



Ministry of Infrastructure  
and Water Management

# Biofuels in relation to food and feed crops

Netherlands Institute for Transport Policy Analysis | KiM

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# Summary

**For many years, food and feed crops have played a modest role as feedstocks for biofuels used in Dutch transport. Waste materials and residues, on the other hand, are slowly becoming more important as feedstocks in this context. The food and feed crops originate outside the Netherlands: mainly from Europe (wheat, sugar beet, maize) and the United States (maize), and increasingly also from Brazil (sugar cane). They are used solely for the production of bioethanol, a gasoline substitute. Their contribution is also set to remain limited in the future.**

Biofuels will be essential if the transport sector is to meet its renewable energy obligations. When it comes to biofuels made from food and feed crops, policy at Dutch and European level attempts to strike a balance between encouraging their use on a modest scale and managing the risks that may be associated with this. The policy includes targets aimed at limiting the use of food and feed crops for biofuel production and in certain cases phasing it out. Across the whole of the European Union (EU), sustainability regulations are in place that all feedstocks for biofuel – including food and feed crops – must meet in order to be able to contribute to the target for renewable energy in the transport sector. The current (and future) limited use of biofuels made from food and feed crops in the Dutch transport sector is in line with this policy.

## **Multiple valorisation**

One opportunity that food and feed crops offer is the fact that they can be used and valorised in multiple ways, referred to as multiple valorisation. It is standard practice to separate proteins from sugars and to make use of both: the proteins for animal feed and the sugars for biofuels. This has the added advantage that the animal feed has a lower sugar content, reducing the methane produced by the animals. Since methane is a greenhouse gas, this serves a dual purpose: the use of the sugars for biofuel prevents CO<sub>2</sub> emissions and less sugar in the feed prevents a lot of methane emissions.

## **Intermediate crops**

Since 2024, intermediate crops have also been added to the list of biobased feedstocks that the EU is incentivising the most. This opens up new opportunities for multiple valorisation. Intermediate crops are cultivated in a period between the main crops. If these are used both to improve the soil and to produce biofuels, it creates a win-win situation. The use of intermediate crops for biofuel production is permitted on the condition that their cultivation does not lead to additional use of land. The statutory frameworks and criteria in place appear to offer an effective means of ensuring that intermediate crops are sustainable.

## **Meeting sustainability criteria**

Ensuring that sustainability criteria are met and enforced is and will remain an important prerequisite for sustainable biofuels in all cases. The government has a role to play in this process.

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# 1 Introduction

**The Dutch and European strategy for the energy transition in the transport sector involves a major role for biofuels. Since biofuels are not produced from fossil feedstocks, their use has less of an impact on the climate than that of fossil fuels.**

Biofuels can be produced from different types of biomass, such as animal or vegetable waste and fat, and food and feed crops, such as maize and sugar beet. According to Dutch and European policy, the use of food and feed crops is permitted up to a certain limit. In addition, the policy is also designed to prevent competition with the food supply or other undesirable consequences, such as deforestation.

In this study, we explore the current situation with regard to the use of biobased feedstocks for biofuels within the transport sector and what proportion of these are accounted for by food and feed crops. We also look at current and future policy in this area, at both Dutch and European level, taking into account previous studies of the potential risks and opportunities associated with the use of food and feed crops as feedstocks for biofuels.



# 2 About biofuels and food and feed crops

Biofuels are fuels that differ from fossil fuels because they are produced from biomass. These are materials of plant or animal origin, such as oil, fats and sugars from certain crops, animal fats and waste materials and residues from the processing industry or wood. Biofuels will be essential within the transport sector if it is to meet the European targets for renewable energy.



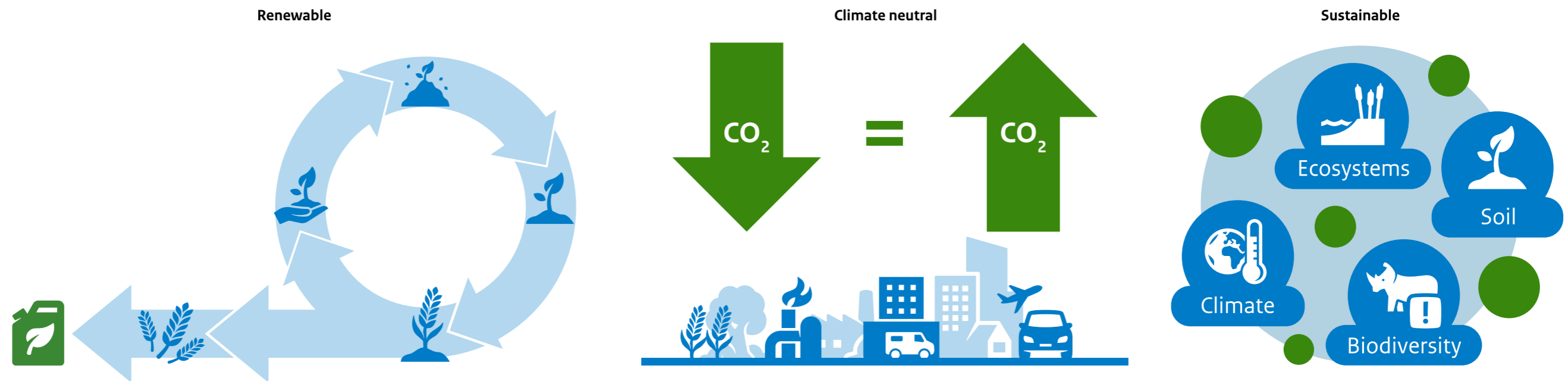
## What is the climate and environmental impact of biofuels?

The feedstocks for biofuels are **renewable**. In addition, the greenhouse gases released when biofuels are combusted are offset by the CO<sub>2</sub> absorbed by the crops that form the basis for the biofuels as they grow.

Biofuels are not completely **climate neutral**. This is partly because of the greenhouse gases emitted during the harvesting, transporting and processing of feedstocks into the final fuel. However, seen within the context of the entire supply chain, these emissions are much lower (legally, they must be 50% to 65% lower, depending on the age of the

production facility) than those from fossil fuels. Because of this, biofuels can play an important role in the energy transition. It should however be noted that, in common with fossil fuels, the use of biofuels is associated with air pollution. This is because they are used in a combustion engine.

Alongside the requirement to reduce CO<sub>2</sub> in the supply chain, broader **sustainability** requirements also apply for the use of biofuels in the EU and the Netherlands. These also cover such areas as soil quality and biodiversity.





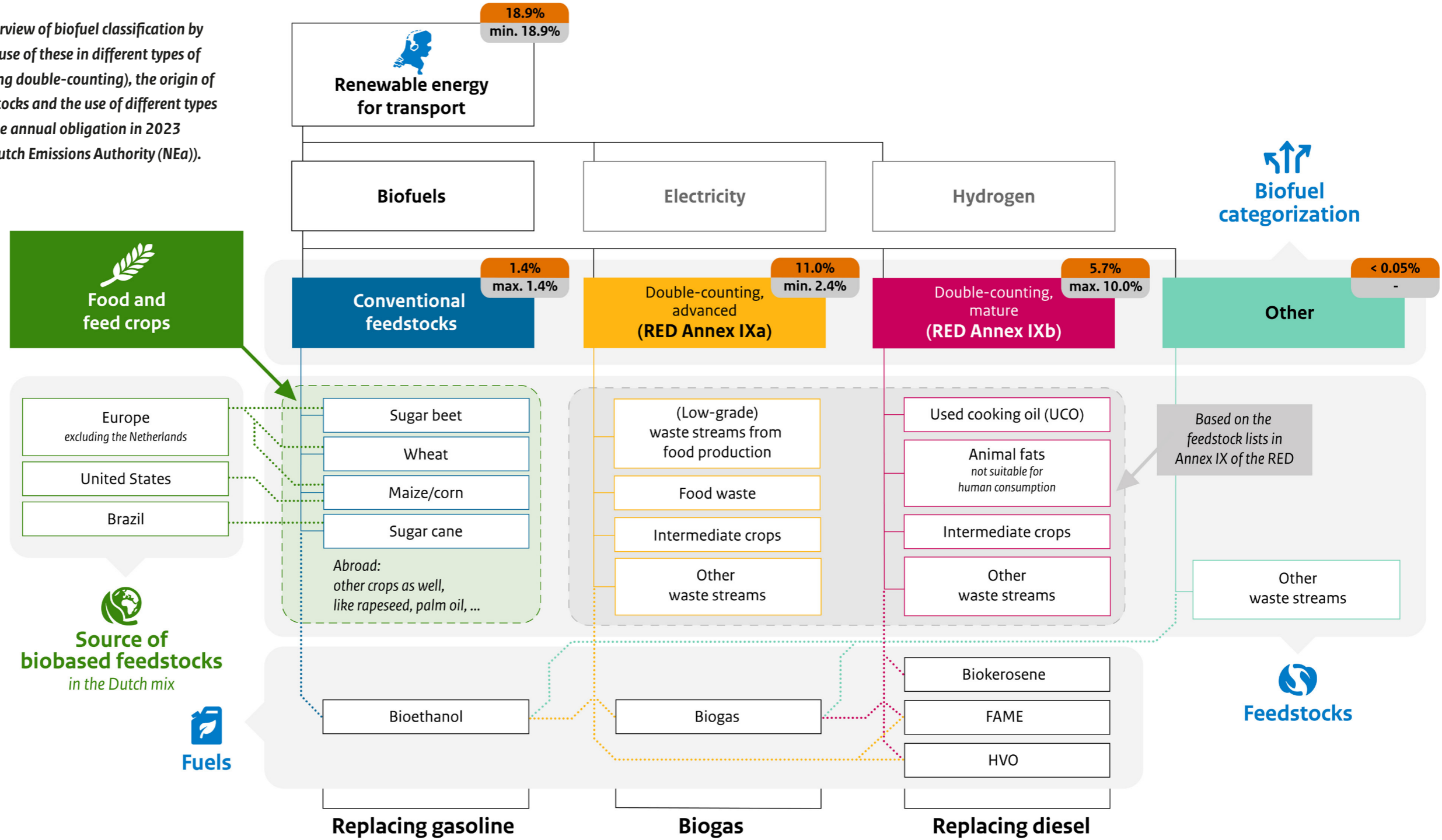
## What types of biofuels are there and how do food and feed crops fit in?

Biofuels can be divided into four categories, based on the origin of the feedstocks used and the method of production:

1. **IXa:** Advanced biofuels, such as those from waste materials and residues, which can only be processed by means of advanced technology (based on the list of feedstocks in Annex IXa of the Renewable Energy Directive (RED) of the European Union);
2. **IXb:** Biofuels from waste materials and residues that can be produced by means of mature (not advanced) technologies, such as oils and fats that are not suitable for consumption (RED Annex IXb);
3. **Conventional biofuels:** from food and feed crops;
4. **Other biofuels:** from feedstocks that do not fall within the above categories.

If food and feed crops are used directly as feedstocks for biofuels, they are classed as category 3 (conventional). In addition, there are also certain waste materials and residues from the food industry and, more recently, also intermediate crops that are permitted for use as feedstocks in categories 1 and 2 (i.e. Annex IXa and IXb biofuels), but only under certain conditions. In the case of intermediate crops for example, the demand for land use is not permitted to increase. Intermediate crops are crops that are grown in a period between the main crops.

Figure 1 | Overview of biofuel classification by feedstocks, the use of these in different types of biofuel (including double-counting), the origin of biobased feedstocks and the use of different types of biofuel for the annual obligation in 2023 (data source: Dutch Emissions Authority (NEa)).



Mandates for renewable energy in Dutch fuel supplies, including double-counting:

**%** = used for mandates in 2023  
**min./max.%** = lower / upper limit in 2023 according to "Besluit energie vervoer"

## What are some examples of food and feed crops for biofuel production?

A wide variety of food and feed crops can be used to produce (conventional) biofuels. Currently, the only biofuels used in the Netherlands are produced from sugar cane, maize, wheat and sugar beet. The Dutch Climate Agreement (*Klimaatakkoord*) also stipulates that it is not permitted to use biofuels made from palm oil or soy bean oil. In other European countries, soy bean and rapeseed are also used to produce biofuels, and sometimes even palm oil.

## What risks are associated with the use of food and feed crops for biofuels?

One much-debated downside of the large-scale use of food and feed crops for biofuels is the competition with the food supply. This competition could reduce food security or increase the price of foods. Additionally, any increase in the demand for food and feed crops for the production of biofuels at global level could cause deforestation if new agricultural land needs to be exploited for that purpose. This damages the ecosystem and the environment and causes additional greenhouse gas emissions (referred to as indirect land use change emissions, or ILUC emissions). However, recent academic sources would suggest that food security and energy security do not need to compete with each other. The link between biofuels and ILUC emissions continues to be debated internationally.

## What opportunities does the use of food and feed crops for biofuels offer?

The standard practice in the production of energy from food and feed crops involves multiple valorisation of the crop. This means that the crops are applied in several ways, maximising their use. As part of this, the sugars are separated from the proteins. It is only the sugars that are used for biofuel production (ethanol); the proteins remain available for use in animal feed, for example. Because this reduces the sugar content in the animal feed, it can also cause the animals to emit less methane.

The use of intermediate crops as feedstocks for biofuels can also lead to similar benefits: as part of crop rotation, the intermediate crops help improve the soil and in biofuel production, they provide an additional feedstock stream. The value that this adds strengthens the business case for the use of intermediate crops.

# 3 Food and feed crops in European policy

**The Renewable Energy Directive (RED III) incentivises the use of biofuels in the European Union member states. The Directive also sets targets to ensure that specific proportions of biofuels and other renewable fuels are used within the transport sector.**

## Which biofuels is the EU encouraging?

The EU aims to encourage the use of advanced biofuels (from feedstocks in Annex IXa) in particular, as well as oils and fats and other feedstocks from Annex IXb. Currently, these feedstocks are double-counted: their use (in terms of energy) counts double towards the renewable energy targets. Conventional fuels produced from food and feedstocks only count once (based on the energy content).

According to the new valuation method based on greenhouse gas savings that member states can apply from 2026 (RED III), Annex IXa and IXb fuels will 'automatically' be accorded a higher value than conventional biofuels. This is because they generally cause fewer greenhouse gas emissions across the supply chain.

## What risks of biofuels does the EU acknowledge and how is it limiting these risks?

In the RED, the EU also acknowledges that the use of certain feedstocks is associated with risks. This primarily concerns the use of food and feed crops for conventional biofuels. This can, for example, contribute to deforestation (ILUC). The contribution that these crops make to the renewable energy targets is not double-counted, but instead a maximum limit applies for each country of no more than one percentage point higher than in 2020 (the member state can opt to lower this further). Feedstocks that are recognised as having a high ILUC risk (based on criteria that currently apply to palm oil only) are being scaled down and will be phased out by 2030.

All biofuels must meet the minimum greenhouse gas saving requirements. More detailed sustainability criteria also apply to biofuels from feedstocks from agriculture, forestry and fisheries. In order to contribute to the transport sector's renewable energy targets, all biofuels must meet these criteria. Because fuel suppliers are obliged to deliver an increasingly larger proportion of renewable energy, these fuels are gaining in value.

## In what ways does RED Annex IX still permit the use of food and feed crops?

Annex IXa contains a number of low-value waste materials and residues from food production, such as palm oil mill effluent (POME) and nutshells. These must meet certain criteria designed to ensure that their use does not result in additional environmental damage.

In 2024, intermediate crops were also added to Annex IX. Intermediate crops are crops that grow in the period between the main crops, for example to improve the soil quality or structure (partly by digging them in after a period of time), to counteract weeds or to absorb residual nitrogen left in the soil after the harvest (catch crops). These may also be crops that could have been used for food (e.g. buckwheat and peas), but serve a different purpose as intermediate crops. As a result of being added to Annex IX, intermediate crops can be used not only as green manure or catch crops, but also as an as yet double-counted feedstock for biofuels (because all parts of the crops are used). There are certain criteria intended to prevent this resulting in the unauthorised use of food and feed crops. In order to serve as a feedstock for Annex IX biofuels, intermediate crops must for example, be cultivated on land where the production of food and feed crops is limited to a single harvest because of a short growing period. The soil's organic-matter content also needs to be maintained.



# 4 Food and feed crops in Dutch policy

In the Netherlands, the European Renewable Energy Directive (RED) has been enacted in the Environmental Management Act (*Wet milieubeheer*), the Energy Transport Decree (*Besluit energie vervoer, Bev*) and the Energy Transport Regulation (*Regeling energie vervoer*). All three of these will be revised and adapted in line with RED III in 2026. In addition, the Climate Agreement (*Klimaatakkoord*) also includes stipulations about biofuels.

What are the most important elements of the Bev in terms of (food and feed crops for) biofuels?

The Bev stipulates a minimum proportion of renewable energy in the fuel mix for transport. A minimum applies for the proportion of advanced biofuels (Annex IXa of the RED) within this mix and there are maximum levels for the proportion of biofuels from Annex IXb and from conventional feedstocks.

These limits currently apply to all supplies of gasoline, diesel and fuel oil in the Netherlands, unless they are intended for inland shipping and maritime shipping. Starting at the time when RED III is to be implemented in 2026, some rules and limits are set to be adapted and supplies to inland and maritime shipping will also count in meeting this obligation. The table on the next page shows the mandatory minimum and maximum proportions of biofuels that apply for the transport sector in the Netherlands.



Biofuels in relation to food and feed crops

## In which areas is Dutch policy on food and feed crops for biofuels stricter than the European directive?

The proportion of conventional biofuels that can count towards the Dutch transport sector's renewable energy target has been limited to 1.4% of the fuel supplied to the sector since 2022. This limit is the same as that for the proportion of conventional fuels in 2020. In this, Dutch policy is stricter than the RED, which permits an increase of one percentage point compared to 2020.

The Climate Agreement already stipulates that it is not permitted to use biofuels made from palm oil or soy bean oil. The Netherlands is also committed to changing the definition of 'high ILUC risk' at European level, in order to include soy bean oil in this category as well.

When it comes to the use of waste materials and residues from the food industry as feedstocks, the Netherlands is committed to the most high-value use. According to the Energy Transport Regulation, fewer waste materials and residues from the food industry can be used for advanced biofuels than stipulated in Annex IXa of the RED. For example, some of these that can still be used for animal feed production are not included on the Dutch list.

Category	Obligation	RED II								RED III
		2018	2019	2020	2021	2022	2023	2024	2025	2026 - 2030
Total	Minimum	8.5%	12.5%	16.4%	17.5%	17.9%	18.9%	28.4%	29.4%	New system based on CO <sub>2</sub> reduction compared to reference
IXa (advanced)	Minimum	0.6%	0.8%	1.0%	1.2%	1.8%	2.4%	2.9%	3.6%	
IXb	Maximum	-	-	-	-	10.0%	10.0%	10.0%	10.0%	
Conventional	Maximum	3.0%	4.0%	5.0%	5.0%	1.4%	1.4%	1.4%	1.4%	

# 5 Food and feed crops in the Dutch biofuel mix

**In 2023, approximately 18% of the energy supply to the transport sector came from biofuels. This proportion has increased significantly in recent years. At the same time, the proportion of conventional biofuels (from food and feed crops) remains relatively limited.**

## What quantity of biofuels are currently being used in the Netherlands?

In 2023, fuels suppliers subject to the obligations set out in the RED supplied 41.1 PJ of biofuels to the Dutch transport market. This is based on the energy content. After taking into account the administrative double-counting for biofuels from Annex IX feedstocks, the figure was 75.3 PJ.

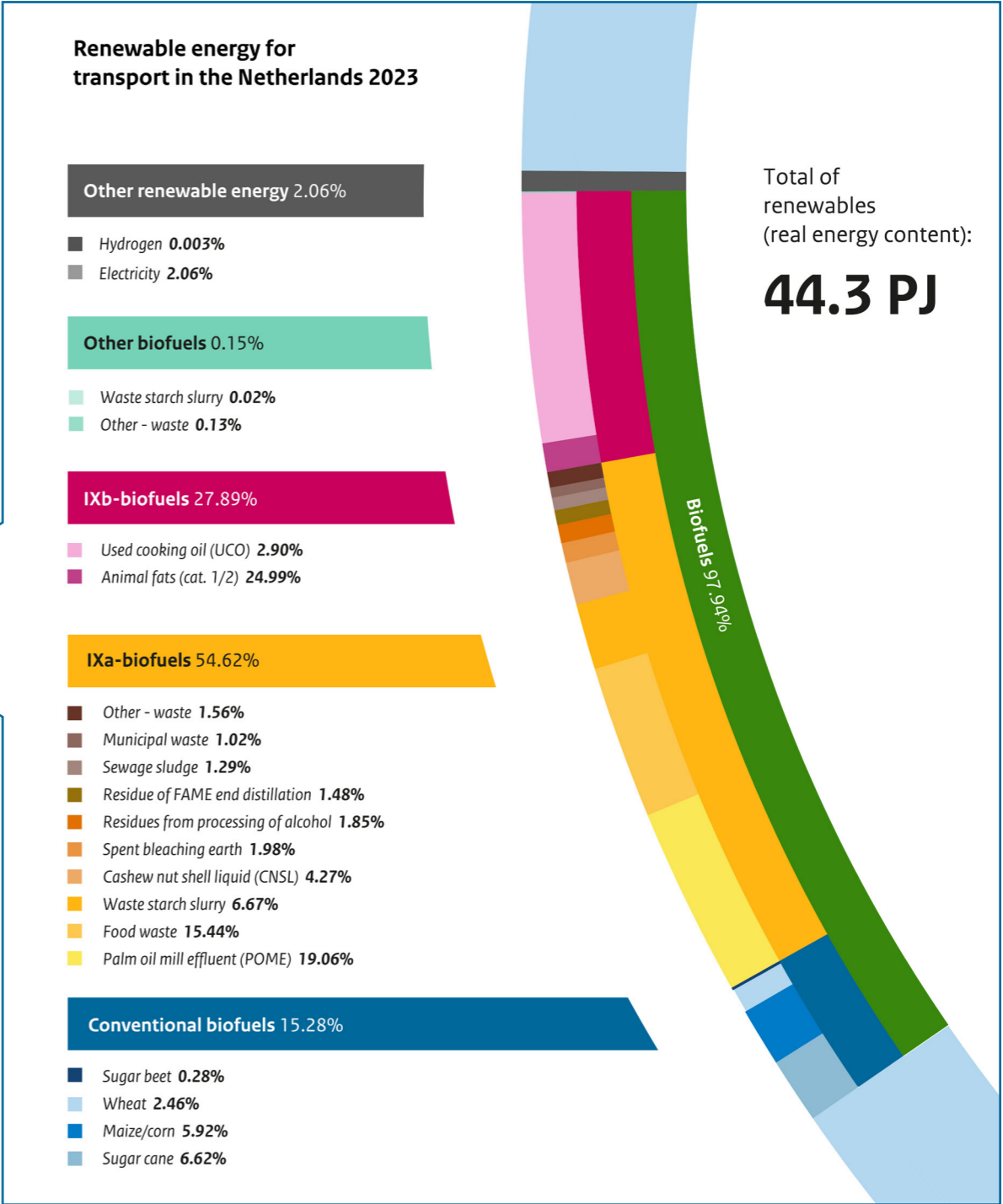
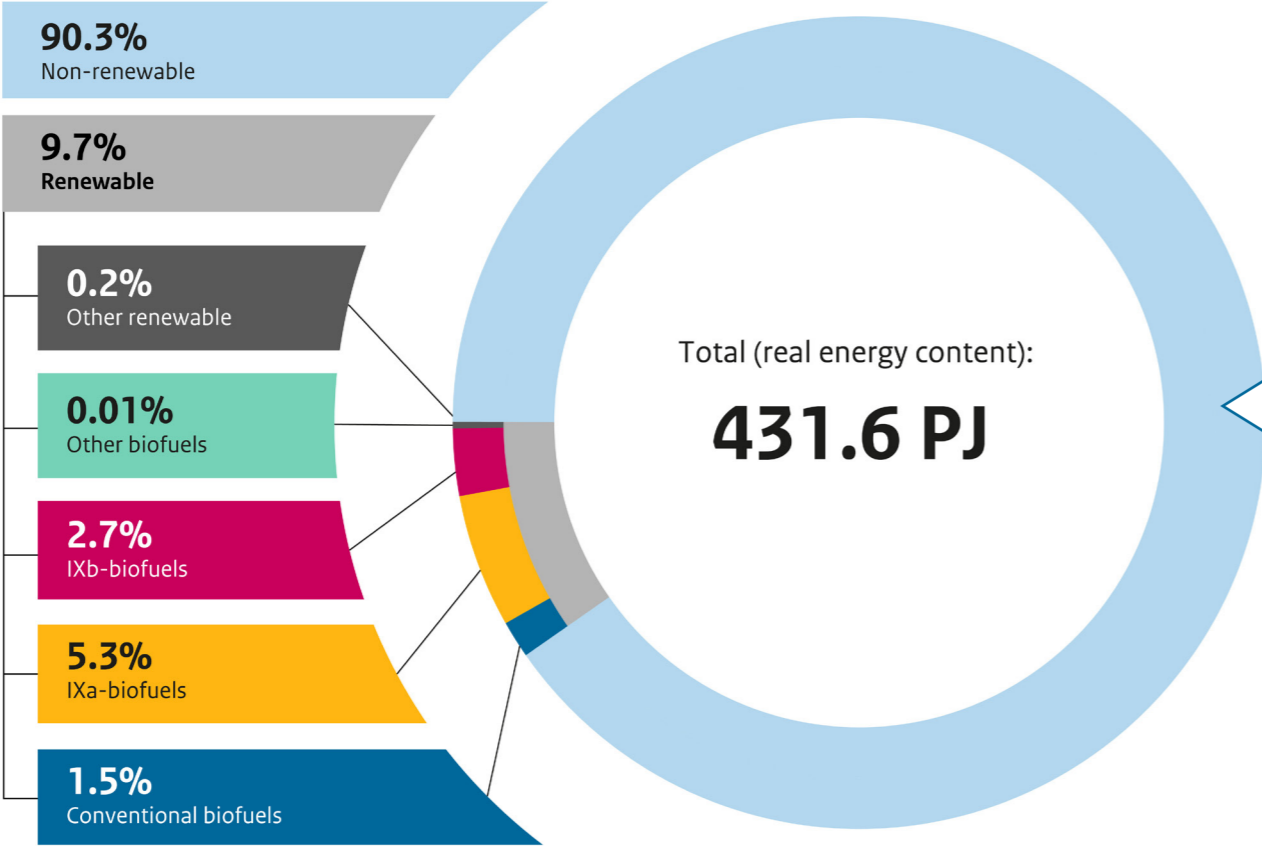
This equates to 18% of all supplies of gasoline, diesel and heavy fuel oil subject to this rule. If we add to this a small proportion of electricity and hydrogen, the total proportion of renewable energy in this sector amounts to 18.9%.

## Which feedstocks are currently used for the biofuels supplied in the Netherlands and what are they used for?

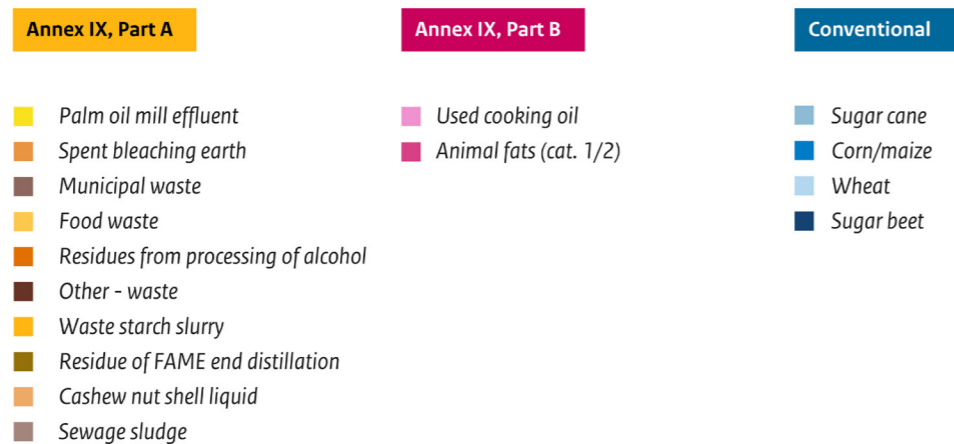
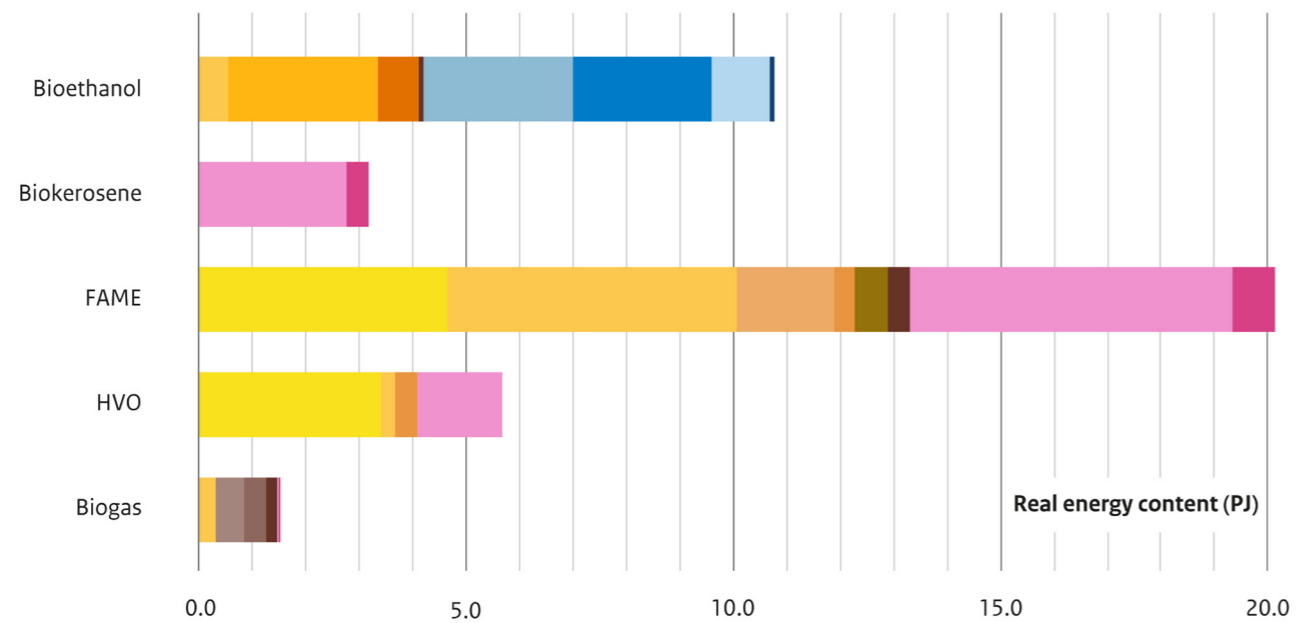
Most Dutch biofuels are produced from feedstocks listed in Annex IXa and Annex IXb of the RED. The proportion of conventional biofuels – 6.6 PJ in 2023 – is produced using the following food and feed crops: sugar cane, maize, wheat and sugar beet. While supplies of biofuels from Annex IX feedstocks have seen a significant increase in the last decade, the supply of conventional biofuels remains stable. Elsewhere in Europe, food and feed crops make up a greater proportion of the mix of feedstocks for biofuels; at European level, rapeseed is the most frequently-used feedstock in this category.

Figure 2 | Breakdown of biofuel feedstocks supplied in 2023 (based on real energy content, i.e. excluding double-counting) (data source: NEa).

Energy for transport in the Netherlands 2023



**Figure 3 | Breakdown of biofuel feedstocks supplied in 2023 (based on real energy content, i.e. excluding double-counting). Bioethanol is a gasoline substitute; biokerosene, FAME and HVO are diesel substitutes. The proportion of ‘other biofuels’ is approx. 0.06 PJ and is too small to be shown (data source: NEa).**



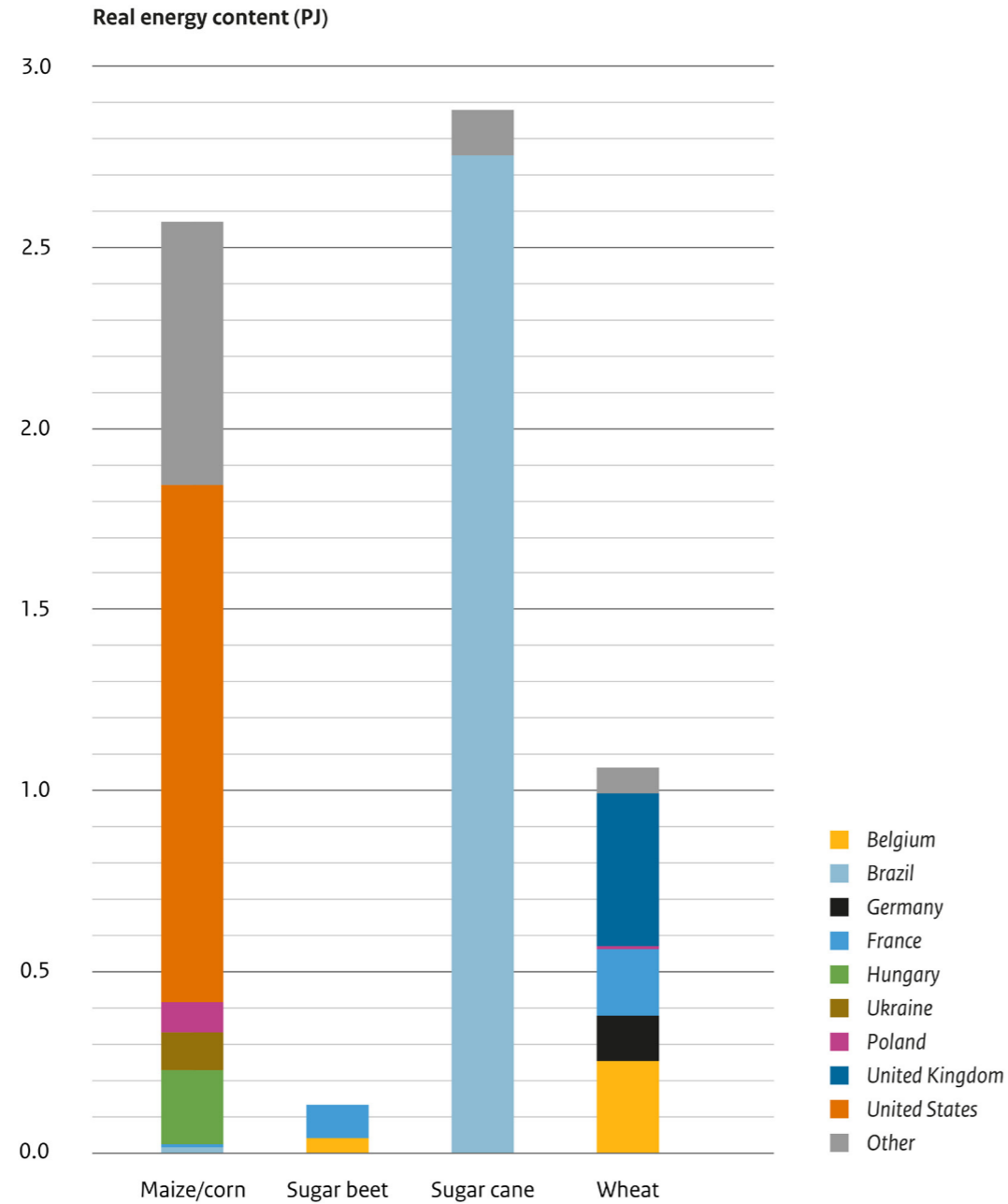
In the Netherlands, biofuels are used as a gasoline substitute (bioethanol), diesel substitute (biokerosene, FAME and HVO) or biogas. In 2023, conventional biofuels were used exclusively for the production of bioethanol.

### Where do the food and feed crops currently used for biofuel supplies in the Netherlands come from and what risks are associated with this?

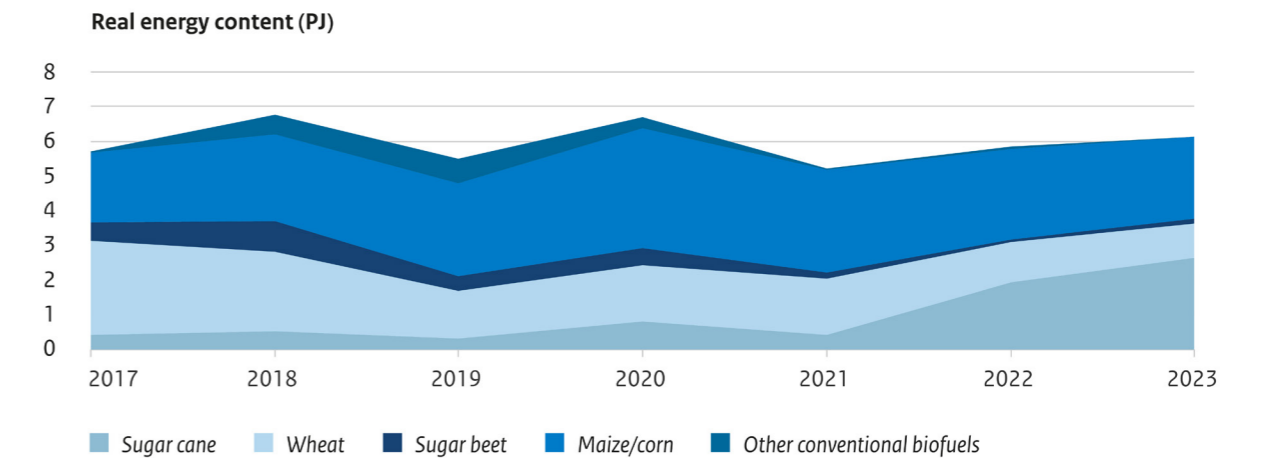
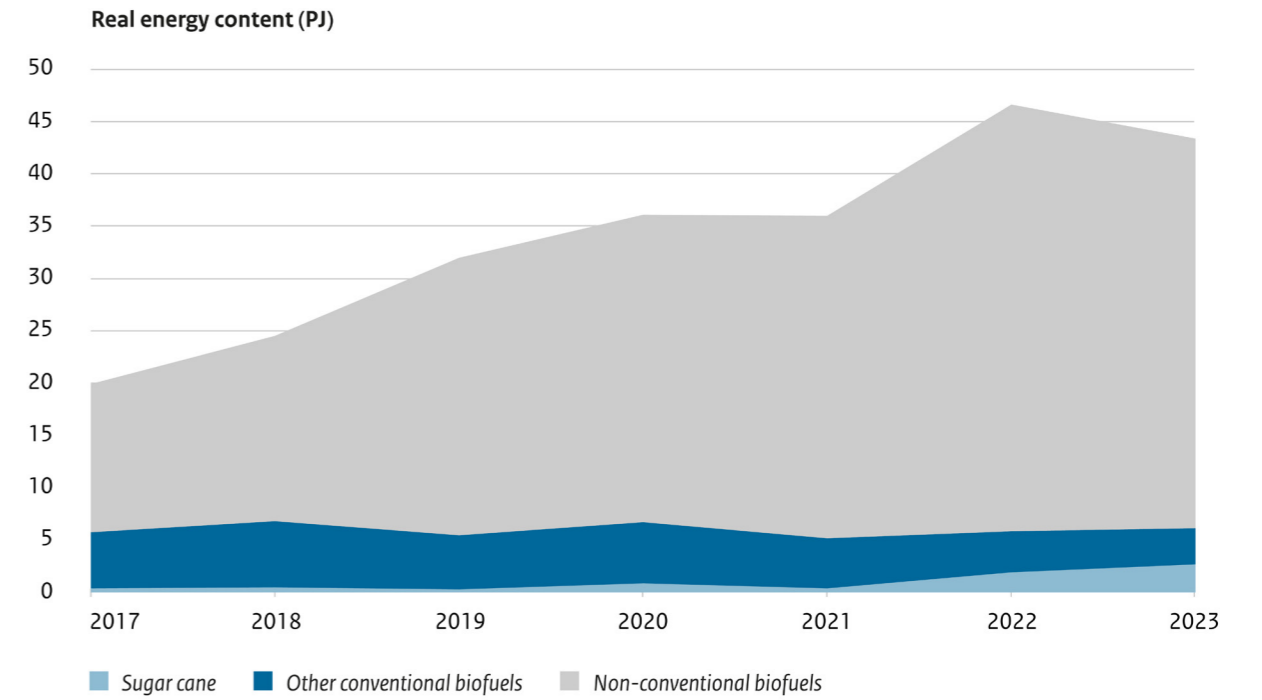
The source of the feedstocks for conventional biofuels varies according to the crop. Wheat and sugar beet come from Europe, the maize comes partly from Europe and the United States and almost all of the sugar cane originates from Brazil. None of these crops come from the Netherlands.

Based on a previous study on the use of feed and food crops for biofuel production, the Ministry of Infrastructure and Water Management noted in 2021 that the risks of deforestation caused by the Dutch use of biofuels “have been addressed or do not occur”, since deforestation is not an immediate risk in Europe or the United States. However, since then there has been a sixfold increase in the proportion of Brazilian sugar cane in biofuels supplied in the Netherlands. There is a risk that this use could involve deforestation. The existing strict rules on certification are intended to deal with this.

**Figure 4 | Breakdown of the origin of food and feed crops for biofuels supplied in 2023 (based on real energy content, i.e. excluding double-counting) (data source: NEa).**



**Figure 5 | Biofuels in the Dutch transport sector (2017-2023), highlighting the proportion of conventional biofuels and, within it, the increasing proportion of biofuels from sugar cane (based on real energy content, i.e. without double-counting) (data source: NEa).**



# 6 Conclusions and policy implications



For many years, food and feed crops have played a modest role as feedstocks for biofuels used in Dutch transport. Waste materials and residues, on the other hand, are slowly becoming more important as feedstocks in this context. Currently, the food and feed crops are used solely for the production of bioethanol, a gasoline substitute. In terms of energy, in 2023 they supplied 1.5% (6.6 PJ) of the fuels for transport in the Netherlands covered by the obligations set out in the RED.

Policy at Dutch and European level attempts to strike a balance between encouraging the use of conventional biofuels from food and feed crops on a modest scale and managing the risks that may be associated with this. The policy includes targets aimed at limiting the use of food and feed crops and in certain cases phasing it out. EU-wide sustainability regulations are also in place that all feedstocks for biofuel production must comply with in order to be able to contribute to the targets for renewable energy. The current limited use of biofuels made from food and feed crops in the Dutch transport sector is in line with this policy.

In some areas, Dutch policy and Dutch use is stricter than the European directive. For example, Dutch policy allows for a lower proportion of food and feeds crops than the RED permits. Based on the Climate Agreement, soy bean oil and palm oil are excluded as feedstocks. At European level, palm oil (a crop with a high ILUC risk) is being phased out by 2030 and no special considerations apply to soy bean oil as yet.

The standard practice for food and feed crops is for the sugars to be separated from the proteins. Only the sugars are used for biofuel production (ethanol); the proteins remain available for use in animal feed. This ensures that the crops are put to maximum use. Since the animal feed has a lower sugar content, the animals produce less methane.

The main risk involved in the use of food and feed crops comes from competition with food supplies and the possibility of deforestation, which can cause environmental damage and additional greenhouse gas emissions (ILUC). In 2021, the Ministry of Infrastructure and Water Management noted that this risk does not apply to conventional biofuels used in the Netherlands because the feedstocks for these came mainly from Europe and United States. However, there has been a significant increase in the proportion of Brazilian sugar cane in biofuels supplied in the Netherlands since then. This increase was not taken into account back in 2021. In principle, mandatory certification of the product supply chain should guarantee the sustainability of biofuels.

In 2024, intermediate crops were also added to Annex IX of the RED. This addition has the advantage that these crops can be put to multiple uses, for example as green manure and as feedstocks (as of yet double-counting) for biofuels. Intermediate crops may also be crops that could have been used for food but serve a different purpose as intermediate crops. They are cultivated in a period between the main crops. One of the conditions for their use in biofuel production is that their cultivation does not lead to any additional use of land.

Similarly to other Annex IX feedstocks and conventional feedstocks (food and feed crops), it would appear that the statutory frameworks and criteria effectively safeguard the sustainability of intermediate crops. Ensuring that these criteria are met and enforced is and will remain an important prerequisite for sustainable biofuels in all cases.

# About this publication

## Method

This study is based on a review of the literature.

## Background report

For more information on the method used, literature consulted and the results, consult the background report that can be downloaded via the website [www.kimnet.nl](http://www.kimnet.nl):

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