Even a share of 20% of wood energy in transport and in heating and cooling would still result in an additional wood residue demand of about 100 Mm³.

Table 4-1: Mainstreaming renewable energy in transport and heating and cooling (cumulative)

	EU Gross final energy consumption (Mtoe)	Roundwood equivalent [a] (Mm³)	Wood residue equivalent [a] (Mm³)
Heating and cooling (mean 2020 and 2030)	**512.5**		
Share additional renewable energy (2030: 10%)	51.25	236.0 [(a)]	295.0 [(a)]
Transport (2030)	**274.0**		
Advanced biofuels (2030: 3.6%)	9.7	86.3 [(b)]	107.9 [(b)]
Renewable electricity, PtX, waste-based fossil fuels or advanced biofuels (3.2%)	8.8	76.7 [(b)]	95.9 [(b)]

Source: own calculation based on EC (2016b; Scenario REF2016, page 37). PtX = renewable liquid and gaseous transport fuels of non-biological origin; assumed loss along production chain of (a) 5% and (b) 50%.

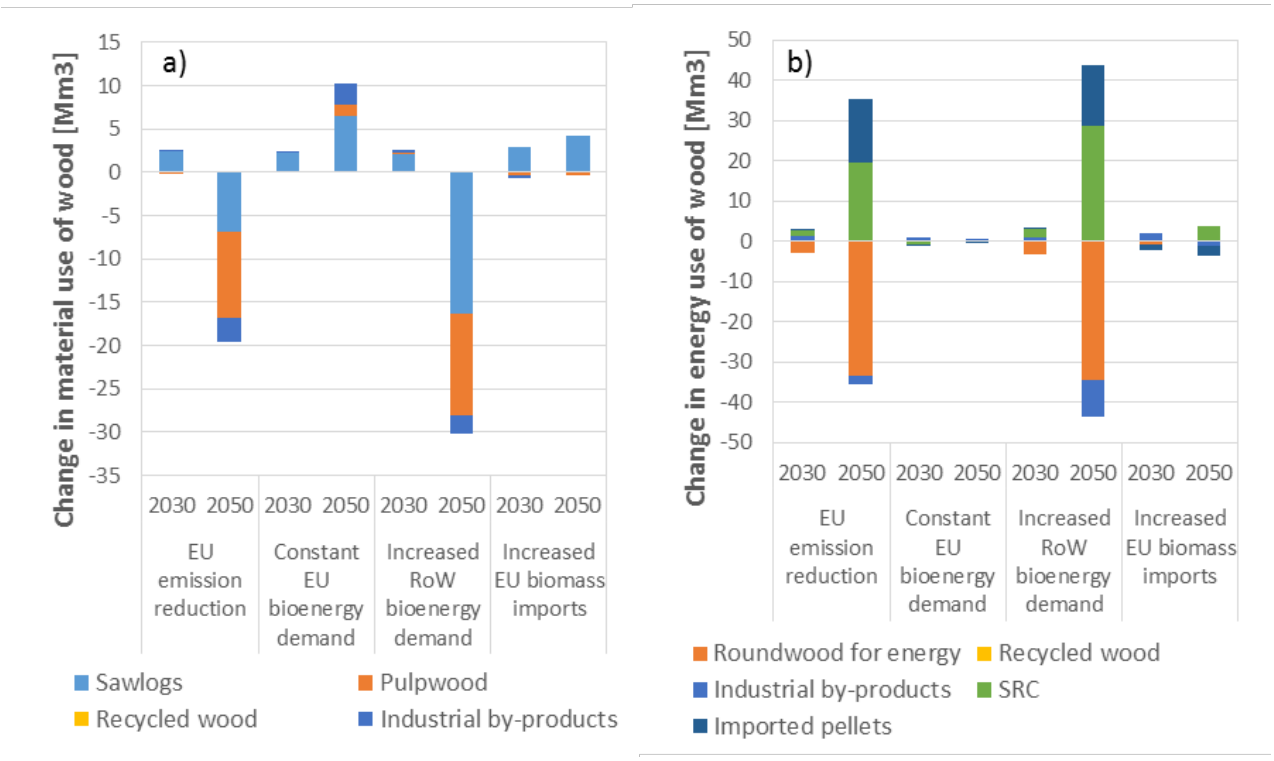
4.1.1. What are the relevant mass flows?

Wood or woody biomass is to be considered as one of the most prevalent biodiversity-relevant biomass sources listed in Annex IX of the RED. This list includes not only "*residues from forestry […], i.e. bark, branches, pre-commercial thinnings, leaves, needles, tree tops*" (listed under point o) but also any "*Other ligno-cellulosic material […] except saw logs and veneer logs*" (listed under point q). In fact, this defines eligibility for advanced fuel for any material taken out of the forest except those logs dedicated for the mentioned purposes. In other words, the ambition of the iLUC directive and the RED proposal mainstreaming the use of *waste and residues* is based on an extended understanding of "*residues*", subsuming material which would be fit for material use but is not, e.g. due to market reasons. In fact this widens the scope for biomass potentials significantly.

There are a large number of studies assessing biomass potentials, and they report considerable ranges of available potentials. The results vary not only from study to study but also within the studies according to multiple scenarios. However, most studies do not differentiate the potential between material and energy use as these overlap, e.g. regarding the use of stemwood from thinning or final fellings. An example is IINAS, EFI and JR (2014) who compared a reference scenario with a scenario based on stricter environmental criteria for the years 2020 and 2030. The results ranged from 580 Mm^3 to almost 900 Mm^3 of wood available from European forests for both material and energy use, indicating a reduction of the potential of about 30% when constraints are applied. Stricter constraints included a general maximum extraction rate of 70%, no residue removal from unproductive sites, and no stump extraction.

Forsell et al. (2016) and Böttcher et al. (2016) used a global land use model within the ReceBio project and showed that the pressure to use roundwood directly for energy and increase EU biomass imports will rise with increasing bioenergy demand. Their analysis demonstrated that constraints on biomass production in the EU28, such as excluding areas of high biodiversity value and not increasing harvest intensities in forests, have implications for resource efficiency of biomass use (Figure 4-1). Reduced production potentials in forests due to constraints could amount to up to 70 Mm^3 (10%) and would partly be compensated by imports and short rotation plantations, but would also reduce wood used for material use.

Figure 4-1: Implications of environmental constraints for biomass production in the EU28 for a) material use and b) energy use under different assumptions of bioenergy demand. Bars show the difference between constrained policy scenarios and unconstrained scenarios under the same conditions.



Source: Böttcher et al. (2016), see also Forsell et al. (2016) for description of the study and scenarios.

Straw from cereals is considered to be the second most-relevant biogenic residue. According to Malins et al. (2014), 140 Mt of agricultural residues (mostly straw from cereals) would be sustainably available per year in Europe, and up to 55 Mt for Germany. Brosowski et al. (2015), however, estimate the unused potential of straw in Germany at 5.5 Mt per year. Evidently, the assumption of conservative restrictions for the conservation of soil organic matter may lower the figures reported by Malins et al. (2014) up to an order of magnitude.

Maniatis et al. (2017) found that advanced fuels can contribute between 7.2% and 10.7% of total EU transport energy needs by 2030. However, this conclusion is based on the assumption that these derive roughly equally from lignocellulosic feedstocks and hydrogenated lipid fuels.

4.1.2. Which technologies are promising?

The debate on “second generation biofuels” started more than ten years ago. Meanwhile few types of technology have approved technological readiness and economic viability by operating plants. IEA Bioenergy Task 39 listed 71 advanced biofuels production facilities worldwide with a cumulative production capacity of 2.5 Mt per year in 2012, including also the hydrogenation of vegetable oils (Bacovsky et al 2013).

Current applied technologies can be characterised as hydrolysis, pyrolysis, gasification and hydrothermal upgrading. Most advanced biofuel production routes were at prototype or demonstration stage, with two – ethanol from dry plant matter and methanol produced through gasification of

woody biomass – being considered ready for commercialisation. Two basic types are considered to treat the residue feedstocks available at large scale most appropriately:

- Hydrolysis and fermentation of lignocellulosic agricultural wastes such as straw or corn stover or from energy grasses or other energy crops to produce cellulosic ethanol. The product can be blended with gasoline in the same way as conventional bioethanol.
- Gasification (heating in partial presence of oxygen to produce carbon monoxide and hydrogen) to produce BtL from woody residues or wastes or energy crops. Gasification produces a synthesis gas which will be converted via Fischer-Tropsch or the "methanol-to-gasoline" process to BtL, which is used in diesel engines.

The gasification approach in particular has turned out to be strongly sensitive to the quality of the feedstock. Successful realisation requires widely homogenous feedstock material. The operating plants strictly require well-defined input qualities, such as corn stover or selected assortments of wood. This aspect has been discussed as one of the crucial factors for closing down the gasification plant CHOREN in Freiberg, Germany (IRENA 2016, Rosendahl 2013).

Table 4-2: The status and technical readiness for various types of fuels

Type	Fuel	Time to deployment after RED II (years)
Commercial	Crop based, HVO, anaerobic digestion to biomethane	0
1st of a kind, ready for commercialisation	Cellulosic ethanol, methanol, DME synthetic biomethane	3
Innovation ready for 1st of a kind	Other lignocellulosic synthetic fuels	4-8
Advanced innovation stage	Pyrolysis oils, synthetic and low carbon fossil fuels	5-10
Early innovation stage	e-fuels, algae, etc.	5-8

Source: Maniatis et al. 2017

4.1.3. Competing requests from electricity and heat sector

The studies on biomass potentials show that biogenic residues and wastes are available but also underline existing limits of availability. Moreover, there is further demand for these feedstocks: e.g. the electricity sector, heat or cooling supply. For many cases, it is still an open question which combination of feedstock, technical option and final utilisation is the most efficient and most environmental friendly, while securely covering the overall demand of sustainable energy at large.

4.2. Sustainability criteria for biofuels, bioliquids and biomass fuels

4.2.1. Plant size

The RED proposal refers to thresholds for the size of bioenergy plants. In case that the plant size is below this threshold, compliance with the RED criteria is not required. Thus, the thresholds for plant size strongly determine to which biomass flows the RED applies.

For example, in Germany in 2014, electricity was produced from 696 solid biomass plants[3] whereof 67% had a size of ≤ 0.5 MW_{el}, 19% of >0.5 to 5.0 MW_{el} and only 14% were lager than 5.0 MW_{el}, of which again, large parts are below 20 $MW_{fuel\ capacity}$ (DBFZ et al. 2015). The plant size distribution of biogas plants producing electricity in Germany in 2013 consists of 19% ≤ 0.5 kW_{el}, 56% in between 151 and 500 kW_{el}, and 25% > 500 kW_{el} (total = 7,700 plants; DBFZ and IWES 2014). Thus, for biomass fuels in Germany, most of the current plant types and large parts of biomass flows would not be covered by the current proposal.

The situation is similar in other EU Member States. For instance, in the United Kingdom, a total of 57 solid biomass plants were in operation for power production in 2011 (RSPB 2011). The Department of Energy Digest of UK Energy Statistics (DUKES 2017) lists eleven of those (19%) as Major Power Producers with plant sizes >20 MW_{el}. However, an analysis by biofuelwatch.org (2015) reports a total of 21 biomass plants with plant sizes >20 MW_{el}, yet omits two plants from the DUKES (2017) list. Moreover, biofuelwatch.org (2015) lists a number of closed or withdrawn plants, so that the precise number of major biomass plants in the UK is unclear. In contrast, a recent analysis of wood chip demand (BASIS 2015) revealed that most plant sizes across Europe fall below the 1MW_{el} threshold, e.g. in Austria, about 75% of plants have a capacity below 1 MW_{el}.

In the EU, 74% of wood chips are burned in plants with a size above 20 $MW_{fuel\ capacity}$. However, wood chips amount to only 31.4% of solid biomass used for energy in the EU (BASIS 2016). This means that wood chips burned in 20 $MW_{fuel\ capacity}$ plants equal about 23% of total solid biomass. Assuming that industrial use of wood pellets also takes place in large plants (3% according to BASIS 2016), total solid biomass consumption in plants larger than 20 $MW_{fuel\ capacity}$ amounts to about 26%. In consequence, the remaining 74% of solid biomass are exempt from compliance with the RED proposal criteria.

Moreover, almost all sustainability criteria covered in the RED are area-related. The exceptions are GHG reduction requirements that consider land use change and also the conversion of biomass.

Due to this situation, it appears inadequate to focus on plant size as a sole blanket threshold, especially for solid biomass (compare Art. 26.1). Evaluation based on plant size alone fails to recognise a number of relevant aspects. For example, a large pellet producer may market its products primarily to smaller heating units in households (much smaller than 20 MW). According to the RED proposal, this biomass would be exempt from compliance with the RED sustainability criteria. In case that the producer served users below and above the plant size threshold, he could use uncritical biomass for the regulated market and critical biomass for the non-regulated one – a situation that strongly resembles the discussion on iLUC effects.

It appears much more suitable to use lower thresholds (e.g. 1 MW for solid biomass as specified in EC 2010) and to combine them with a threshold for the size of the biomass producer and/or economic operators along the production chain.

[3] Approved under the German Renewable Energy Law (EEG).

Example solid biomass: A suitable threshold for the economic operator could be related to the size of forest areas cultivated by smallholders, e.g. 100 ha[4], and the biomass growth on this area. The mean annual increment of forests in EU Member States (EU-28) amounts to about 4.7 m³/ha. This value, however, differs strongly between Member States, e.g. due to the climatic conditions. High annual increments can be found in Denmark (10.7 m³/ha), Germany (10,4 m³/ha) and Ireland (9.2 m³/ha), and low growth in Sweden (2,8 m³/ha), Spain (1,9 m³/ha) and Cyprus (0,3 m³/ha) (compare Table A-3 in the Annex). In reference to the European mean annual increment of 4.7 m³/ha, the annual increment of 100 ha amounts to 470 m³/a[5] or about 280 t/a. In case that one of the economic operators along the production chain exceeds annual production of a threshold of, e.g. 280 t, of solid biofuels, compliance with land related criteria should be shown.

Example gaseous biomass: A plant size threshold of 0.5 MW (electrical capacity) appears rather large and should be reduced to, e.g., 0.1 MW_{el}. In Germany, such a biogas plant with a size of 0.1 MW_{el}. would still require biomass grown on about 80 ha agricultural land. When looking at raw material for biofuels, all biomass must comply with the RED criteria independent of the amount of cultivated farmland. Thus, there is no reason why agricultural raw materials used in small-scale biogas plants shall get an exception for land-related criteria. However, an exception for GHG reduction criteria may be acceptable.

4.2.2. Risks from land use change

The structure of the RED proposal is based on the assumption that the use of forest biomass is not associated with risks that can occur from land use change. The following examples shall illustrate that forestry may cause land use change and that measuring compliance for criteria addressing land use change requires a reference date:

- *Primary forests:* An area was primary forest in 2008. Harvesting for material use started in 2015, thus converting the primary forest to a secondary forest. Using harvested wood in 2021, e.g. as feedstock for advanced biofuels needs to be in line with sustainability criteria set up in Art. 26.5 and 26.6. Here, Art. 26.5 (a)/(b) (iii) proves if an area is of "high conservation value" at the date of production, but not in relation to January 2008. Thus, the former primary forest can be used for feedstock production for advanced biofuels. This would not be possible under the RED 2009.
- *Highly biodiverse grassland:* An area was highly biodiverse grassland in 2008. The area is reforested in 2010 destroying the highly biodiverse grassland status. In 2025, thinning activities lead to forest residues that are used as feedstock for advanced biofuels in compliance with Art. 26.5.
- *Wetland:* A regularly flooded forest stand (wetland) is drained in 2015 to facilitate forest activities. The area can be used as feedstock for biofuels, bioliquids and biomass fuels again in compliance with Art. 26.5.

We interpret the goal of the Commission to "*extend existing sustainability and greenhouse gas saving criteria for biofuels in transport to encompass solid and gaseous biomass in heat and electricity*" (EC 2016) in a manner that all biomass from agriculture and forestry (liquid, solid and gase-

[4] Dutch "Sustainability criteria for biomass for energy purposes" (NTA 8081): "*An organization may be called smallholder, if the total surface area for cultivation is not over 50 hectare in case of arable farming and not over 100 hectare in case of forestry.*" http://www.betterbiomass.com/wp-content/uploads/2015/08/Interpretation-document-07-en.pdf

ForCES/FSC: "*A forest is usually considered 'small' if it is less than 100 hectares in size. In some places, forests up to 1,000 hectares can be considered small*". http://forces.fsc.org/download.certified-smallholders.4.pdf

[5] See https://bwi.info (mean value for all tree species)

ous) used in any energy sectors (transport, electricity and heating and cooling) shall meet the land use change-related criteria of RED (2009). This would mean that Art. 26.2 to 26.4, which shall mitigate against negative impacts from land use change, should apply to biomass from agriculture and forestry, and the examples above illustrate the need to include forestry in Art. 26.2 to 26.4.

4.2.3. Area of high conservation value and highly biodiverse forest

Art. 26.5 introduces the term high conservation value: "*areas of high conservation value, including wetlands and peatlands, are [identified and] protected*". This wording may partly fill the identified gap of highly biodiverse forests (see Section 3.4). However, the term high conservation value is not defined in the RED proposal, and identifying wetlands and peatlands should not be interpreted as an exhaustive list of areas covered under this term. In fact, areas of high conservation value should cover wetlands (Art. 26.3), peatlands (Art. 26.4), primary forests, protected areas and highly biodiverse grasslands (Art. 26.2) as well as highly biodiverse forests (new category).

The Commission Regulation on highly biodiverse grassland (EC 2014) gives a definition on areas that should be handled as highly biodiverse (namely species-rich). This definition is quite broad and can be applied one-by-one for defining highly biodiverse forests.

The RED proposals demands "*management systems*" that are in place at forest holding level (Art. 26.5 (b)) to identify and protect areas of high conservation value. However, for "*monitoring and enforcement systems"* on the basis of "*national and/or sub-national laws"* (Art. 26.5 (a)), it is assumed that the location of forest areas of high conservation value is already known, and their identification is not requested. However, the underlying assumption of this exception is that states worldwide have already completed identification and designation of forest areas of high conservation value. This exception should be refused or at least combined with the need to show that the monitoring and enforcement system is based on the identification of forest areas of high conservation value.

Due to the absence of a reference date in Art. 26.5 (see 4.2.2), e.g. a highly biodiverse secondary forest that lost its high conservation value in 2020 as a result of management intensification can be used for wood harvesting under the RED proposal afterwards.

These explanations highlight the need to carefully define the term high conservation value, guarantee their identification and to include a reference date in Art. 26.5. In addition, including highly biodiverse forests and forestry in Art. 26.2 to 26.4 would be straightforward (compare also Section 4.2.2).

4.2.4. Highly biodiverse grassland

The RED proposal introduces the grassland definition "spanning more than one hectare" in (Art. 26.2 (c) (), first sentence). From a nature protection perspective, such a threshold, taken from the definition of forests, is not appropriate for highly biodiverse grasslands as many highly biodiverse grasslands cover areas below one hectare. Furthermore, it is very questionable why the grassland definition should be changed in the RED 2020 despite the fact that the Commission Regulation on highly biodiverse grassland (EC 2014) did not include such a change – within a process that lasted from 2009 until 2014.

Also, including the wording "*and has been identified as being highly biodiverse by the relevant competent authority,*" in Art. 26.2 (c) (ii) is very critical from a nature protection perspective. Even in countries that follow high nature protection goals, not all highly biodiverse grasslands are identified by a competent authority. In all likelihood, this lack of official identification is yet more common in

countries with lower nature protection goals. Moreover, this change is not mentioned in the Commission Regulation on highly biodiverse grassland (EC 2014).

4.2.5. Peatland

Agricultural cultivation of peatland is strongly associated with high GHG emissions, even when no further drainage occurs. However, forestry practices have the opportunity to protect peat against oxidation more efficiently than agricultural approaches (e.g. forests on peatland in Scandinavia). Thus, when extending Art. 26.2 to 26.4 to all biomass sources (including biomass from forests), it is justifiable that biomass origins from forests on peatland as long as the forestry practices are adopted in a manner that peat oxidation is minimised.

4.2.6. Forestry production

Art. 26.5 of the RED proposal outlines basic sustainability requirements like legality of harvesting (Art. 26.5 a (i)), forest regeneration of harvested areas (Art. 26.5 a (ii)) and that harvesting does not exceed long term increments (Art. 26.5 a (v)). These aspects are sufficiently defined.

However, the aspects identification and protection of areas of high conservation value (Art. 26.5 a (ii); see Section 4.2.3) and minimising impacts of forest harvesting on soil quality and biodiversity (Art. 26.5 a (ii)) are imprecise.

For example, minimising impacts on biodiversity might be interpreted in a more or less ambitious manner:

- Not ambitious: harvesting does not take place during the breeding period of birds to minimise impacts on the regeneration of birds. Other management activities are not restricted and, e.g. harvesting of old habitat trees and regeneration of harvested areas with non-native species is allowed.
- Very Ambitious: An impact analysis for all species groups is carried out in the managed area and the development of populations is continuously monitored. The monitoring of populations of critical species is attended by nature protection techniques (e.g. minimal viable population concept). Especially rare habitat structures are protected and developed by using high logging diameters, setting aside areas and excluding a proportion of old trees from logging. Forest regeneration takes place by native and site-adopted species.

The RED 2020 criteria for sustainable forest management related to biodiversity and soil could range between such extremes. Hennenberg et al. (2013) identify several criteria that shall be included when extending the RED on solid biomass based on a literature review, country studies and results from workshops. In the following, the three most relevant aspects for mitigating impacts on biodiversity and soils are listed:

- Additional criteria related to soil quality:
  - Wood compartments with a diameter below 7 cm are left in the field, unless evidence is provided that extraction of this fraction does not negatively impact soil carbon content and soil nutrient supply.
  - No root extraction is applied.
  - Measures against soil erosion are applied and their effectiveness is monitored.
- Additional criteria related to biodiversity:

- Protection and development of biodiversity-relevant habitat structures
- Protection against invasive species
- Protection and development of a native and site-adapted species composition

Linkages between the RED proposal and the LULUCF regulation need to be taken into consideration. The three additional LULUCF requirements formulated in the RED proposal cannot be considered strong safeguards against a potential degradation of forests in countries supplying wood for bioenergy use in EU countries. This is because in most cases, NDCs are currently not explicit on the inclusion of the LULUCF sector into the national GHG emission reduction target. Also, the rules on how to account forestry emissions against the target have not been specified by countries.

The LULUCF Regulation proposal introducing accounting rules for EU Member States is currently discussed. The proposal requires, as a principal commitment, each Member State to ensure that accounted GHG emissions from land use are entirely compensated by an equivalent accounted removal of CO_2 from the atmosphere in non-ETS sectors (the 'no debit rule'). The proposal specifies the rules for accounting. An important open question is that of the reference period assumed for accounting emissions and removals from managed forest land. For ensuring environmental integrity of the 2030 GHG emission reduction target and the RED, the reference period should not include the recent years (since 2009) that are characterised by more intensive harvest in many countries, also due to increased bioenergy use.

Neither RED proposal nor LULUCF Regulation require that the carbon sink in managed forest that currently still exists in all EU Member States needs to be maintained. In fact, accounting against a reference could even lead to the situation where managed forests become a source of CO_2 that is not accounted for. This remains a major risk for forest-based biomass for bioenergy and threatens the climate integrity of the 2030 target. A safeguard within the new RED could be a provision that does not allow the use of bioenergy from exporting countries reporting net emissions from managed forests or introducing an emission factor (similar to iLUC emission factors) to those biomass feedstocks.

4.2.7. Agricultural production

Requirements for agricultural practices (former Art. 17.6) have been deleted from the RED proposal. This is an unacceptable regression and a serious fall below existing RED requirements. As a minimum requirement, the RED 2020 should still refer to the sustainability requirements of the Common Agricultural Policy (CAP). In fact, the opposite would be appropriate: reflecting the meta-standard ISO 13065 published in 2015 mandatory sustainability requirements for agricultural raw materials from outside the EU may also be applicable under the RED. In principle, this is now proposed for biomass from forestry.

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Annex

Table A-1: Definition of "Non-food cellulosic material" and "Ligno-cellulosic material"

Feedstocks and fuels (Annex IX)	Definition in Article 2
(p) Other non-food cellulosic material as defined in point (s) of the second paragraph of Article 2.	(s) Article 2: "non-food cellulosic material" means feedstocks mainly composed of cellulose and hemicellulose, and having a lower lignin content than ligno-cellulosic material; it includes food and feed crop residues (such as straw, stover, husks and shells), grassy energy crops with a low starch content (such as ryegrass, switchgrass, miscanthus, giant cane and cover crops before and after main crops), industrial residues (including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted), and material from biowaste;
(q) Other ligno-cellulosic material as defined in point (r) of the second paragraph of Article 2 except saw logs and veneer logs.	(r) Article 2: "ligno-cellulosic material" means material composed of lignin, cellulose and hemicellulose such as biomass sourced from forests, woody energy crops and forest-based industries' residues and wastes;

Source: iLUC Directive and own evaluation

Table A-2: Advanced biofuels – feedstocks and fuels listed in Annex IX

Feedstocks and fuels	Biodiversity relevant	Primary production	Production residue	Industrial residue	Waste	Non-biomass
Part A						
(a) Algae if cultivated on land in ponds or photobioreactors.	L	X				
(b) Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC.	L				X	
(c) Bio-waste as defined in Article 3(4) of Directive 2008/98/EC from private households subject to separate collection as defined in Article 3(11) of that Directive.	L				X	
(d) Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in part B of this Annex.	L				X	
(e) Straw.	**H**		**X**			
(f) Animal manure and sewage sludge.	L			X		
(g) Palm oil mill effluent and empty palm fruit bunches.	L			X		
(h) Tall oil pitch	L			X		
(i) Crude glycerine.	L			X		
(j) Bagasse.	L			X		
(k) Grape marcs and wine lees.	L			X		
(l) Nut shells.	**H**		**X**			
(m) Husks.	**H**		**X**			
(n) Cobs cleaned of kernels of corn.	**H**		**X**			
(o) Biomass fraction of wastes and residues from forestry and forest-based industries, i.e. bark, branches, pre- commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil.	**H**		**X**	**X**	**X**	
(p) Other non-food cellulosic material as defined in point (s) of the second paragraph of Article 2.	**H**	**X**	**X**	**X**	**X**	
(q) Other ligno-cellulosic material as defined in point (r) of the second paragraph of Article 2 except saw logs and veneer logs.	**H**	**X**	**X**	**X**	**X**	
(r) Renewable liquid and gaseous transport fuels of non-biological origin.	L					X
(s) Carbon capture and utilisation for transport purposes, if the energy source is renewable in accordance with point (a) of the second paragraph of Article 2.	L					X
(t) Bacteria, if the energy source is renewable in accordance with point (a) of the second paragraph of Article 2.	L	X				
Part B						
(a) Used cooking oil.	L				X	
(b) Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council.	L				X	

Source: iLUC Directive and own evaluation. H = high risk (marked in red); L = low risk.

Table A-3: Mean annual increment for forest in EU Member States in 2010

	Forest area (1.000 ha)	Mean annual increment (1.000 m^3)	Mean annual increment (m^3/ha)
EU (28 countries)	**159,236**	**744,198**	**4.7**
Austria	3,860	25,136	6.5
Belgium	681	4,610	6.8
Bulgaria	3,737	14,361	3.8
Croatia	1,920	8,144	4.2
Cyprus	173	47	0.3
Czech Republic	2,657	20,463	7.7
Denmark	587	6,263	10.7
Estonia	2,234	11,514	5.2
Finland	22,218	93,379	4.2
France	16,424	82,871	5.0
Germany	11,409	118,590	10.4
Greece	3,903	4,511	1.2
Hungary	2,046	9,775	4.8
Ireland	726	6,678	9.2
Italy	9,028	32,543	3.6
Latvia	3,354	19,680	5.9
Lithuania	2,170	11,030	5.1
Luxembourg	87	650	7.5
Malta	0	0	0.0
Netherlands	373	2,738	7.3
Poland	9,329	62,300	6.7
Portugal	3,239	19,087	5.9
Romania	6,515	29,260	4.5
Slovakia	1,939	13,465	6.9
Slovenia	1,247	9,165	7.3
Spain	18,247	35,479	1.9
Sweden	28,073	79,347	2.8
United Kingdom	3,059	23,113	7.6

Source: Eurostat