

RED II and advanced biofuels

Recommendations about Annex IX of the Renewable Energy Directive and its implementation at national level

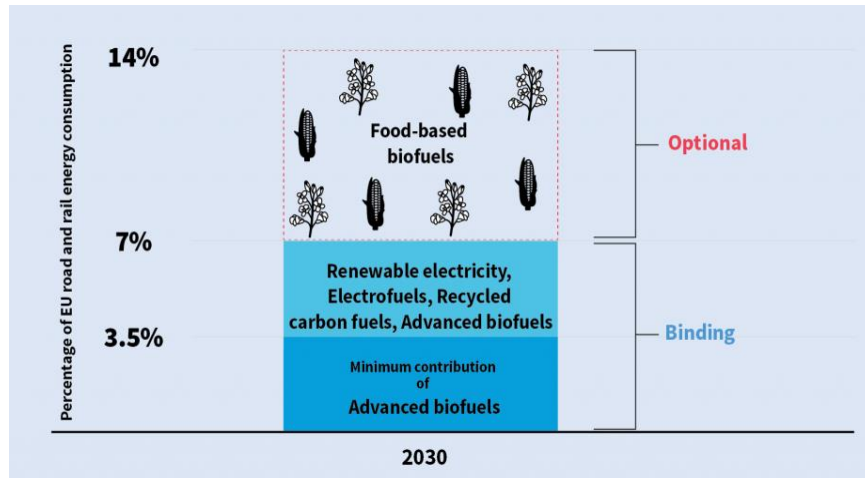
May 2020

Summary

The Renewable Energy Directive limits the share of unsustainable crop based biofuels and promotes certain types of biofuels produced from a list of materials defined in its Annex IX. This list is the basis for member states to define the different levels of support to different types of biofuels under their national framework. Whereas the list was intended to include only sustainable waste and residues for biofuels production, it actually includes some unsustainable feedstocks. This briefing assesses the raw materials in the Annex IX, highlights the limitations of the RED sustainability rules and proposes a way forward to ensure that the most sustainable options are supported by national policies and eventually at EU level.

1. Introduction - Annex IX and advanced biofuels

The Renewable Energy Directive (2018/2001)ⁱ contains the Annex IX which lists the feedstocks that receive special treatment for the purposes of the RED II transport target. Advanced biofuels are defined as liquid or gaseous biofuels made from materials listed in Part A of the Annex. They have a specific sub-target starting at 0.2% in 2022, at least 1% in 2025, and increasing to at least 3.5% in 2030. The Annex IX came into existence in 2015 with the ILUC directiveⁱⁱ, which amended the original RED of 2009ⁱⁱⁱ (see Annex I of this briefing for the full list and Annex II for a description of the main feedstocks).



The part B covers Used Cooking Oil and animal fats (category I and II) and it is subject to a cap^{iv} at 1.7% of transport energy. All the biofuels produced from the list can count twice their energy content towards the transport renewable targets. Multipliers are seen as a tool to strengthen support to alternative fuels that are not food and feed based biofuels, with a view of bringing new fuel technologies to the market.

The main concern with the list originally proposed by the Commission in the ILUC Directive was the fact that problematic feedstocks appeared on the list, in the absence of a detailed impact assessment^{v,vi}. As part of the final compromise of the REDII, the list will be reviewed every two years with a view to add new materials to the list, but none can be removed in the period to 2030. This last point is very problematic in view of the sustainability concerns around several feedstocks listed in Annex IX.

To be added to the list, a raw material needs to be assessed with regard to principles listed in Article 28(6)^{vii}:

- (a) *the principles of the circular economy and of the waste hierarchy^{viii} established in Directive 2008/98/EC;*
- (b) *the Union sustainability criteria laid down in Article 29(2) to (7);*
- (c) *the need to avoid significant distortive effects on markets for (by-)products, wastes or residues;*
- (d) *the potential for delivering substantial greenhouse gas emissions savings compared to fossil fuels based on a life-cycle assessment of emissions;*
- (e) *the need to avoid negative impacts on the environment and biodiversity;*
- (f) *the need to avoid creating an additional demand for land.*

Because the current Annex IX list was not based on very transparent and detailed criteria, certain feedstocks have significant displacement or land use change emissions^{ix} and would not meet the above mentioned principles. The first review of Annex IX had to be done by June 25th 2019, and the 2019 Renewable energy progress report notes that currently there are no materials that meet the requirements to be added.^x

2. Classification of raw materials in the RED

2.1. The legal categories under RED and their different requirements

2.1.1. Overview of the categories

The feedstocks listed in Annex IX fall under different categories, namely wastes, residues, co-products and a few primary products.

Wastes are defined in the REDII and waste framework directive (2008/98/EC)^{xi} as “*any substance or object which the holder discards or intends or is required to discard*”. Based on this definition, examples of wastes in Annex IX include used cooking oil (when not used for other uses), the industrial and municipal wastes and sewage sludge.^{xii} They are end-of-life products, but many of them have an energy use, or even an animal feed use in some regions, as is the case for used cooking oil. Therefore, despite being categorized as wastes they might still have valuable uses and potentially cause displacement emissions when diverted for biofuel production.

Residues are defined in the REDII as “*a substance that is not the end product(s) that a production process directly seeks to produce; it is not a primary aim of the production process and the process has not been deliberately modified to produce it;*”. An example of residue is bagasse, when not already used for energy use.

By-products are not defined in the REDII, but are defined in the waste framework directive (2008/98/EC), and some materials in Annex IX clearly meet the criteria. A material is a by-product if the following conditions are met:

- (a) further use of the substance or object is certain;*
- (b) the substance or object can be used directly without any further processing other than normal industrial practice;*
- (c) the substance or object is produced as an integral part of a production process; and*
- (d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts, has certain further use, can be used directly without any further processing other than normal industrial practice, is produced as an integral part of a production process, and further use is lawful.*

2.1.2. Impacts of the classification

The categories are important to define the applicable sustainability criteria, traceability requirements and apply specific Life Cycle Assessment (LCA) rules. Regarding LCA rules, the directive states that wastes and residues “*shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials*”, as their generation is generally not considered to be the intended product of a given production system^{xiii}. Thus, the greenhouse gas (GHG) profile for a given feedstock could be very different depending on whether it is classified as a co-product or residue^{xiv}.

The different types of classification lead to a system with different levels of expectations and different certification requirements. Certification schemes do not have to certify and trace back the upstream part of the process (before the mill or the refinery) for waste and residues^{xv}. When classified as co-products, the full set of sustainability criteria can be applied to biofuels. Likewise, when produced from “*agricultural, aquaculture, fisheries or forestry residues*”, biofuels need to comply with criteria related to direct land use, e.g. “*not be made from raw material obtained from land with a high biodiversity value*”, such as primary forest^{xvi}. But, if they do not fall in this category of residues, for example if they are classified *industrial* residues, they only need to meet the greenhouse gas emissions saving criteria, nothing more.

Classification under RED	GHG savings threshold	Sustainability criteria	Traceability up to the upstream part
Co-products	Applicable.	Applicable.	Applicable.
Residues of agriculture, aquaculture, fisheries or forestry	Applicable.	Applicable.	Not applicable.
Industrial residues	Applicable.	Not applicable.	Not applicable.

2.2. The varying implementation by member states

The uncertainty in classification has led to a situation where different countries classify raw materials in different categories, because of varying interpretations. Some countries also allow double counting for certain feedstocks but not for others. Two examples below:

- **Crude tall oil** is included in the Annex IX but it is considered a co-product in the UK^{xvii}. In France, it is not subject to double counting, due to its significant use in other industries.
- **Animal fats category 1 and 2** are part of Annex IX part B, but the UK classifies animal fat category 2 as a product^{xviii}. Germany does not allow animal fats to count under its advanced fuels policy, because of their existing uses in other industries and the distortive effects it would have if animal fats were driven to the biofuels market^{xix}.

Feedstocks not in Annex IX – the issue with PFAD

The interpretation is also very important for the fuels not explicitly listed in Annex IX, which are not explicitly included in the category of food and feed crop biofuels in the RED, such as Palm Fatty Acid Distillate (PFAD). Several countries have decided to remove incentives to PFAD biofuels, either by classifying them as co-products or by not applying double counting anymore to these fuels.

The Netherlands, the UK, Norway, Germany and Sweden do not classify PFAD as a residue.

- **The UK** Department for Transport explains that “*The treatment of PFAD in the RED GHG calculations indicates that it is to be treated as a product. PFAD has a significant economic value in relation to the main product (palm oil) and a variety of productive uses.*”^{xx}
- In its Strategy against imported deforestation, **France** highlights that it maintains PFAD in the category of first-generation biofuels^{xxi} but recent developments show a risk changing this classification in the country, because of pressure by Oil major Total^{xxii}.

- **Finland** is home to Neste oil, the biggest producer of renewable diesel and big user of PFAD for its biofuels. The government of Finland is the largest shareholder of Neste Oil^{xxiii} and the state classifies PFAD as a residue.

To avoid driving additional deforestation, member states should classify PFAD as a co-product of palm oil and phase out support to this type of fuels as soon as possible.

3. Shortcomings of REDII sustainability criteria for Annex IX fuels.

The general sustainability criteria in the REDII are insufficient to ensure that using some feedstocks from Annex IX for the production of transport fuels would be beneficial for the climate. There are general sustainability requirements for biofuels in Annex IX to be counted towards RED targets such as a 65% GHG savings threshold and that the raw materials cannot be sourced from certain areas like highly biodiverse grassland^{xxiv}. The sustainability criteria and compliance mechanism are detailed in Articles 29 and 30 of the REDII but these do not cover all the potential impacts and therefore do not guarantee their sustainability in practice.

3.1. Issues with the rules in place

The lack of proper sustainability safeguards is especially true in the case of forest biomass. The general approach to sustainability of forest biomass in the RED is not adequate to prevent unsustainable forest feedstocks to be used and supported by the policy. The sustainability requirements are assessed on the basis of sustainable forest management only, which is only as strong as its implementation. Such a plan provides an estimate, but doesn't take into account the actual carbon impacts of using forest biomass for energy (the carbon debt). For the products and by-products of the forestry sector in Annex IX (especially round wood - pulpwood and thinnings - and harvesting residues), there will be a link to the LULUCF sector. Increased extraction rates of these raw materials will increase the carbon emissions in the LULUCF sector, because carbon stocks and sinks will decrease. An increased use of biomass extracted from forest would lead to increased overall emissions.^{xxv} On top of this, there are no requirements on the maximum extraction rates for harvesting residues, which if overharvested may decrease fertility and soil carbon of the forests, potentially lowering future growth (and carbon sequestration) rates.

For agricultural residues, the REDII criteria do not ensure that extraction rates are kept at sustainable levels. This is relevant for straw and corn cobs, two feedstocks in the list which have significant potential. There is a vague requirement for operators or national authorities to have monitoring or management plans in place in order to address the impacts on soil quality and soil carbon^{xxvi}. How this will be implemented in practice remains unclear and there is no way to ensure sustainable harvest of these residues in the absence of mandatory requirements and strong compliance mechanisms.

Fuels produced from Annex IX need to meet the same minimum GHG emissions savings as all biofuels, ranging from 50-65% depending on the start date of the installation. **This includes only direct emissions and any potential displacement emissions are not included.** Displacement emissions essentially quantify the climate impact of not following the waste hierarchy and cascading use principles. If a material is not anymore used for its previous purpose, say for feed, the animal still needs to eat and an alternative feed must be sourced, potentially causing emissions. Significant indirect emissions suggest that biofuel feedstock is a sub-optimal use for the material. The displacement emissions can be large, up to the point where the biofuel increases overall emissions as identified by ICCT (2017)^{xxvii} and Malins (2017)^{xxviii} and thus these emissions need to be taken into account in policy.

Monitoring and verification mechanisms need to be strictly enforced, as the fuels made from Annex IX feedstocks can have higher market value than conventional biofuels due to the double counting mechanism, and the part A fuels have a specific sub-target. Certification schemes and member states officials need to ensure that the fuels are actually made from the raw material claimed, an impossible task when analysing the final fuel properties. The authorities also have a legal requirement to ensure materials have not been intentionally modified or contaminated in order to meet the definition of waste. However, the European court of auditors has identified that the European Commission and national authorities have insufficient control of the current biofuels certifications schemes.^{xxix} Recently in the Netherlands, one of the largest market for used cooking oil biodiesel, criminal investigators identified that a third of the biodiesel reported as having used cooking oil as feedstock could in fact be virgin oil biodiesel.^{xxx}

3.2. Using the waste hierarchy in national implementation to prevent market distortions and displacement effects

The waste hierarchy is a core principle that should guide member states' decisions regarding biofuels. There is a clear reference to it in article 3 (3) of the RED: "*Member States shall ensure that their national policies (...) and their support schemes, are designed with due regard to the waste hierarchy as set out in Article 4 of Directive 2008/98/EC to aim to avoid undue distortive effects on the raw material markets.*"^{xxxii} The waste hierarchy clearly indicates the hierarchy that should apply regarding waste prevention and management: (a) prevention; (b) preparing for re-use; (c) recycling; (d) other recovery, e.g. energy recovery; and (e) disposal.^{xxxii} It is clear that the directive opens the possibility to member states to adopt legislation that restricts the use of certain waste streams to a higher priority order. Member States therefore have a legal basis to reduce support for biofuel from that material, for example by not applying double counting, even if their use at national level would still count towards the EU targets.

Applying the waste hierarchy principle would also ensure that the competing uses of the raw materials are considered, to avoid diverting a raw material, be it a product, by-product, waste or residue, from a higher value use. The existing Annex IX list includes raw materials that definitely have a higher value potential use within the waste hierarchy, for instance pulpwood (for paper) and tall oil (bio-based chemicals).

3.3. The issues associated with specific feedstocks on the list

Below, we highlight specific feedstocks but this does not constitute an exhaustive list of all the eligible feedstocks under the REDII framework and the issues associated with them. Several feedstocks and categories in Annex IX will require a case by case analysis. This case by case analysis will be especially important for broad categories included on the list, namely:

- o) *Biomass fraction of wastes and residues from forestry and forest-based industries, namely, bark, branches, pre-commercial thinnings, leaves, needles, tree tops, sawdust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil;*
- p) *Other non-food cellulosic material.* This category includes agricultural residues, energy, cover, and ley crops^{xxxiii}.
- q) *Other ligno-cellulosic material except saw logs and veneer logs.* This category can cover pulp wood, woody energy crops and tree stumps.

- **Examples of feedstocks which should not receive preferential treatment by member states and should be removed from the EU list:**

Due to their current use in other industries and the conflicts in the hierarchy of use, driving certain feedstocks for biofuels production creates significant displacement emissions^{xxxiv}. These feedstocks should not be part of Annex IX, if the principles of article 28(6) are applied. This includes but is not limited to:

- Crude tall oil.
- Crude glycerine.
- Pre-commercial thinnings.
- Pulp wood and trees stumps (eligible under q).

➤ **Examples of feedstocks which require additional oversight before deciding on support:**

- Straw^{xxxv}, needles and leaves. Sustainable extraction levels need to be enforced first.
- Biomass fraction of mixed municipals waste and biomass fraction of industrial waste. should only be supported after a strict application of the waste hierarchy, to identify potential competing uses and preferably from separate collection. If biomass fraction of mixed municipal waste (b in the list) receives preferential support, it could counter the separate collection requirement for biowaste planned from December 2023 (in line with article 22 of Waste Framework Directive (WFD))
- Palm oil mill effluent and empty palm fruit bunches. These derive from the production of palm oil, which raises sustainability questions and would increase import dependence, as they are not sourced in Europe. Also, they could be used for local energy demand in producing countries (POME can be used for biogas production). Same concerns apply to bagasse from the sugarcane industry.
- Cellulosic energy crops (under p) and woody energy crops (under q) should only be eligible if evidence is provided that these are grown on abandoned or marginal land, while having no negative impacts on biodiversity, water, soil quality and land use and proving clear ecosystems and carbon benefits compared to natural vegetation/carbon sinks.^{xxxvi}
- Saw dust and cutter shavings.

➤ **The case of animal fats and Used Cooking Oil (UCO)**

Ramping up the use of animal fats and UCO could have unintended negative consequences. Animal fats are being used by other industries, such as the chemical industry to make soaps. If the animal fats used to make soap are used to produce biodiesel, a substitution material of similar characteristics will be needed. Cheap vegetable oil such as palm and soy oil are often used as substitutes, creating additional demand and driving deforestation.

UCO sourced domestically with a robust chain of custody can bring high GHG savings compared to fossil fuels. However, there are real concerns about the ‘used’ status of these oils because UCO may be driving deforestation indirectly. It is thus crucial to scrutinise the origin of UCO more closely and to build a more rigorous chain of custody. Most markets outside of the EU are existing markets for UCO as animal feed and import to the EU will lead to substitution and indirect land use change.

The contribution of these biofuels is limited under RED II as they can count up to a maximum of 1.7% towards the 7% target. However, this is a ‘soft cap’ and countries can inquire the Commission for setting a higher limitation. Countries should not go beyond the soft cap of 1.7%, if this is dependent upon the use of feedstocks causing indirect displacement effects.

4. Availability of Annex IX materials

Many feedstocks listed in Annex IX have existing and potentially better uses which impacts their availability for energy uses. Specific support for the use of some feedstocks is therefore questionable, based on the principles of the waste hierarchy and cascading use^{xxxvii}. As an example, straw has many potential roles: straw incorporation increases the soil carbon content, and thus maintains soil health, but in some cases a proportion could be sustainably removed for other purposes. As a rough rule of thumb, the ICCT suggested that 4t/ha should be left to the field, to maintain or increase soil organic carbon content.^{xxxviii} If straw is collected, the straw could be used as animal bedding, advanced biofuels or even made into bio-based chemicals. These existing and alternative uses need to be considered when evaluating how much of each feedstock is available for the purposes of advanced biofuels. Unsustainable levels of feedstock use should not be considered towards the potential target or supported.

A previous T&E analysis showed that the current target for Annex IX part A fuels, if double counting is used, could be met with sustainable EU domestic resources^{xxxix}. The analysis focused on the cellulosic and ligno-cellulosic wastes and residues, as these feedstocks potentially could provide the highest volumes. The non-cellulosic material (e.g. sludges, waste lipids) provide significantly lower quantities of sustainable feedstocks, and thus were excluded for simplification, as they do not change the scale of the sustainable availability.

Technical availability is not the first obstacle to the use of many of the feedstocks listed in Annex IX for advanced biofuels. Before availability becomes a limiting factor, investments are needed to expand advanced biofuel production capacity from its current industrial infancy. Different materials can be handled with different conversion technologies, which are at various development levels. None of the pathways for conversion of cellulosic material to liquid biofuels have yet been successfully commercialized at scale, while biomethane production through anaerobic digestion is very much a commercial technology.

The feedstocks listed in Annex IX are mainly available domestically in the EU, with the exception of bagasse, palm oil mill effluent and empty fruit bunches which are residues of the sugarcane and palm oil industries and are not present in the EU. However, evidence shows that some countries rely on significant amounts of imports to meet their targets, e.g. used cooking oil.

5. Conclusions & Policy recommendations

The REDII provides a framework to support Annex IX fuels, but it includes several unsustainable feedstocks, which do not respect the waste hierarchy or could cause significant displacement emissions. While new materials can be added to Annex IX by the Commission, once included there is no mechanism for materials to be removed.

5.1. Recommendations for national implementation

Member states can apply differentiated support to the listed materials thanks to the legal requirement in Article 3(3) that renewable energy policies should give due regard to the waste hierarchy. Should it be clearly identified that the use of a given material as biofuel feedstock would violate the waste hierarchy, member states have a legal basis to reduce support for biofuel from that specific material, even if its use would still be counted towards its national targets. On that basis, we propose the following recommendations to member states:

- Member states should apply **the waste hierarchy**, based on Article 3(3) of the REDII and provide policy support only to raw materials in line with it. A strict application of the waste hierarchy would rule out certain feedstocks in Annex IX from policy support, as highlighted above in the briefing.

- Before setting any support, countries should identify the **domestic availability of the Annex IX feedstocks**, how they are currently used in the country and the environmental impacts of these feedstocks. The countries should conduct an impact assessment of the potential consequences of the policy, including market distortion effects but also impacts on biodiversity and ecosystem services. Without this knowledge, the target might be set too high and drive unsustainable feedstocks.
- When looking at **research and investments schemes**, support should be granted to developing biofuels from raw materials **which show a clear sustainable potential**. It does not make sense to focus research on pathways which have only minimal feedstock availability (e.g. waste streams that could be further reduced), have higher uses or will create dependence on imports, thus not making a large impact in GHG emissions reductions.

5.1. Recommendations for changes in the EU framework

- **A robust assessment and amendment of the current list, not only potential new feedstocks, is needed.** The criteria for feedstocks to be added to the Annex IX^{xl} include references to the circular economy and the waste hierarchy, but it is totally unclear whether and how these requirements were taken into account for the existing list. It is crucial that a future review allows for an assessment and removal of problematic feedstocks already on the list.
- **The CO2 emissions associated with displacement effects should be accounted under the GHG methodology in the RED.** As explained above, the use of certain raw materials for energy use lead to displacement effects which can be very significant according to analysis by the ICCT (e.g. crude tall oil, crude glycerine).
- **Additional sustainability safeguards** need to be developed quickly and enforced as part of the sustainability criteria. This is especially important for sustainable removal rates to be applied for agriculture and forestry residues.
- **The EU framework needs to be designed in a way that supports stronger monitoring and verification processes for waste and residue based biofuels.** The expected set-up of an EU-wide database will be a step in the right direction, but additional efforts and rules will need to be defined to develop clear chains of custody and avoid potential fraud cases.

Further information

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Annex I

Annex IX – DIRECTIVE (EU) 2018/2001

Part A. Feedstocks for the production of biogas for transport and advanced biofuels, the contribution of which towards the minimum shares referred to in the first and fourth subparagraphs of Article 25(1) may be considered to be twice their energy content:

- (a) Algae if cultivated on land in ponds or photobioreactors;
- (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;
- (c) Biowaste as defined in point (4) of Article 3 of Directive 2008/98/EC from private households subject to separate collection as defined in point (11) of Article 3 of that Directive;
- (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;
- (e) Straw;
- (f) Animal manure and sewage sludge;
- (g) Palm oil mill effluent and empty palm fruit bunches;
- (h) Tall oil pitch;
- (i) Crude glycerine;
- (j) Bagasse;
- (k) Grape marcs and wine lees;
- (l) Nut shells;
- (m) Husks;
- (n) Cobs cleaned of kernels of corn;
- (o) Biomass fraction of wastes and residues from forestry and forest-based industries, namely, bark, branches, precommercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil;
- (p) Other non-food cellulosic material;
- (q) Other ligno-cellulosic material except saw logs and veneer logs.

Part B. Feedstocks for the production of biofuels and biogas for transport, the contribution of which towards the minimum share established in the first subparagraph of Article 25(1) shall be limited and may be considered to be twice their energy content:

- (a) Used cooking oil;
- (b) Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009.

Annex II

Description of Annex IX feedstocks

Feedstock	What it is and how it is produced	Existing practice or use (or its current function i.e. soil carbon)
a) Algae if cultivated on land in ponds or photobioreactors	Purposely grown aquatic biomass.	Food and feed additives, pharmaceuticals.
b) Biomass fraction of mixed municipals waste	Organic household waste which is not separated at origin.	Landfill, incineration. Recycling, composting.
c) Separately collected household biowaste	Organic household waste which is separately collected from households.	Landfill, incineration. Recycling, composting.
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;	Very broad category of raw materials. Could include industrial organic wastes such as: waste paper, cardboard, wood, food waste occurring at the production stage.	Recycling, landfilling and incineration.
e) Straw	Dry stalks of crops that remain following the removal of the grain and chaff during the harvesting of grains.	Large amounts of straw are left on field or incorporated into the soil to maintain soil health. If extracted, it can be used for animal bedding and fodder. Used also for heat & power, horticulture, mushroom production, frost protection and a wide range of products (bottles, bags, etc.).
f.1) Animal manure	Animal faeces.	Spread to fields as fertiliser or turned into biogas.
f.2) Sewage sludge	Sludge from sewage treatment of industrial or municipal wastewater.	Biogas production (for heat and electricity), incineration, spread to land.

g.1) Palm oil mill effluent (POME)	By-product of the palm oil processing industry – an oily acidic liquid with high concentrations of organic solids and fertiliser nutrients.	A waste which is remediated in pools (emitting CH ₄ and CO ₂), or used to produce biogas.
g.2) Empty Fruit bunches (EFB)	By-products of the palm oil processing industry, the residual after pressing the oil from the fruit.	EFB are typically combusted for onsite heat & power production, or incinerated. Some are also composted or used in paper and board production.
h) Tall oil pitch	Residue from the distillation of crude tall oil, which is a by-product of the pulp industry (paper making).	Currently largely used for energy use in the pulp mills.
i) Crude glycerine	By-product of biodiesel production. Biodiesel production yields around 10% crude glycerine.	May be upgraded for the manufacture of high-value food additives, anti-freeze, pharmaceutical and cosmetic products. Lower value uses are in heat & power, AD, animal feed, waste water treatment or cement.
j) Bagasse	The fibrous residue from the sugarcane crushing process, after the removal of sugar juices.	Used as a fuel for on-site heat and power (50%), incinerated without energy recovery (40%), or in paper and board manufacture (10%).
k.1) Grape marcs	Grape marc, or ‘pomace’, is the residue that remains after the pressing of fresh grapes to extract juice for wine making.	Increasingly used for other alcoholic beverages, grape seed oil, food colourings, sweeteners, preservatives, and health products. Originally used for mulch.
k.2) Wine lees	The sediment remaining in the vessels used in wine fermentation.	Similar current and former uses as for grape marcs.
l) Nut shells	Shells of nuts such as almonds, walnuts, hazelnuts etc.	Largely used for energy, though material uses exist.
m) Husks	Husks are the protective outer covering of seeds, nuts, grains or fruit	Mainly energetic use, but could be also a component of animal feed.
n) Cobs cleaned of kernels of corn	The central, fibrous core of a maize ear to which the maize kernels are attached.	Typically left to field during harvesting.

o) Biomass fraction of wastes and residues from forestry and forest-based industries, namely, bark, branches, pre-commercial thinnings, leaves, needles, tree tops, sawdust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil;		
o.1) Bark	The bark of trees.	Energy and mulch for horticulture. In some cases left to forest during harvesting.
o.3) Pre-commercial thinnings	Wood from uneconomic forestry management practices.	The wood is usually small diameter and left to forest floor.
o.4) Needles and leaves	Needles and leaves of trees. Would be usually collected together with treetops /branches.	The needles and leaves contain many significant nutrients for soil heath.
o.5) Tree tops and branches	Primary residues of forest harvesting operations.	In some regions, collected on selected sites for energy.
0.6) Saw dust and cutter shavings	Secondary residues from the processing timber at saw mills.	Paper, wood products, energy (heat and power).
0.8) Black and brown liquor	Black and brown liquor are the cooking liquors from the kraft pulping process, when digesting pulpwood into paper pulp.	Mainly for energy use (heat and power) for on-site use. Tall oil is extracted from black liquor prior to energy use.
0.10) Fibre sludge	Waste of pulp making.	Fibres too short for paper making. Used for energy, if used.
0.11) Lignin	Main component (40-45%) of black liquor.	Currently not common practice to extract lignin from black liquor.
0.12) Tall oil	By-products of the pulpwood industry. A yield of 30–50 kg / ton pulp is to be expected.	Use in chemicals and energy (heat and power). Non-energetic uses may contribute 1.0–1.5% to the mill's revenue.
p) Other non-food cellulosic material	This is a very broad category. The definition in REDII includes agricultural residues, energy, cover, and ley crops.	Depending on the material.
p.1) Cellulosic energy crops	Grassy energy crops such as Miscanthus, Switchgrass, giant cane, sorghum and hemp grown as main crops.	These energy crops are grown on agricultural land, and are perennial, thus with one seeding, it will yield biomass for multiple years.

p.2) Intermediate crops	Ley and cover crops (grass-legume mixtures), grown in between the main crop with a low starch content.	The “normal practice” now is leaving land without a crop in winter, or grow a winter crop. Intermediate crops could in some cases be added to the rotation, with the aim to produce fodder for livestock and improve soil fertility.
q) Other ligno-cellulosic material except saw logs and veneer logs.	This is a very broad category and could include almost anything, from recycled paper to pulp wood, to tree stumps.	Depending on the material.
q.1) Pulp wood	Small diameter trees and pulp-wood that have been grown specifically for the forestry products sector (e.g. paper, panel-board, fencing industries).	Part of growing stock in forest, sequestering carbon from the atmosphere. Main material use in paper and board production, and higher value fencing, furniture, and building materials.
q.2) Woody energy crops	Mainly Short Rotation Coppice (SRC), which is a dedicated woody energy crops, such as willow, poplar or eucalyptus, depending on geography.	These energy crops are grown on agricultural land, and are perennial, thus with one planting, the plantations will grow 20-30 years. Harvested every 2-5 years.
q.3) Tree stumps	After a tree has been cut and felled, the stump is usually a small remaining portion of the trunk, with the roots still in the ground.	Keeps organic carbon sequestered in the biomass for decades/centuries and increases soil carbon levels. Makes forest more biodiverse as provides dead wood habitat for insects.
Annex IX Part B		
a) Used cooking oil	Used cooking oil, collected from restaurants and households.	Used for animal feed outside Europe. Mainly used for biodiesel production in EU, other smaller uses for oleochemicals.
b) Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009.	The rendering (crushing and heating) of animal by-products. Category I carries a health risk, Category II is lower risk material such as digestive tracts or animals that have died on-farm.	Oleochemical applications and for energy (heat and power).

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- ⁱ Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC
- ⁱⁱ Directive (EU) 2015/1513 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015L1513>
- ⁱⁱⁱ Directive 2009/28/EC <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1562755255739&uri=CELEX:32009L0028>
- ^{iv} The cap does not apply to Malta or Cyprus. The cap level can also be modified by the member state. ““Member States may, where justified, modify that limit, taking into account the availability of feedstock. Any such modification shall be subject to approval by the Commission” Article 27, 1. (b) of Directive 2018/2001.
- ^v SWD (2012)343. ILUC directive impact assessment https://ec.europa.eu/energy/sites/ener/files/swd_2012_0343_ia_en.pdf
- ^{vi} Ecofys (2013) Assessing the EC ILUC proposal - Dutch National Impact Assessment <https://www.nvdb.org/getattachment/d24de992-687a-434a-a6ea-008363bf4749/20130425-Ecofys-Assessing-the-EC-ILUC-proposal.aspx>
- ^{vii} Directive 2018/2001, Art. 28 (6).
- ^{viii} Article 4(1) of directive 2008/98/EC: “The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy: prevention; preparing for re-use; recycling; other recovery, e.g. energy recovery; and disposal.”
- ^{ix} ICCT (2017) Potential greenhouse gas savings from a 2030 greenhouse gas reduction target with indirect emissions accounting for the European Union https://theicct.org/sites/default/files/publications/RED-II-Analysis_ICCT_Working-Paper_05052017_vF.pdf
- ^x COM(2019) 225 final, Renewable energy progress report https://ec.europa.eu/commission/sites/beta-political/files/report-progress-renewable-energy-april2019_en.pdf
- ^{xi} Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02008L0098-20180705>
- ^{xii} Defense terre (2013) Wastes, residues and co-products for biofuels and bioliquids <https://www.transportenvironment.org/sites/te/files/publications/Wastes%20and%20Residues%20-%20Briefing%20Note%20%28March.1.2013%29.pdf>
- ^{xiii} The directive utilizes an ‘allocation’ approach in LCAs, where upstream emissions are attributed proportionally to the energy content of the primary product, and if applicable, any co-products. The RED II allocation approach does not attribute a portion of the upstream production emissions to wastes and residues.
- ^{xiv} Directive 2018/2001, Annex V C
- ^{xv} <https://www.iscc-system.org/wp-content/uploads/2018/01/Feedstock-Classification-its-Implications-and-Double-Counting-in-EU-Member-States.pdf>
- ^{xvi} Directive 2018/2001, Article 29 (3).
- ^{xvii} “Crude tall oil arises from the process of pulping coniferous wood. The pulping process involves cooking woodchip in a chemical mixture and this gives rise to a soapy material which is separated from the pulp and liquor. It is then acidified and heated to convert it into crude tall oil. Crude tall oil is a product of the pulping process.” RTFO guidance, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/855618/list-of-feedstocks-including-wastes-and-residues-year-2020.pdf

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- ^{xviii} “Tallow is a product of the meat rendering process. Category 2 tallow has a high economic value and a variety of productive uses. It is a direct substitute for other products (e.g. palm oil).” RTFO guidance.
- ^{xix} <https://theicct.org/blog/staff/eu-alternative-fuels-oils-limit-20191119>
- ^{xx} https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/855618/list-of-feedstocks-including-wastes-and-residues-year-2020.pdf
- ^{xxi} « Concernant les « PFAD », les distillats d'acide gras de palme, la France maintient leur classification parmi les matières permettant de produire des biocarburants de première génération. » https://www.ecologique-solidaire.gouv.fr/sites/default/files/2018.11.14_SNDI_0.pdf
- ^{xxii} <https://www.novethic.fr/actualite/environnement/biodiversite/isr-rse/bioraffinerie-de-la-medee-nouveau-micmac-entre-total-et-le-gouvernement-sur-l-exoneration-d-un-sous-produit-de-l-huile-de-palme-148082.html>
- ^{xxiii} <https://www.neste.com/corporate-info/investors/shareholders-0>
- ^{xxiv} Unless evidence is provided that the harvesting of the raw material is necessary to preserve its status as highly biodiverse grassland.
- ^{xxv} Seppälä et al (2019) Effect of increased wood harvesting and utilization on required greenhouse gas displacement factors of wood-based products and fuels. Journal of Environmental Management Volume 247. <https://www.sciencedirect.com/science/article/pii/S0301479719308333>
- ^{xxvi} Directive 2018/2001, Article 29 (2).
- ^{xxvii} ICCT (2017) Potential greenhouse gas savings from a 2030 greenhouse gas reduction target with indirect emissions accounting for the European Union https://theicct.org/sites/default/files/publications/RED-II-Analysis_ICCT_Working-Paper_05052017_vF.pdf
- ^{xxviii} Malins (2017) Waste not want not https://theicct.org/sites/default/files/publications/Waste-not-want-not_Cerulogy-Consultant-Report_August2017_vF.pdf
- ^{xxix} ECA (2016) Special report No 18/2016: The EU system for the certification of sustainable biofuels <https://www.eca.europa.eu/en/Pages/NewsItem.aspx?nid=7171>
- ^{xxx} Inspectie leefomgeving en transport (2019) Signaalrapportage ILT, Fraude met certificering duurzame biodiesel, Mei 2019, https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2019Z10033&did=2019D20643
- ^{xxxi} A similar principle is explicitly mentioned in recital 21.
- ^{xxxii} For specific waste streams, Member States may only depart from the waste hierarchy where this is justified by lifecycle thinking on the overall impacts of the generation and management of such waste in order to encourage the options that deliver the best overall environmental outcome.
- ^{xxxiii} Article 2 (42) ‘non-food cellulosic material’ means feedstock mainly composed of cellulose and hemicellulose, and having a lower lignin content than ligno-cellulosic material, including 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; cover crops before and after main crops; ley crops; industrial residues, including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted; and material from biowaste, where ley and cover crops are understood to be temporary, short-term sown pastures comprising grass-legume mixture with a low starch content to obtain fodder for livestock and improve soil fertility for obtaining higher yields of arable main crops;’
- ^{xxxiv} https://theicct.org/sites/default/files/publications/RED-II-Analysis_ICCT_Working-Paper_05052017_vF.pdf

^{xxxv} IEEP, 2012, Mobilising cereal straw in the EU to feed advanced biofuel production

https://ieep.eu/uploads/articles/attachments/7027de1e-dc4d-43e8-8126-16402efe66ed/IEEP_Agricultural_residues_for_advanced_biofuels_May_2012.pdf?v=63664509775

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https://www.transportenvironment.org/sites/te/files/publications/a_new_EU_sustainable_bionenergy_policy_FINAL.pdf

^{xxxvii} The cascading use principle gives priority to higher value uses that allow the reuse and recycling of products and raw materials and promotes energy use only when other options are starting to run out. Further explanation [available here](#).

^{xxxviii} ICCT (2017) Review of the impact of crop residue management on soil organic carbon in Europe https://theicct.org/sites/default/files/publications/EU-crop-residue-mgmt_ICCT-working-paper_15122017_vF.pdf

^{xxxix} Transport & Environment (2017) A target for advanced biofuels <https://www.transportenvironment.org/publications/target-advanced-biofuels>

^{xl} Art. 28 (6) of the REDII