Guidehouse
outwit complexity

Risk assessment bio feedstocks

In the category ‘other’

Prepared for:

Rijksdienst voor Ondernemend Nederland

Rijksdienst voor Ondernemend Nederland (RVO)

Submitted by:

Guidehouse Netherlands B.V.
Stadsplateau 15
3521 AZ Utrecht The Netherlands
+31.30.662.3300

28 March 2025

Table of contents

1. Samenvatting

Dit rapport presenteert een risicobeoordeling van bio-grondstoffen in de context van het herziene Nederlandse biobrandstofquotasysteem binnen de Jaarverplichting Energie Vervoer, die verandert van een energiedoelstelling naar een CO_2-reductiedoelstelling. Binnen deze herziening wordt de preferentiele behandeling d.v.m. dubbeltelling van Annex IX A grondstoffen achterwege gelaten, waardoor brandstoffen met dezelfde CO_2-reductiepotentie in principe even aantrekkelijk worden om de CO_2-reductiedoelstellingen te behalen. Door de toenemende vraag naar deze grondstoffen binnen de biobrandstofsector zou er een marktverstoringseffect kunnen optreden en/of zou de kans op fraude kunnen toenemen. Binnen dit project ligt de focus ligt op potentiële marktverstoringen en fraude risico's die verband houden met grondstoffen die niet zijn opgenomen in Bijlage IX van de Richtlijn Hernieuwbare Energie (RED), specifiek binnen de categorie 'overige'. Hiervoor hebben we gekeken naar een selectie van representatieve grondstoffen: putvet, dierlijke vetten categorie 3 en soapstock.

Dit rapport is gebaseerd op de resultaten vanuit een kort onderzoeksproject voor RVO.

Belangrijkste bevindingen

Voor de marktverstoringsrisico's wordt putvet voornamelijk gebruikt in biobrandstoffen met beperkte alternatieve toepassingen, wat een laag risico op marktverstoring met zich meebrengt. Dierlijke vetten categorie 3 worden breed gebruikt in sectoren zoals diervoeding en in de oleochemische industrie, wat leidt tot een hoog risico op marktverstoring als ze worden omgeleid naar biobrandstoffen. Soapstock wordt gebruikt in de oleochemische industrie, wat een gemiddeld risico op marktverstoring met zich meebrengt vanwege de potentiële omleiding naar biobrandstoffen.

Wat betreft de frauderisico's, heeft putvet een middelmatig frauderisico vanwege mogelijke administratieve fraude en potentieel samenvoegen met andere grondstoffen zoals gebruikt frituurvet. Dit wordt voornamelijk versterkt omdat putvet momenteel grotendeels afkomstig is uit China met lagere regelgevende controle en waar voorheen al frauderisico’s waren omtrent gebruikt frituurvet. Dierlijke vetten categorie 3 hebben een laag frauderisico vanwege strikte regelgeving en traceerbaarheid door de hele toeleveringsketen. Soapstock heeft een middelmatig tot hoog frauderisico vanwege de diverse samenstelling, waardoor het moeilijk is om de oorsprong te traceren en er kans is op menging met andere plantaardige oliën.

Indicator	Putvet	Dierlijke vetten cat. 3	Soapstock
Marktverstoringsrisico			
Huidige & alternatieve toepassingen			
Vervangingsalternatief binnen andere sectoren			
Huidige beschikbaarheid			
Potentieel om aanbod te vergroten			
Broeikasgasbesparingen			
Prijsconcurrentie			
Frauderisico's			
Fysieke gelijkenissen met vervangers			
Consistente classificaties en definities			
Kenmerken van de toeleveringsketen			
Verzekering			

Conclusies en aanbevelingen

Een conclusie vanuit het project is dat putvet minimale risico's met zich meebrengt voor marktverstoring, maar wel een verhoogd risico op fraude. Dierlijke vetten categorie 3 en soapstock vertonen aanzienlijke zorgen, de verhoogde vraag naar deze grondstoffen in de biobrandstofsector kan bestaande markten verstoren, vooral voor hoogwaardige toepassingen.

In de herziening van de Jaarverplichting Energie Vervoer is er een optie om een correctiefactor op te nemen om het niveau van interesse in de grondstoffen in de categorie 'overige' te beperken. Een dempingsfactor zou een manier kunnen zijn om de risico's van deze soorten grondstoffen te verminderen, aangezien ze niet onderworpen zijn aan een limiet, zoals bijvoorbeeld Bijlage IX Deel B. Echter, aangezien niet alle risico's van marktverstoring en frauderisico's uniform zijn over de binnen dit project geanalyseerde grondstoffen in de categorie 'overige', kan het toevoegen van een blanco vermenigvuldigingsfactor onbedoelde effecten hebben voor die grondstoffen waar momenteel geen marktverstoring of frauderisico's worden waargenomen. Desalniettemin kan het selectief toepassen van de dempingsfactor een diepgaande analyse van elke andere mogelijke grondstof binnen de categorie 'overige' rechtvaardigen, om definitief vast te stellen of risico's van toepassing zijn en aannames uit dit document overdraagbaar zijn, of dat vooral binnen de Nederlandse context een grondstof deze substantiële risico's mogelijk niet ziet. Deze aanpak kan helpen de integriteit van hoogwaardige markten te behouden en de kans op fraude te verminderen.

De bevindingen benadrukken de noodzaak van zorgvuldige monitoring van grondstofstromen en het belang van duidelijke definities en classificaties om zowel marktverstoring als fraude in het evoluerende biobrandstoflandschap te voorkomen.

2. Introduction

In the revision of the 'Jaarverplichting Energie Vervoer' (Annual Obligation for Energy Transport) to implement the RED III in the Netherlands, the target basis will be changed from achieving an energy target (PJ) to a CO_2e reduction target. In addition, the double counting of residual flows included in Annex IX of the RED will be abolished in the revised Jaarverplichting. This means that there is no longer any preferential treatment of the Annex IX feedstocks, and raw materials that are not included in that list can therefore potentially receive an equal (or even better) valuation if they achieve an emission reduction comparable to raw materials that are included in Annex IX. The only difference is that for the raw materials in Annex IX Part A, a (relatively limited) sub-target is included in the Regulation.

The remaining target, after the sub-targets have been met and the caps on food and feed fuels and Annex IX Part B are filled is still considerable, which is expected to increase the pressure on the use of raw materials in the 'Other' category when implementing the RED III. This 'other' category consists of feedstocks that are not food or feed feedstocks and not feedstocks listed in Annex IX. They are thus not conventional or advanced, but fall in a third 'other' category. The main rationale for not including certain raw materials in the updated Annex IX list of feedstocks is that there is a risk of unfair competition with other uses, including potentially higher-value applications than energy, such as animal feed or oleochemicals. This may result in a risk of market distortion. Another reason may be an increased risk of fraud. Raw materials under Annex IX Part B are limited to 1.7% of the energy content of transport fuels supplied for consumption or use on the market and can therefore only cause a limited amount of market distortion. The raw materials that were not included in the Annex IX list do not have to adhere to this cap and could therefore be treated more favourably in comparison to the Annex IX Part B feedstocks, creating an increased incentive for fraud.

Since the remaining obligation, outside the sub-targets, is considerable, there is a possibility that the current set-up could provide a certain 'pull' to the raw materials in the 'other' category, whereby these raw materials could be pulled away from their current applications. In the event that this current application is seen as of a higher quality than use in the transport sector, this could be undesirable and not in line with the cascading principle or the waste hierarchy. For this reason, as a precautionary measure, there is the option to apply a correction factor in the current structure of the Energy Transport Decree to disincentivise certain feedstocks.

This study aims to assess the risk of market distortion of higher-value market applications and the possible risk of fraud of certain feedstocks not listed in Annex IX. This will be executed by qualitatively assessing the extent to which there is a risk, that not intervening or making changes to the currently proposed policy could be at the expense of higher-quality applications of specific 'other' raw material flows. This assessment is conducted on a selection of three types of feedstocks that are considered to be representative for the possible effects that could occur.

This report is based on the results of a short research project for RVO.

3. Review of feedstocks

This chapter provides an overview of the feedstocks that are considered to have a high risk of market distortion and a high risk in fraud according to the 'Assessment of the potential for new feedstocks for the production of advanced biofuels'[1] (further referred to as the 'Annex IX study'). From this longlist of feedstocks, three representative feedstocks relevant for the Dutch context were shortlisted. These are **brown grease, animal fats category 3** and **soapstock**.

3.1 Identifying feedstocks

3.1.1 Market distortion

The previously conducted Annex IX study[2] assessed the market distortion risks of different feedstocks, in a scenario in which they are being considered for addition to the REDII Annex IX. It thereby focusses on the European / global context, mainly considering alternative uses of the feedstock, currently, and how supply and demand dynamics could shift the flow of the material.

More specifically, market distortions were evaluated at both global and local levels by comparing current feedstock supply to current demand from biofuel/biogas and non-energy sectors (e.g., food, feed, oleochemicals). If supply significantly exceeded demand, the risk of market distortion from increased feedstock use for biofuel/biogas production was assessed as 'low'. Conversely, if demand exceeded supply, the risk was assessed as 'high'. The 'elasticity' of feedstock supply, reflecting the ability to increase production in response to increased demand, was also assessed. Feedstocks produced primarily through crop cultivation were mostly considered elastic, while residues or wastes from existing supply chains are generally rigid. The evaluation process involved the identification of current supply and demand, assessing supply elasticity, and considering the potential for feedstock substitution in other sectors due to increased biofuel demand.

To assess future feedstock potential, the production potential for 2030 and 2050 was forecasted in the Annex IX study based on existing growth projections or using proxy data such as GDP and industry market size when direct forecasts were unavailable. Current uses and their expected growth rates were considered to assess the available potential for biofuel production, taking into account other uses of the feedstock and supply elasticity. The focus was primarily on the EU potential, with insights into global potential provided where relevant: Animal fats category 3 in their analysis for example is mostly confined to a European-level review, since the definition of 'category 3' is not widely used outside of Europe, as well as import restrictions somewhat constrain trade of the feedstock to the inner-EU market. For other feedstocks such as UCO, more global considerations are taken into account, such as the factor that most supply of this feedstock comes from outside Europe and therefore is likely to also do so in the future.

The report used this analysis, the Annex IX report, using the methodology outlined above, then concludes on a list of feedstocks. These feedstocks, if increasingly used for biofuel production, could potentially distort existing markets from which these flows would be diverted from. The following list of feedstocks is marked as containing some or significant concern of market

[1] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU
[2] Ibid.

distortion in the report, in most cases owing to a large amount of other uses without the option to simply increase supply:

- Potato and sugar beet pulp
- Final molasses
- Pomace with oil
- Cover and intermediate crops
- Animal fats category 3 and animal by-products
- Soapstock and derivatives
- Palm fatty acid distillate (PFAD)
- Technical corn oil
- Distillers' dried grain with solubles (DDGS)

Brown grease was marked as 'no concern' for market distortion, due to it not having significant other uses outside of the energy sector.

Building on this list of feedstocks, for the scope of this paper these feedstocks were selected for an in-depth analysis which seemed most appropriate for the Dutch context. This means, that they were evaluated by a selection of stakeholders as posing as specifically important for some Dutch industries, and currently find wide-spread use within the country. The most prominent example for this was animal fats category 3, a feedstock for which a number of non-biofuel sectors submitted position papers outlining concerns regarding a pull of production streams into the biofuel sector.

3.1.2 Fraud risk

The Annex IX study assessed the fraud risk of the feedstocks that were reviewed for potential adoption in Annex IX. The study identified two types of fraud risk based on previous fraud cases regarding biofuels. These are: **Administrative fraud**, where a biofuel producer claims and sells more sustainability credits than actually exist, including creating fake certificates. This is not limited to Annex IX specific feedstocks and is the most common type of fraud uncovered. And **feedstock fraud**, where feedstocks that are not classified as Annex IX feedstocks are deliberately modified so that they can be reported as waste-based or advanced feedstock. This could for example mean mixing virgin oil with a waste-based or advanced feedstock to increase the overall volume.

This analysis will focus on the latter type of fraud, feedstock fraud, as it is specific to the types of feedstocks. Feedstock fraud can occur due to fraud elements incentivising fraud that are related to increase the profits that can be gained, called **primary risk indicators**. These are related to policy incentives and market patterns (such as available supply and feedstock market prices). These primary risk indicators include:

1. **Physical characteristics of the feedstocks:**

    a. <u>The physical characteristics</u> of the feedstock, whether there are substitutes with similar properties that can be fraudulently substituted or mixed with the waste-based feedstock. Key is that it would be difficult to identify the nature of the feedstock through visual inspection or simple tests.

b. The possibility of alteration of process of the feedstock, whether the economic operator has the option to purposefully modify a production process to generate higher amounts of the residues/wastes at the expense of the main process.

2. **Feedstock definition characteristics:**

   a. Definition across countries, whether there is a risk in the incompatibility or inconsistency of the definition across countries. Feedstocks with poorly understood definitions, or that have different definitions across borders, are more prone to (un)intentional fraud.

   b. Feedstock classification, whether a feedstock is classified as a waste or residue differently across borders which might cause differences in GHG calculations.

Besides these primary risk indicators related to the feedstock itself, there are **secondary indicators** that relate to the ease of fraud related to the type and complexity of the supply chain. These secondary risk indicators include:

1. **Supply chain characteristics**

   a. Trade patterns, whether there is a potential for (un)intentional fraud due to the number of intermediaries or global trade of the feedstock. Additional trade steps increase the risk of misreporting and make it more challenging to detect the falsification of the feedstock.

   b. Rule of law in producing countries, whether there is sufficient enforcement of laws in place in the producing countries that insures traceability and transparency of transactions. This is assessed using the World Justice Project Rule of Law Index.[3]

2. **Assurance**

   a. Origin tracking and feedstock segregation, whether assurance providers can establish the exact origin of the feedstock, especially in supply chains with no strict segregation. This is especially important if the auditing is post-source point. Fraud occurring at waste generation level is difficult to detect for auditors.

Based on the above criteria, there were several feedstocks that scored medium and high regarding fraud risk. Intermediate crops, especially commodity crops, and crops from degraded and polluted land scored high on the risks regarding physical characteristics as it is not possible to further distinguish these types of crops from a main crop post-harvest. These feedstocks also scored medium to high risk regarding the feedstock definition characteristics, as these feedstocks are not (yet) clearly defined. The recent additions to the Annex IX list of feedstocks do include intermediate crops and crops grown on degraded land with a definition and the Commission is working on an Implementing Regulation that will contain further guidance regarding the definition and certification of these feedstocks. That should make the definition clearer and lower the risk levels of these feedstocks.

[3] World Justice Project. WJP Rule of Law Index.

There were several processing residues derived from food and feed that were classified as high risk based on their physical characteristics in the Annex IX study, such as but not limited to: sugar (final molasses), olive oil extraction residues and high oleic sunflower oil extraction residues. Raw methanol also scored high based on physical characteristics. Bakery and confectionery products scored high on the feedstock definition characteristics as it is a broad category. Used cooking oil (UCO) scored high regarding physical characteristics.

3.1.3 Dutch context

In the Dutch context, there are three representative feedstocks that are relevant to further investigate in the context of the new CO_2-reduction target and the risks of market distortion/fraud. These feedstocks are **brown grease, animal fats category 3, and soapstock and derivatives**. In the Annex IX study, brown grease was flagged for fraud risk, animal fats category 3 for market distortion risk and soapstock and derivatives scored high on market distortion risk and medium-high for fraud risk. These feedstocks could be considered representative, as they all cover very different risk profiles. All three of these feedstocks are not on the current list of Annex IX feedstocks and would fall in the 'other' category, with the exception of soapstock (further elaborated below). Another feedstocks that was of interest was low grade starch slurry. This feedstock is reviewed in less detail than the main three feedstocks. Low grade starch slurry is currently already in use in the Dutch biofuel market, but not covered in the Annex IX study.

Brown grease

Brown grease used to be classified in the Netherlands as an advanced feedstock for biofuel production until the end of 2022 and together with UCO represented the largest feedstock shares for biodiesel production.[4] Brown grease is the material collected in grease traps for oils and fats from wastewater from restaurants and other commercial kitchens. It is a lower quality feedstock compared to UCO (also termed yellow grease).

In 2022, the share of brown grease increased from 7.8% to 26.2%, while UCO decreased from 43.6% to 27.6%. 41% of FAME consumed in the Netherlands was produced using brown grease. 98.1% of this feedstock originated from China.[5] NEa flagged the origin of brown grease as a fraud risk, as UCO comes from the same region and national legislation in third countries does not always make a clear distinction between the two feedstocks.[6] Market uptake of biofuel produced from brown grease was recently mostly observed in the maritime sector. Starting from 2023, brown grease was nationally no longer classified as an advanced biofuel if it goes to the maritime sector and is classified in the category 'other'. The 2023 NEa report on energy used in the transport sector reports that brown grease is no longer used in the transport sector due to the removal of the advanced biofuel status. This gap was partly filled by an increase of POME.[7]

Animal fats category 3

[4] Nederlandse Emissieautoriteit, Rapportage Energie voor Vervoer in Nederland 2022. Rapportage hernieuwbare Energie voor Vervoer in Nederland 2022 | Publicatie | Nederlandse Emissieautoriteit.
[5] Nederlandse Emissieautoriteit, Rapportage Energie voor Vervoer in Nederland 2022. Rapportage hernieuwbare Energie voor Vervoer in Nederland 2022 | Publicatie | Nederlandse Emissieautoriteit.
[6] Brinkmann Consultancy, Ketenanalyse biodiesel. Opdrachtgever: NEa
[7] Nederlandse Emissieautoriteit, Rapportage Energie voor Vervoer in Nederland 2023. Rapportage hernieuwbare energie voor vervoer in Nederland 2023 | Publicatie | Nederlandse Emissieautoriteit

Animal fats are segregated into three categories based on their levels of potential risk to human and animal health. Category 1 and 2 are high risk materials that are not fit for human consumption and are currently included in Annex IX part B point b and animal fats category 3 have the lowest risk and includes material fit for human consumption, animal products without a specified disease risk and former foodstuffs and catering waste. If products of different risk categories are mixed, the entire mix is classified to the highest risk category in that mix.

Animal fats category 3 in the EU are the most widely used animal fats for biofuel production[8], but in the Netherlands are not significantly used for this purpose in the transport sector. It makes part of the ‘other waste’ category together with some of other smaller feedstocks which together make up 1.6% of the feedstocks used for bioenergy in Dutch transport. Nevertheless, there concerns have been expressed by the Dutch pet food and feed sectors regarding the potential risk of market distortion which could occur if animal fats category 3 would be widely deployed in the transport sector. Advocacy groups and associations associated with these sectors provided written feedback expressing their concerns. They indicated that flow of animal fats category 3 into the biofuel sector would be especially harmful to their sectors, with the pet food industry suggesting that animal fats are “practically irreplaceable” due to its characteristics.[9] This concern is furthered by the implication that through generally rising transport biofuel targets, the pressure on alternative feedstocks which are not currently widely used for biofuels in the Netherlands, such as animal fats category 3, could increase. This can be explained through anticipated supply pressure on UCO, palm oil and soy oil, for which animal fats could pose as replacement alternative.[10]

Soapstock

Soapstock and derivatives (hereby after referred to as soapstock) are produced during the refining process of vegetable oils. Soapstock is often used in animal feed and can also be used in the production of soap or other oleochemical products. Another application is biofuels, although this is not implemented on a large scale yet in the Netherlands. Within the Annex IX study for the European context, some stakeholders listed FAME production as the most common usage for soapstock already. The Annex IX study flagged that soapstock is sometimes classified as a residue and sometimes as a by-product. In the Netherlands soapstock is classified as a by-product and is therefore counted as the parent feedstock. In most cases, this would be from virgin vegetable oils made from food and feed crops and therefore be a conventional biofuel under the food and feed cap. There are cases however, that soapstock is made from oilseeds from non-food or feed crops, such as intermediate crops. It could then be classified as either ‘other’ or advanced depending on the classification of the parent feedstock. Due to the uncertain nature of the classification of this feedstock, it is still important to understand the market distortion risks and fraud risks if it were to be included in the ‘other’ category.

Under the new Regulation promoting sustainable aviation fuels, ReFuel Aviation, soapstock were explicitly excluded from counting towards the blending target.[11] Although there is no official

[8] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU
[9] Implications of RED to Netherlands - provided by RVO.
[10] Ibid.
[11] Article 4(5) of REGULATION (EU) 2023/2405: “SAF produced from the following feedstocks shall be excluded from the calculation of the minimum shares of SAF set out in Annex I to this Regulation: ‘food and feed crops’ as defined in Article 2, second paragraph, point (40), of Directive (EU) 2018/2001, intermediate crops, palm fatty acid distillate and palm and soy-derived materials, and soap stock and its derivatives.”

communication on why soapstock was excluded from ReFuel, a voluntary scheme explains that it was due to the risk of ILUC (indirect land use change) emissions.[12] The Annex IX study flagged the potential risk of increasing land demand as a significant concern, as it is likely that a diversion of soapstock to biofuel uses would increase the demand for high risk substitutes such as maize, palm oil and soy. Seeing as it is a by-product of vegetable oil production, soapstock production itself may also carry increased land use and sustainability concerns.

It cannot be traced back how much soapstock was used as a feedstock for biofuels consumed in the Netherlands as it is booked in to the HBE-system alongside the parent material they originate from. Nevertheless, the CEO of Bukom, a company that processes and sells residues among which soapstock, anticipates that the demand for wastes and residues will increase due to biofuels.[13] Currently the main driver for an increase in demand is due to livestock farming and the associated rising animal feed demand, one possible end use for soapstock.[14]

Other feedstocks

Starch slurry can fit in three categories either as a conventional feedstock, an advanced feedstock or a feedstock in the ‘other’ category. In the reference list of eligible feedstocks to be booked into the HBE system, *waste starch slurry* is defined the same as in Annex 5 of the Regeling Energie Vervoer that outlines feedstocks eligible as an advanced industrial waste feedstock, where the feedstock is derived from wet milling wheat. The *low grade starch slurry* in the ‘other’ category is also defined in the reference list, with a distinction that it is made from dissolved starch and sugar from the dry milling of barley.[15] The 2023 Nea rapportage ‘Energie voor Vervoer’ on the breakdown of different feedstocks of bioenergy reports that a part of the low grade starch slurry falls in category ‘other’ because it does not fit the requirements of the ‘Regeling energie vervoer’.[16] The part that falls into the ‘other’ category made up 88% of the ‘other’ category, making it a significant and important feedstock. Unfortunately low grade starch slurry made from barley was not covered in the previous Annex IX study, the waste starch slurry from wheat was covered but as it is not in the ‘other’ category in the Dutch context, so not deemed relevant for further analysis in the scope of this paper.

In 2022, Fish Oil Ethyl Ester (FOEE) was the only feedstock booked into the category 'other'. It is defined as "From Omega 3 production. Unsuitable for human and/or animal consumption.".[17] Within the current Annex IX a feedstock is defined in part A which reads, “Waste fish oil classified as categories 1 and 2”, and the Annex IX report[18] states that all fish oil categories are covered within Annex IX, either in A or B (likely referring to fish oil methyl esters). Nevertheless, FOEE seems to be distinctive from other fish oils and non-classified, placing it into the category ‘other’ in the Netherlands. Being classified as unsuitable for consumption, it likely cannot be used towards the otherwise common uses of fish oil, mostly in the nutrition industry. The risk of market distortion

[12] RSB (2024). Sustainable feedstock assessment for sustainable aviation fuel production in southeast Asia.
[13] BUKOM - MVO
[14] The Global Acidulated Soapstock market is Growing at Compound Annual Growth Rate (CAGR) of 5.6% from 2023 to 2030.
[15] NEa. Referentiegegevens REV. https://www.emissieautoriteit.nl/onderwerpen/register/referentiegegevens
[16] NEa. Rapportage Energie voor Verover in Nederland 2023. Rapportage hernieuwbare energie voor vervoer in Nederland 2023 | Publicatie | Nederlandse Emissieautoriteit
[17] Nea. Referentiegegevens REV | Register Energie voor Vervoer 2022-2030 | Nederlandse Emissieautoriteit.
[18] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.

within this feedstock is therefore questionable, but not certain since the feedstock does not receive attention within the Annex IX study.

Another consideration which could be made is the fact, that though somewhat different in their make-up and uses, the assumptions made could carry implications for other feedstocks. Some of the feedstocks which were marked as ‘high risk’ on the fraud or market distortion indicators in the EU-level report[19] could potentially see similar results on the Dutch level, as is the case for animal fats here. These feedstocks which were marked as ‘high risk’ can be revisited in the longer feedstock lists above. Additionally, new feedstock streams of previously uncommon feedstocks into the Dutch market can be remarked as carrying specific risks, especially linked to fraud. An example of such would be Cashew Shell Liquid Nut (CNSL) which from one reporting year to the next in 2022 spontaneously saw a large amount of imports into the Netherlands, while no volumes had been reported previously[20]. A certain awareness of potential risks related to quickly growing volumes of one specific feedstock, especially advanced ones, is recommended.

[19] Ibid.
[20] Nederlandse Emissieautoriteit, Rapportage Energie voor Vervoer in Nederland 2022. Rapportage hernieuwbare Energie voor Vervoer in Nederland 2022 | Publicatie | Nederlandse Emissieautoriteit.

3.2 Current situation of the feedstocks

The previous part of this report outlined in detail the selected feedstocks and their characteristics This section then presents an assessment of the current situation of the selected feedstocks in the Dutch context, as assessed along the categories of market distortion and/or fraud. While the following table and sections provide an overview and summary of conclusions, the detailed assessment per category per feedstock including sources can be found in the annexes of this paper.

Risk indicators	Brown grease	Animal fats cat. 3	Soapstock
Market distortion risk			
Current & alternative uses			
Replacement alternative within other sectors			
Current availability			
Potential to increase supply			
GHG savings			
Price competitiveness			
Fraud risks			
Physical similarities to substitutes			
Consistent classifications and definitions			
Supply chain characteristics			
Assurance			

3.2.1 *Brown grease*

Brown grease was selected as a feedstock which might pose certain risks if its use in the Dutch biofuel sector were to increase. Though not previously listed as high-risk for market distortion in the Annex IX study, for completeness, this feedstock was assessed for both market distortion and fraud indicators. The more detailed outcome of this analysis can be found below.

3.2.1.1 *Market distortion risk*

Brown grease overall is assessed as carrying a **low risk** of market distortion. Though it carries some similarity with higher-value feedstocks such as UCO, brown grease tends to be significantly more contaminated, implying that pre-processing is necessary for many uses. As such, brown grease at this point in time is mostly used for biofuel (and biogas) production in Europe, and in the Netherlands more specifically. This implies that use in biofuels is seen as in line with the waste hierarchy principle, seeing as no higher-value application for the feedstock currently is predominant.

In addition, the general supply of brown grease is also possible to expand, should appropriate infrastructure and collection systems be established, nationally and globally. This implies that additional streams of feedstock could be available in the future. Due to the lack of competing industries which might need the feedstock and potential to increase the supply of the feedstock, a risk of market distortion is not really given, and all flow of brown grease into the biofuel sector should be viable.

3.2.1.2 Fraud risk

The overall fraud risk of brown grease is assessed as **medium**. Brown grease is a feedstock that is consistently defined as a waste and is visually and chemically distinct from the other waste fats such as UCO and animal fats. However, as technology further develops, pre-treatment will be improving which will make the fats more visually similar. It also increases the steps in the supply chain, increasing opportunities for fraud.

There is a potential of administrative fraud due to the way the supply chain and certification is currently set up. A NEa report warned that the fat content of ISCC compliant brown grease could be administratively inflated and other fats such as animal fats category 3 would be blended in to compensate on the mass balance.[21] The report advised that ISCC set up similar tools to audit UCO and brown grease as is done for POME to give more guidelines to auditors which could limit the fraud risks. The Union Database would also decrease the chance of fraud throughout the supply chain, but any fraud risk at the points of origin or collection points that registers the feedstock in the Union Database remains.

Nearly all of the brown grease used in the Netherlands originates from China, where the separation between UCO and brown grease is not optimal. China ranks low in the Rule of Law index, suggesting that they are less likely to have sufficient regulatory oversight to control against fraudulent practices. There is a risk that UCO and brown grease are not properly separated at the beginning of the supply chain. Similar to the certification and auditing of UCO, it is not possible to have perfect oversight of the points of origin.

3.2.2 Animal fats category 3

Animal fats category 3 is a feedstock which already finds application in the biofuel sector, but in the Netherlands currently is mostly used in alternative sectors such as the pet food industry. This product was within the Annex IX report assessed to carry substantial market distortion potential, as well as some of the Dutch industries which currently use animal fats category 3 submitted position papers, voicing concerns about a potential change of flows. The position held by the pet food and feed industries is that a change of this flow would carry significant risks of feedstock available for their use. As such, it was decided to undertake an in-depth assessment of Animal fats in the Dutch context, for market distortion and fraud for completeness of the picture.

3.2.2.1 Market distortion risk

The overall risk of market distortion for animal fats category 3 can be seen as **high**. A major contributing factor to this is that currently, animal fats category 3 find application in many other sectors. Some discussion exists regarding the status of animal fats category 3 as a waste product due to these varied other applications, and it is usually seen as a by-product instead.

The major other industries which utilise this feedstock are pet food and feed, oleochemicals, and to some extent the food industry. Though some shift in the oleochemical sector towards vegan

[21] Brinkmann Consultancy. (2023). Ketenanalyse biodiesel. Ketenanalyse biodiesel | Publicatie | Nederlandse Emissieautoriteit

materials such as virgin oils, especially for cosmetics, has been observed, the remaining industries continue to rely on a steady flow of animal fats. It is also within these industries especially, that animal fats category 3 is seen as nearly irreplaceable, due to its unique characteristics of providing both energetic content as well as palatability. Potential alternatives, which might not actually provide the same value to all industries, additionally should be assessed for additional land use requirements and sustainability markers, e.g. as is the case for virgin oils; as well as it should be kept in mind that waste alternatives such as UCO already are experiencing increased supply pressure due to an increasing use in biofuels. It should be remarked that some industry players, mostly producers of the feedstock, highlight that currently a part of the available animal fats category 3 is already in use for biofuels without such larger negative effects. This observation could be potentially explained through the lessened use in the oleochemical sector, freeing up some part of the feedstock. The pet food industry especially holds the opposing view that some additional pressure on the feedstock has already been created through some use of animal fats category 3 in biofuels. This development should continuously be monitored.

Considering the supply of animal fats category 3, it is expected to decrease over the coming decades. Animal fats production is directly related to the number of animals rendered, and with an anticipated diminished meat demand this number is projected to decrease. Though current supply remains stable, this would create an additional pressure on the feedstock. Additionally, the import of additional feedstock from outside Europe, where production might not decrease, is made difficult by European regulation on the food safety requirements of imports. These requirements mean that only assigned factories outside of Europe can even produce animal fats for import into the EU, and much available stock remains ineligible. These factors and the already increasing amount of animal fats used int the biofuel sector, where it remains interesting due to its GHG emissions savings, has pushed pricing of the feedstock in the past year. Industry associations expect this development to continue. Overall, without a disincentivising of utilisation of animal fats category 3 for the biofuel sector in the Netherlands, the risk of market distortion is assessed as high.

3.2.2.2 Fraud risk

There is an overall **low risk** of fraud when it comes to animal fats category 3. Animal fats have similar free fatty acids (FFA) contents as palm oil which could make it difficult to distinguish and there could be a risk of blending. However, animal fats are usually sold solid whereas other fats are sold as liquids. This could provide a clear distinction for animal fats from other fatty acids.

Animal fats category 3 could be potentially mixed with animal fat category 1 and 2, as they have the same physical characteristics. There are however strict rules around keeping the streams separated as it concerns human health risks. Additionally, there is little economic incentive as animal fats category 3 produces a high quality meal which would decrease if blended with lower quality fats. The industry aims to maximise overall economic value thus would not risk downgrading their fats and would likely not deliberately change the production process to generate more animal fats.

The rules around these fats are strict at an EU level and only facilities in third countries that are approved by the European Commission are allowed to export to the EU market. There is good traceability across the supply chain from point of origin to end use, which makes deliberately mislabelling, reclassifying or blending challenging.[22]

3.2.3 Soapstock and derivatives

Soapstock and its derivatives was assessed as **high risk** of market distortion in the Annex IX report. While it had not previously been listed in an earlier stage of this project as a feedstock of special concern, during a stakeholder workshop, several participants remarked that it might be an interesting feedstock to look at. It was hence selected for an in-depth review, following the indicator structure for market distortion and fraud subsequently.

3.2.3.1 Market distortion

The market distortion potential for soapstock is assessed as **medium**. While a current application in other sectors is given, the feedstock outside of the Netherlands according to a stakeholder consultation held as part of the Annex IX study is already used in other European countries for biofuel production. Generally, the feedstock is not a waste but a by-product of vegetable oil production, and potentially high indirect emissions depending on the methodology used could make it less attractive for the use in biofuels.

Soapstock and its derivatives currently find application in the oleochemical industry, as the name suggests, and to some extent for the production of livestock feed. Currently most supply is covered through demand, which is the reason for the feedstock being assessed as of risk in the Annex IX study. Nevertheless, this risk of market distortion is decreased by the fact that supply is expected to increase. Seeing as this by-product of vegetable oil production is dependent on the production of these virgin oils, and the production of such is expected to increase over the coming decades, the flow of feedstock is also expected to expand. This projected increase in oilseed and therefore vegetable oil production can be traced back to rising demand, from both biofuel and other sectors globally: Having grown substantially over the past years and continuing to do so.[23][24] Additionally, it could be replaced in many of its current uses also within the Netherlands through alternatives. One major concern which remains is that most alternatives, e.g. virgin oils, have higher land use and sustainability risks associated.

Overall, some concern for market distortion exists due to soapstock currently being fully utilised in alternative sectors without any indication of oversupply. Nevertheless, the supply is expected to increase, and alternatives for other sectors exist – these might just carry higher concerns for land use and sustainability risks. More prominently, an argument could be made for disincentivising soapstock use in biofuel production due to its potentially associated high indirect emissions; which if considered in the GHG calculations methodology would make the feedstock less attractive for biofuel production under the upcoming Dutch quota system.

[22] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU
[23] OECD-FAO (2013). OECD-FAO Agricultural Outlook 2013.
[24] Agricultural Economic Insights (2022). aei.ag/overview/article/vegetable-oil-trends-production-oilseeds.

3.2.3.2 Fraud

The overall fraud risk for soapstock is **medium to high**. Soapstock is made during the refinement process of any vegetable oil and can therefore be made with a wide variety of feedstocks. This causes a disparity in chemical properties of soapstock with varying levels of fatty acid composition. There have been several methods to distinguish what feedstock soapstock was made from, such as looking at the fatty acid content, however there is no agreed upon general industry standard. The wide variety of what soapstock is also makes it appear similar to other materials. Feedstocks with a high fatty acid content, such as UCO or unrefined vegetable oil, could pass on as soapstock as they are difficult to distinguish. There is also a risk of contamination of virgin vegetable oils and to deliberately mix virgin vegetable oils with soapstock to make it appear as soapstock. However, as soapstock has a lower price than virgin vegetable oil, there is little economic incentive to do so. This remains a risk however as the possibility is there. There is another risk that the refinement process of vegetable oil could be made less efficient deliberately to generate more soapstock. Soapstock is not uniformly defined or classified. Across literature, there is no consensus whether soapstock is a residue, by-product or co-product. There is no one definition of soapstock, especially as this category also includes the derivatives.

Regarding the supply chain, soapstock is produced anywhere vegetable oils are refined. It is thus produced globally, including countries with a weaker rule of law where there is a higher risk of fraud. Soapstock is currently already in use in various industries, there are already quite some parties involved in the supply chain which could increase the risk of fraud as there are multiple intermediaries. Soapstock could be traded internationally, however it is often not traded. In 2019, trade of soapstock outside the EU was around 6.6 thousand tonnes and trade within the EU was around 117 thousand tonnes of soapstock compared to the estimated 13 million tonnes of soapstock that could be produced.[25] This risk is thus assessed as medium, as there is potential along the supply chain for fraud but as it is not widely traded the risk remain contained. This could of course change in the future if there is more incentive for using this feedstock and trade increases.

Soapstock is segregated in the vegetable refining process and tends to be kept separate which makes auditing simpler. Soapstock tends to not be mixed with other vegetable oils, but could be mixed with soapstock from a different feedstock. There is no standardisation of soapstock production, so it is difficult to trace back the exact origin of the feedstock as it could have been mixed with other soapstocks prior to being shipped to a biofuels facilities. Traceability of the exact point of origin is therefore classified as a high risk.

3.2.4 Concluding remarks

Although brown grease was not assessed as high risk for market distortion or fraud, in the Dutch context it could be a widely used feedstock within the ‘other’ category with the new incentive of a CO_2-based target instead of an energy-based target. While brown grease due to its limited alternative applications does not score high on market distortion indicators, animal fats category 3 does score, and it can hence be assumed that some of the concern from other industries holds. Soapstock, similar to animal fats, scored a high risk of market distortion due to its widespread use in alternative industries. Nevertheless, our research indicates that the alternatives based on

[25] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU

commodity crops are slightly more readily available, but connected to a high risk for land demand: The diversion of soapstock and derivatives from existing uses to biofuel production would likely cause increased production of medium and high-risk land-use substitutes, including barley, maize, and vegetable oils such as palm oil and soy oil.[26]

[26] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU

4. Scenarios

The scope of this report is to analyse feedstocks for their associated risks in the context of the Dutch market. Within the new Jaarverplichting, which moved from an energy based target to a CO_2 reduction target, there is an option to use a multiplier on certain feedstocks in the 'other' category. This multiplier could be used to curb the effects of the low carbon intensity, making the 'other' category less attractive to use. This will decrease their attractiveness in the market and might make the advanced biofuels look more interesting with relatively higher CO_2 savings. This chapter will outline two potential scenarios within the Dutch biofuel quota system, and how associated risks might change under each of them. The following section will first outline these two scenarios, before presenting anticipated changes to the feedstock risks under each. This analysis is based on both a desk study and a stakeholder workshop conducted on 19 March 2025 with participants from different Dutch governmental bodies where insights were gathered from the Netherlands Enterprise Agency (RVO) Dutch emissions authority (NEa), Ministry of Infrastructure and Water Management (I&W), and the Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN).

In the workshop, after an introduction to the feedstocks by Guidehouse (based on their background research), the five participants could vote on what they perceived to play the largest role when it comes to the attractiveness of the feedstock. The results can be found in the tables below. Related to brown grease, all five participants agreed that the market price compared to alternatives would have the biggest influence in the scenarios regarding market distortion, followed by how the carbon intensity of the feedstock would compare to other feedstocks (three out of five votes). Regarding animal fats cat. 3, four participants indicated that the market price would have the largest influence, followed by a tie between whether other markets have viable alternatives and the carbon intensity of the feedstock (three votes each). On fraud risks, four participants voted that the supply chain characteristics of brown grease were the largest concern, followed by a tie between the physical similarities to substitutes and assurance (three votes each). For animal fats cat. 3 there was a similar result, four participants agreed that the assurance risk has the largest influence regarding fraud risk, followed by a three-way tie with two votes each: physical similarities to substitutes, consistent classifications and definitions and supply chain characteristics. The participants then got to assess the influence of each indicator per feedstock per scenario, which will be further detailed down below in the individual scenarios.

Table 1 Amount of votes on the question 'Which indicator will have the largest influence in future scenarios regarding market distortion'

Indicator	Brown grease	Animal fats category 3
Whether the feedstock currently is deployed in different markets	0	1
Whether those other markets have viable alternatives	0	3
Whether there is currently enough supply available which can be increased in the future	1	0
How the carbon intensity compares to the other feedstocks	3	3
The market price of the feedstock compared to alternatives	5	4

Table 2 Votes on the question 'Which indicator will have the largest influence regarding fraud risk?'

Indicator	Brown grease	Animal fats category 3
Physical similarities to substitutes	3	2
Consistent classifications and definitions	1	2
Supply chain characteristics	4	2
Assurance	3	4

4.1 Scenario 1 (Status quo)

Current plans for the revised Dutch biofuel quota system do not include multipliers, as previously had been held by especially advanced feedstocks in the old HBE system (fuels produced from Annex IX feedstocks). Instead, all feedstocks would be assessed according to their associated GHG emissions savings per specified energy unit without incentivising, or disincentivising, of specific feedstocks.

4.1.1 Stakeholder workshop outcomes

In the workshop, the participants could vote on whether an indicator per feedstock would worsen in this scenario in comparison to the current state. The participants could give a score to a statement from 1 to 5, a score of 3 would indicate no change in comparison to the current situation, a score below 3 would indicate a decrease in comparison to the current situation and a score above 3 would indicate an increase in comparison to the current situation.

Regarding brown grease, the participants agreed that the carbon intensity of brown grease would make this a very attractive feedstock to use in this scenario with a score of 4.5 out of 5. The participants also scored a slight increase of fraud risk of brown grease based on the physical similarities of brown grease to substitutes (3.6 out of 5). It would seem that this scenario and an increase in demand would not have a significant impact on the fraud risks regarding brown grease when it comes to this indicator.

For animal fats category 3, participants voted a 3.2 to the influence of the market price compared to alternatives in this scenario, indicating that the market price would not have a large influence. A reasoning could be that the market price is relatively stable as there are alternative uses in other markets for this feedstock. The carbon intensity compared to other feedstocks would have a much larger influence however, scoring a 4 out of 5. For fraud, the participants scored a 3.6 for assurance, indicating that there is a slight increase of fraud risk regarding the traceability and auditing of this feedstock although it is not a significant increase.

4.1.2 Brown grease

For brown grease, it was assessed that generally it would be quite interesting as a feedstock for biofuels in the Dutch market. Due to attractive GHG emissions savings, brown grease achieving higher savings than many other advanced feedstocks, an opportunity exists to receive a rather large amount of EREs per energy unit. This was also indicated by participants in the stakeholder workshop. Considering its price point, which is assumed somewhat similar but potentially slightly lower than UCO, this assumption still holds considering the high GHG emission savings

Seeing as brown grease does not have many current alternative uses, most existing flows should be able to flow into the biofuel sector without a significant risk of market distortion. Supply over time through investments and the building of infrastructure could be increased, to support increased demand. In scenario 1, market distortion hence does not pose as much of an issue for brown grease.

An increase of demand in this scenario would lead to an increase in fraud risk, mainly as most of the brown grease previously consumed in the Dutch transport sector primarily originated from China. There is an increased risk of fraud due to the supply chain characteristics and the physical similarities of pre-treated brown grease and UCO, as these streams could be mislabelled or blended. UCO faces a cap under Annex IX B, this is not the case for brown grease and there could be an increased incentive to classify UCO as pre-treated brown grease.

4.1.3 Animal fats category 3

For animal fats category 3, under the status-quo scenario, it was assessed that the feedstock would be attractive to use. The GHG savings of this feedstock would the main contributing factor for use in the Dutch biofuel market, as indicated in the stakeholder workshop. Seeing as supply is anticipated to decrease within Europe, and the challenge of importing animal fats to Europe, a growing use of animal fats category 3 in the biofuel sector would result in a diversion from other sectors. For some industries, such oleochemicals, this could partially be covered through other raw materials, but for some like the pet food industry this could be more challenging; although some of the available replacements might not be as desirable in use, due to associated land use and sustainability concerns.

Considering a slight increase in pricing already over the past year and beyond, and the anticipated effect if the status quo scenario would hence depend on the willingness to pay of either sector. Pet food and feed industries, which rely on the feedstock, would potentially have to compete for the feedstock and consider passing prices on to consumers. The biofuel sector would likely pull in increased amounts of this feedstock up to a certain price point, seeing as an increased pressure on alternatives equally exists. An example of this increased pressure is the future supply of POME, estimated to decrease under the EUDR enforcing new documentation and due diligence requirements for imports of also this feedstock. This would mean that the risk of market distortion for animal fats under the status quo scenario is assessed as high.

An increase of animal fats category 3 would lead to a limited increased risk of fraud, as there is robust traceability along the supply chain (in-line with the ABP Regulations). Due to the strict rules concerning human health on the segregation of category 1, 2 and 3 fats, it is unlikely that these streams would be mixed as it would likely downgrade the value of the fats. Furthermore, the rendering of animal by-products produces a meal as well as animal Fats. In the case of category 3 material the meal (termed PAP) has a high value as it can be used for animal feed. However, if the rendering process produces a higher risk fat, then the meal would also be determined to be high risk and could no longer be used as animal feed. There is currently no economic driver to deliberately downgrade material is this way. Additionally, import of this feedstock is very limited, only those with prior acceptance of the Commission are allowed to export to the EU which increases the levels of assurance.

4.1.3.1 Soapstock and derivatives

For soapstock, a medium risk of market distortion under the current conditions was assessed. If one were to consider its attractiveness to use under the Dutch biofuel quota obligation without multipliers, then it would heavily depend on associated emissions. GHG savings attributed to soapstock and derivatives are compared to those of POME, which would potentially make the feedstock attractive for its ability to score a rather large amount of Emissie Reductie Eenheid (ERE). Nevertheless, indirect associated emissions and land use change risks are large, seeing as a further use in biofuels could lead to a market shift in other sectors to utilise more conventional feedstocks such as virgin oils. An incentive therefore exists from a market distortion side to prevent too much of a shift of soapstock into the biofuel market.

Regarding market distortion, under this scenario, the risk is somewhat dependent on associated GHG emissions and price point. Supply is expected to increase, taking some pressure of the potential price and alternative industries which might also use this feedstock. Especially the oleochemical industry in some instances might also be willing to pay increased prices, producing more high-value end products which often can see prices directly passed on to consumers. Nevertheless, should the pull into the biofuel sector see alternative industries choosing to replace soapstock, this might happen with other oils which hold increased land use, cultivation emissions (in the case of oil crops) and sustainability risks, making this undesirable. It would hence be recommendable in case no dampening multiplier is applied, as the case under this scenario 1, to ensure that the high associated ILUC are considered in some way. This could be done by putting a special rule for the exclusion of this feedstock towards targets in place, as done for SAF targets.

The level of risk of soapstock was already assessed to medium-high in the current scenario and would likely become high risk with significant concern in a situation where there is a higher policy incentive, creating an increase in demand. Due to the nature of soapstock it is relatively easy to find alternatives with similar physical characteristics, which could lead to intentional contamination of virgin vegetable oils, mislabelling or blending of vegetable oils with soapstock. Furthermore, soapstock from various origins and different batches could be aggregated before arriving at a biofuels facility, which makes traceability more challenging as the exact origin of the feedstock cannot be determined.

4.2 Scenario 2 (Dampening multiplier)

A ‘‘dampening multiplier’ would act as a sort of negative multiplier, dividing potentially assigned GHG emission savings of a certain feedstock before accounting them towards biofuel quota units. The aim of placing such on certain feedstocks which are considered undesirable for biofuels for a number of potential reasons, would be to disincentivise their use.

4.2.1 Stakeholder workshop outcomes

Similar to scenario 1, the participants could vote on whether an indicator per feedstock would worsen in this scenario in comparison to the current state. The participants could give a score to a statement from 1 to 5, a score of 3 would indicate no change in comparison to the current situation.

For brown grease, the participants gave the carbon intensity of the feedstock in this scenario a 2.5 indicating a slight decrease of importance in this scenario compared to the current situation. It shows that the demand for brown grease would not differ much from how it is today, based on the carbon intensity. Regarding the fraud risk of physical similarities to substitutes, the participants gave this a 2.4 for brown grease. Once again, a slight decrease from the current situation. This shows that adding the correction factor would in fact curb the increase of the risk of market distortion through an decrease of demand and curb the increase of fraud risk.

Animal fats category 3 yielded very similar results, as can be expected. Regarding the importance of market price, the participants gave this a 3 in this scenario. Similar to scenario 1, participants perceive the market price to be rather stable for this feedstock and not be the largest contributor to demand in the biofuels sector. Regarding the carbon intensity we do see a large difference with scenario 1: scenario 1 participants voted a 4 out of 5 whereas for scenario 2 participants scored the carbon intensity at a 2.3. This indicates that the carbon intensity is the largest driver for the demand of animal fats category 3 and that demand could be decreased compared to the current situation when implementing a correction factor. Regarding fraud risk, participants voted the increased risk of assurance at a 2.6, which is a slight decrease compared to the current situation but not a significant difference.

4.2.2 Feedstock implications of the scenario

4.2.2.1 Brown grease

For brown grease, it is assumed that a decrease of GHG savings through a dampening multiplier would make the feedstock slightly less attractive. This had previously been the case in the HBE system, when brown grease was removed from the list of advanced feedstocks, leading to brown grease mostly disappearing from the Dutch biofuel market. While in the status quo scenario an incentive to utilise the feedstock would be re-introduced owing to its high GHG emissions savings, it is likely that a dampening multiplier lowering associated savings would aid in maintaining brown grease usage levels at their current level.

From perspective of market distortion, seeing as the competition for the feedstock is low, this could in the Dutch context potentially decrease the price for brown grease, seeing as not many other industries would be willing to pay status-quo pricing. Without competitive demand keeping up prices, brown grease from a market perspective might still be interesting for use in the Dutch biofuel market. This would nevertheless depend on other countries and their interest in utilising brown grease for biofuels, seeing as prices are not independently set for the Dutch market. Assuming that a use for biofuels will continue in other markets, brown grease will become slightly less attractive for the Dutch use. Previously, all the brown grease for the Dutch transport sector was imported. Without an incentive, it is unlikely that brown grease will flow into the Dutch market.

4.2.2.2 Animal fats category 3

For animal fats category 3, GHG emissions were rated as potentially most important characteristic towards biofuel usage attractiveness. Should these decrease through a dampening multiplier, it can be assumed that other industries such as pet food would still continue to pay higher prices for the feedstock: Without the matching reward of sufficient EREs, biofuel producers might likely not be willing to pay the same fees. Hence, the risk of market distortion would in this scenario be mitigated.

4.2.2.3 Soapstock and derivatives

For soapstock, it is mostly GHG emissions which matter for its attractiveness to use in the Dutch biofuel sector. Seeing as a flow from alternative sectors is somewhat likely under the status quo scenario, a dampening multiplier for GHG value would lessen this risk and maintain business as usual. It is expected that other sectors such as the oleochemical industry would continue to pay higher prices, making soapstock less attractive for the Dutch biofuel market. A similar effect can be expected not only through a dampening multiplier, but also a recognition of indirect emissions risks.

5. Concluding remarks

The feedstocks included within the context of this project were brown grease, animal fats category 3 and soapstock. These three were chosen, as they all represented a different risk profile, presenting through them a good variation of the (potential) other feedstocks in the ‘other’ category. In 2022 and 2023, the largest feedstocks in the ‘other’ category were Fish Oil Ethyl Ester (FOEE) and low grade starch slurry / sugar effluent. Also, for these there could be a risk with the new CO_2-based targets that the popularity of this ‘other’ category increases. This can pose as an issue if the ‘other’ feedstocks are currently used in alternative sectors without many replacements or over-supply available, or if the risk of fraud for an ‘other’ feedstock is high due to its particular characteristics.

Based on our analysis, with the current foreseen revision of Jaarverplichting Energie Vervoer, the market distortion risk could be high for animal fats category 3 and soapstock, but is expected to be lower for brown grease as it has little alternative higher value applications. However, an increased demand for brown grease would in turn increase the fraud risk, as this feedstock is quite sensitive to fraud together with soap stock. Animal fats category 3 would not experience a higher degree of fraud risk, as the supply chain is under good supervision due to the nature of the feedstock.

This conclusion can be seen as somewhat applicable to other feedstocks contained within the long lists of feedstocks stemming from the Annex IX paper (see chapter 2.1). Many of the there included feedstocks share similarities with the ones reviewed in the scope of this paper which led to them being listed in the Annex IX paper as holding a risk of market distortion if increasingly used for biofuels. These similarities include characteristics such as a wide-spread use in other sectors outside biofuels, combined with a non-elastic supply not allowing for more feedstock overall to become available. Though this previous study was conducted on a European level, and some feedstocks might be less common for certain alternative uses within the Netherlands specifically, a suspicion exists that at least for several of the feedstocks from the long list, conclusions from this paper remain transferrable.

In the revision of the Jaarverplichting Energie Vervoer there was an option to include a correction factor to curb the level of interest of the feedstocks in the ‘other’ category. A dampening multiplier could be an option to reduce the risks of these types of feedstocks as they are not subject to a cap, like for example Annex IX Part B is. However, since not all market distortion risks and fraud risks are uniform across the analysed feedstocks in the ‘other’ category, adding a blank multiplier might have unintended effects for those feedstocks where currently no market distortion or fraud risks are perceived. Nevertheless, only applying the dampening multiplier selectively might warrant an in-depth analysis of every other possible feedstock within the ‘other’ category, to conclusively find if risks are applicable and assumptions from this paper transferrable, or if especially within the Dutch context a feedstock might not see these substantial risks.

Other feedstocks that could be of interest to look further into once there is more guidance regarding the contents of the feedstocks and the verification of the feedstocks are low grade starch slurry intermediate crops and crops from severely degraded land. Lowgrade starch slurry already plays a big role in the Dutch transport sector and dominates the ‘other’ category. Intermediate crops and crops from severely degraded land are different to the other feedstocks in this list, as they do not by default belong to the ‘other’ category but could belong to Annex IX if they meet the criteria.

Appendix A. Brown grease detailed feedstock overview

A.1 Market distortion risk

Table 3 Alternative uses for the feedstock and current uses

Factor	Guiding question(s)	Information	Assessment
Current use in NL	What is the feedstock currently used for?	• Usually discarded (disposed of in landfills or combusted with limited aggregation and trading),main use biofuel, depending on quality also used for animal feed production, and industrial lubricants. • Possible use for PHAs (but requires cleaning / processing, hence not super feasible).[27]	Low - Current use mainly biofuels, otherwise discarded
Demand	Is the demand so high that it covers all potential supply?	• Some brown grease still goes to waste, hence not all supply is covered by demand.	Low - Demand does not fully cover supply.
Replacement alternatives within other sectors	Are there viable replacements which are a) not (much) more expensive and have no other negative effects, e.g. environmental?	• Not much usage in other sectors, therefore no alternatives necessary. • In any case, brown grease tends to be a lower quality feedstock and could more easily be replaced with similar, higher-quality feedstocks, e.g. UCO.	Low - Replacement in other sectors usually not necessary (limited application).

Table 4 Availability

Factor	Guiding question(s)	Information	Assessment
Supply – current	Is the supply higher than the demand? Is the feedstock currently produced in NL? Is the feedstock usually used on site or transported further distances?	• Availability of brown grease or 'grease separator contents' in Germany is estimated to be around 428,500 tonnes. [28] • European level data on brown grease production or collection is not available.[29] • The collection of brown grease using grease traps is currently not that widespread in Europe, with the possible exceptions of	Low - Inner-European supply limited due to lacking supply chain structures, theoretically supply exceeds demand.

[27] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.
[28] Umweltbundesamt (Federal Environment Agency) (2019). BioRest: Verfügbarkeit und Nutzungsoptionen biogener Abfall- und Reststoffe im Energiesystem (Availability and utilization options of biogenic waste and residual materials in the energy system). Abschlussbericht (final report) Report 115/2019. Available at: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-09-24_texte_115-2019_biorest.pdf
[29] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.

		Austria, Germany, the Netherlands and Sweden. • Much of brown grease is not collected from the market (lack of supply chains). • Some brown grease still goes to waste, so technically the supply within Europe is higher (in potential) than the associated demand.	
Potential to increase supply – production	Is the supply elastic? Could more be produced without other negative effects, e.g. environmental?	• Supply of brown grease depends on the volume of vegetable oil/animal fats consumed as well as the volumes collected in grease traps. • The brown grease supply chain is significantly underdeveloped, from the infrastructure for collection to aggregation and treatment. This is a major barrier to its use, alongside the limited installation of grease traps in the first instance. Hence, increased production would necessitate larger investments.[30]	Medium - Supply could be increased with the right infrastructure adjustments – but investments are needed, hence only in the long-term.
Potential to increase supply – import	Could more feedstock be imported from outside NL?	• The Nea states: "De grondstoffen voor geavanceerde biobrandstoffen, met name putvet en POME zijn vooral uit Zuid- Oost Azië afkomstig", hence currently mostly imported. 98% of brown grease in 2022 came from China.[31] • Global oilseeds production is expected to increase by around 1.5% p.a. for the period 2018-2027; and with increased oilseed usage the amount of available brown grease theoretically should as well.[32] • The production of brown grease is expected to grow as the demand for vegetable oil and animal fat is expected to rise.[33]	Low - Global production is projected to increase, hence more could potentially be imported.

[30] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.
[31] Nea (2022).
[32] FAO (2018). OECD-FAO AGRICULTURAL OUTLOOK 2018-2027.
[33] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.

Table 5 GHG intensity reduction potential

Factor	Guiding question(s)	Information	Assessment
GHG Savings	What are the associated GHG savings?	• Emissions factor carbon intensity 12 gCO2/MJ	
GHG in comparison	How do they fare compared to other feedstocks?	• Brown grease is a lower quality feedstock compared to UCO and has a slightly high emissions factor. • Generally speaking, the emissions savings still align with advanced feedstock requirements.	Medium - Average for advanced feedstock

Table 6 Price

Factor	Guiding question(s)	Information	Assessment
Price	What is the current market price?	• Brown grease pricing not reported by major market sites . • UCO (maybe comparable) hovered around 900 €/t in early 2024.[34] • Potentially could be assumed to be somewhat lower than UCO due to lower quality (higher level of contamination).	
Price competitiveness with other feedstocks	Is the feedstock competitive compared to other feedstocks with similar GHG savings?	• If comparable to UCO, pricing higher than e.g. animal fats or RSO or POME; likely somewhat comparable.	Medium - Likely comparable
Price competitiveness of other sector uses	Can the other sector pay more than the biofuel sector for the same feedstock?	• Not much competition from other sectors for the feedstock.	Low - Not many alternative uses

[34] Internal source.

A.2 Fraud risk

Table 7 Fraud[35]

Factor	Guiding questions	Information	Assessment
Physical characteristics	Could the feedstock be altered either through the physical similarities of a substitute or due to deliberate alteration of the production process?	• Before pre-treatment brown grease is chemically and visually distinct from other similar feedstocks. It may become visually similar after pre-treatment. • There is potential for intentional contamination of other fats and oils to become visually similar to brown grease. • It is unlikely that other streams would be mixed with brown grease as it would decrease the overall value of the feedstock.	Low-Medium risk. Distinct feedstock but options for intentional contamination especially after pre-treatment.
Feedstock definition characteristics	Is the feedstock consistently defined internationally and does it have consistent classification?	• Brown grease has consistently been classified as a waste across countries. • Definitions across countries are quite similar but not fully aligned. Especially in the major production countries the definition seems to be similar to UCO.	Medium. Brown grease is classified as a waste but could contain streams of UCO and other waste fats if the definition in the country of origin isn't aligned.
Supply chain characteristics	How long are the trade patterns and how is the Rule of Law in the producing countries?	• 98% of the brown grease used in Netherlands comes from China. • Brown grease supply chains tend to be a specialized trading market with shorter supply chains. There could be more entities in the future as pre-treatment technology improves and there is an increase of incentives to do so. • Brown grease it typically segregated in the supply chain due to the high water content and impurity content, it would degrade other fats. The pre-treatment tends to be costly, this reduces the risk of falsifying transfer documents and limits the market participants. • China has a 0.47 and is ranked 95 on the Rule of Law index	Medium-High. China is less likely to have sufficient regulatory oversight to control against fraudulent practices especially if there are increasing incentives which could make supply chains more complex.

[35] Source: "Annex IX study" ('Assessment of the potential for new feedstocks for the production of advanced biofuels') unless stated otherwise

		which would be considered high risk.	
Assurance	Can assurance providers establish the exact origin of the feedstock?	• Through self-declarations, the feedstocks should be traceable to the point of origin. However, similar to the situation with UCO, oversight of al the points of origin is not possible.	Medium. Although the auditor can check a sample of the points of origin, it is not possible to have perfect oversight of all the points of origin.

Appendix B. Animal fats category 3

B.1 Market distortion risk

Table 8 Alternative uses for the feedstock and current uses

Factor	Guiding question(s)	Information	Assessment
Current use in NL	What is the feedstock currently used for?	• Biofuels / combustion fuel at rendering plant (largest use currently – Annex IX report) in the EU – nevertheless, this does not seem to be the case in the Netherlands according to the Nea.[36] • Animal feed / nutrition industry (2nd largest use) o Industry calls for protection of waste hierarchy principle. o Feedstock producers claim overall amount used for feed quite low. • Oleochemical production, e.g. cosmetics. • Combustion for heat and power (all animal fats, lesser for cat.3), more in EU than NL. • Food (lesser extent).	High - Wide-spread use in other sectors
Demand	Is the demand so high that it covers all potential supply?	• Annex IX report suggest that a reduction in Category 3 animal fat availability could lead to a shift in feeding patterns and increased reliance on grains for energy.[37] • End-uses are plenty currently, and demand is high.	High - Currently all availability is used
Replacement alternatives within other sectors	Are there viable replacements which are a) not (much) more expensive and have no other negative effects, e.g. environmental?	• Irreplaceable in pet food due to characteristics (e.g. fatty acids, energy content, palatability).[38] • Closest replacement are other oils (which could also be used for biofuel / are already in use). • In food and feed applications, vegetable oils would provide the closest substitutes, and with Category 3 animal fats and palm oil having similar fatty acid	High - Replacements are fully utilised for other uses / more land would be required

[36] Nederlandse Emissieautoriteit, Rapportage Energie voor Vervoer in Nederland 2022.
[37] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.
[38] Implications of RED to Netherlands - provided by RVO.

		profiles and prices palm oil would be one possibility. • E4tech identify palm and rapeseed as the most likely substitute oils (along with palm fatty acids).[39] • In the oleochemicals industry, there has been a shift over the last decade from using European animal fats to using palm oil as feedstock (cheapest available virgin vegetable oil).[40] • These replacements would increase demand for land, which poses as sustainability issue • RED pp: Supply pressure on UCO, palm oil and soy oil will push additional demand on Cat III animal fats -> alternatives list animal fat as alternatives, hence likely no additional supply of alternatives available. • Additionally, the supply of alternatives (soy, palm) is projected to decrease in response to the EUDR.[41]	
Current use for biofuels	Is the feedstock currently being used for biofuel production?	• Biofuel usage is the largest end-use in Europe, though other uses are substantial, especially in the NL specifically. • Has steadily increased over the past few years.[42] • Use of Category 3 animal fats in biofuel production has steadily increased over time. In 2010, it was around 240 kt, while in 2019 over 700 kt was used (representing 30% of total supply). Use has exceeded 400 kt since 2015. Animal fats (all categories) represented 5% of the total feedstock mix in 2018.[43] • Animal feed industry in lobby paper points out that some shift	Medium - Feedstock is currently already used, lobby group positions vary

[39] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU
[40] Resourcewise (2024). Oleochemicals: Volatility on the Horizon.
[41] Implications of RED to Netherlands - provided by RVO.
[42] EFPRA (2023). PP supplied by RVO.
[43] Navigant (2020). Technical assistance in realisation of the 5th report on progress of renewable energy in the EU. Analysis of bioenergy supply and demand in the EU (Task 3): final report. Available at: https://op.europa.eu/en/publication-detail/-/publication/b9c0db60-11c7-11eb-9a54-01aa75ed71a1/language-en/format-PDF/source-166348766

		from feed to biofuels has already taken place, posing as danger to this industry (additional market pressure, distortion of competition). • Production industry claims that currently, much animal fat cat.3 is used for biofuel without creating much market pressure for pet food (flow more from food and oleochemicals). • RED (III), SAF, maritime fuel mandates mean an incremental need of 150 to 500 kT of animal fats in Netherlands alone.[44]	

Table 9 Availability

Factor	Guiding question(s)	Information	Assessment
Supply - current	Is the supply higher than the demand? Is the feedstock currently produced in NL? Is the feedstock usually used on site or transported further distances?	• Category 3 animal fat is a by-product from slaughterhouse activities (rendering), hence is also produced in the NL. • In the EU, over 20 million tonnes of animal by-products emerge annually from slaughterhouses, plants producing food for human consumption, dairies and as fallen stock from farms.[45] • The main producers in the EU are Germany and France (around 3 million tonnes each), with significant volumes also in Spain, Italy, the Netherlands and Poland (around 1.5 to 2 million tonnes each). • Some supply is currently being exported.[46] • Seasonal availability: Rendering activity is typically high in the fourth quarter due to seasonal meat demand, which results in a higher availability of raw material, while demand for animal fats also increases, particularly among pet food and animal feed manufacturers.	Medium - Current supply stable

[44] Implications of RED to Netherlands - provided by RVO.
[45] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU
[46] EFPRA (2023). PP supplied by RVO.

Potential to increase supply - production	Is the supply elastic? Could more be produced without other negative effects, e.g. environmental?	• The supply has remained somewhat stable over the last 20 years (slight increase due to optimization of processes in splitting of materials).[47] • Supply is rigid, not elastic (Annex IX report) -> directly related to amount of animals reared for meat.[48] • An increase in demand for animal fats would not result in more animals being raised. • Meat production is projected to decrease in the future (2030, 2050) -> supply of animal fats cat.3 can be expected to drop (as also reported by EFPRA).[49]	High - Rigid supply with projected decrease in supply
Potential to increase supply – import	Could more feedstock be imported from outside NL?	• Global meat production in 2015-2016 stood 258 million tonnes, which realised an estimated 100 million tonnes of animal by-products (fats and protein).[50] Outside of the EU, the key regions of production are China, North and South America (in particular the U.S. and Brazil). • Export of animal fats to the EU is possible, but challenging due to differences in material treatment methods and handling rules in these markets. Only facilities approved by the European Commission are allowed to export to the EU which makes it administratively burdensome and costly.[51] • To illustrate, all of the animal fats consumed for biofuels production in the EU in 2018 were from reported as EU origin.[52] • EFPRA report: previously some import of beef fat (especially from Argentina), no longer	High - Import generally is possible but hurdles are quite high due to regulation; other uses also apply abroad

[47] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.
[48] Ibid.
[49] EFPRA (2023). PP supplied by RVO.
[50] MVO (2016).
[51] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU.
[52] Navigant (2020).

		happens (since 2023, imports only from UK outside EU).[53] • Similar to the EU, animal fats are commonly used as animal feed and in the oleochemicals sector. As such, increased demand for biofuel production in the EU will also likely result in distortion to these existing markets.	

Table 10 GHG intensity reduction potential

Factor	Guiding question(s)	Information	Assessment
GHG Savings	What are the associated GHG savings?	• 9 CI gCO_2/MJ (0.085 ton CO_2/GJ savings)	
GHG in comparison	How do they fare compared to other feedstocks?	• The savings are higher than for animal fats cat.1&2. • Generally speaking, emissions factor is quite desirable (lower half of advanced feedstocks).	Medium - Savings generally quite attractive for biofuel use

Table 11 Price

Factor	Guiding question(s)	Information	Assessment
Price	What is the current market price?	• Price for whole beef carcasses has increased in the past years.[54] • Prices for European Category 3 animal fats were relatively stable in 2024, with assessed prices fluctuating in the range of €50-100 per tonne, depending on the quality specification. • Prices for animal fats with up to 15% FFA fell by €85.50 per tonne year on year to average €825 per tonne DDP NWE in 2024, compared with the average of €910.50 per tonne DDP in 2023, Fastmarkets data showed.[55] • Early 2024, prices were hovering around 870 €/t, so prices have been increasing.[56] • Other qualities followed a similar trend, with edible-grade	

[53] EFPRA (2023). PP supplied by RVO.
[54] EFPRA (2023). PP supplied by RVO.
[55] Fastmarkets (2025). Continued uncertainty to drive volatility in EU animal fats market: 2025 preview - Fastmarkets.
[56] Internal source.

		beef tallow dropping by €162.66 per tonne year on year to an average €1,018 per tonne in 2024, down from the average of €1,180.70 per tonne recorded in 2023. • Edible-grade beef reached its highest price in late January, assessed at €1,125 per tonne DDP, and the lowest price was recorded in September, at €945 per tonne, pressured by low demand in Europe alongside other fat grades. • All animal fat grades increased in price in late May on rumors about the European Commission announcing anti-dumping measures against Chinese biodiesel, which were announced in July as a result of an investigation launched in December 2023.	
Price competitiveness with other feedstocks	Is the feedstock competitive compared to other feedstocks with similar GHG savings?	• Increased biofuel blending mandates and newly introduced sustainable aviation fuel (SAF) production obligations will keep animal fats demand high; plus, vegetable oils are expensive, with no bearish factors in sight. • The price spread between January-delivery mixed animal fat, 15% free fatty acid (FFA) content, DDP North-West Europe (NWE) and crude palm oil CIF Rotterdam reached €442.40 ($461) per tonne on December 12, below the highest yearly level of €486.61 per tonne recorded in November; the spread reached a yearly low of €9.04 per tonne in May.[57] • The spread between that grade of animal fat and rapeseed oil FOB Dutch mill was €216 per tonne on December 12; its yearly high was €370 per tonne in November, while the lowest spread was assessed at €46 per tonne in February.	High - Cheaper than alternatives

[57] Fastmarkets (2025). Continued uncertainty to drive volatility in EU animal fats market: 2025 preview - Fastmarkets.

Price competitiveness of other sector uses	Can the other sector pay more than the biofuel sector for the same feedstock?	• Feedstock producer lobby claims that for animal feed / pet food, animal fat only poses as a small amount of oils used and the price is therefore set by vegetable oils instead • Studies generally show a willingness of consumers to spend on pet food (fast-moving consumer goods), e.g. in this industry prices could potentially be passed on.	Medium - FMCG can potentially pass on partial price increases

B.2 Fraud

Table 12 Fraud[58]

Factor	Guiding questions	Information	Assessment
Physical characteristics	Could the feedstock be altered either through the physical similarities of a substitute or due to deliberate alteration of the production process?	• Animal fats are physically similar to other waste oils, making them hard to distinguish. They have a similar fatty acid profile as palm oil. Animal fats are often sold solid, whereas other waste oils are typically sold as liquids which could be a distinction. • There is little economic incentive to deliberately alter the meat production to create more category 3 animal fat. • There is a potential risk of mixing the fats of the different categories. The risk is low however as rendering plants aim for a high level of segregation and it is unlikely they would risk downgrading the fat.	Low. There is a small risk that category 1 and 2 would be mixed in with 3, although there are strict rules regarding separating the streams and there is little economic incentive to.
Feedstock definition characteristics	Is the feedstock consistently defined internationally and does it have consistent classification?	• Production, trade and use of animal fats in the EU is strictly regulated. The definitions and classifications are uniform. • Even if third countries have different classifications, only category 3 equivalent animal fats can be exported to the EU.	Low. There are strict rules which limits the fraud risk of mislabelling or reclassification along the supply chain.

[58] Source: "Annex IX study" ('Assessment of the potential for new feedstocks for the production of advanced biofuels') unless stated otherwise

Supply chain characteristics	How long are the trade patterns and how is the Rule of Law in the producing countries?	• Due to the strict market in the EU, the operators need to be licensed from origin to end-use. • Trade is possible, but challenging due to strict rules. Only facilities that have been approved by the European Commission can export to the EU and it needs to be registered in the EU TRACES database.	Low. Supply chains tend to be short and well monitored with strict rules.
Assurance	Can assurance providers establish the exact origin of the feedstock?	• Transport of animal fats is strictly controlled from point of origin to end use. There is full traceability of the material along the supply chain.	Low. There is full traceability along the supply chain.

Appendix C. Soapstock and derivatives

C.1 Market distortion risk

Table 11. Alternative uses for the feedstock/current uses

Factor	Guiding questions	Information	Assessment
Current use in NL	What is the feedstock currently used for?	• Currently used for oleochemicals (e.g. soap makers) and livestock feed, with the first being the primary use and the latter in limited amount (limitation to 3.5% of feed, due to digestibility of long acid chains[59]). • Acid oil from soapstock is listed in the EU Feed catalogue (Commission Regulation 2017/1017). • Acid oil can be used in the production of rumen protected fats, which is a specialty product for dairy cattle production. However, it is likely a relatively niche use of soapstock and derivatives. • A small amount might be used for fertilisers or other chemicals. • In the Annex IX study, some stakeholders say the 'main use' of acid oil is for FAME production, and several others list FAME as an existing use.[60] Nevertheless, in the Nea reports it is not remarked as currently being used for biofuel in the Netherlands to a substantial level. • Overall, soapstock is not considered a waste product. It is a by-product of the chemical neutralisation process in vegetable oil refining.	Medium - Many alternative uses exist, while some supply already flows into the biofuel sector.
Demand	Is the demand so high that it covers all potential supply?	• Within the EU, all supply is currently covered through demand.[61]	High - Studies suggest that all supply is

[59] Casali, B.et al. (2021). Enzymatic Methods for the Manipulation and Valorization of Soapstock from Vegetable Oil Refining Processes. Sustainable Chemical, 2(1), 74–91. https://www.mdpi.com/2673-4079/2/1/6.

[60] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU

[61] Ibid.

		• There exists an extra supply pressure on soapstock due to increased demand for this feedstock and its alternatives from the biofuel industry: Due to other fatty acids, e.g. palm oils being restricted, alternative feedstocks are of higher demand already which creates increased feedstock uncertainties for the oleochemical industry.[62] • Soapstock and derivatives appear to be mostly or entirely used in livestock feed and oleochemicals. Diverting this feedstock to biofuel production would likely cause high risk of market distortion.[63]	currently covered by demand.
Replacement alternatives within other sectors	Are there viable replacements which are a) not (much) more expensive and have no other negative effects, e.g. environmental?	• Replacement options are mostly other vegetable oils: If soapstock and derivatives is displaced from oleochemicals production, the likely substitute would be virgin vegetable oils such as palm oil and soybean oil, understanding that we must select a substitute material with elastic supply.[64] • The diversion of soapstock and derivatives from existing uses to biofuel production would likely cause increased production of medium and high-risk substitutes, including barley, maize, and vegetable oils such as palm oil and soy oil, with an overall high risk of increased demand for land.	High - Other vegetable oils may act as a replacement, but these carry significant land need concerns.

Table 12 Availability

Factor	Guiding questions	Information	Assessment
Supply – current	Is the supply higher than the demand? Is the feedstock currently produced in NL? Is the	• Soapstock is a by-product of vegetable oil production, which also takes place in the NL. Hence, local production exists	High - Feedstock is produced and used in NL, with no indication of over-supply.

[62] Infinium Insights (2021). Infineum Insight I Oleo feedstock uncertainty.
[63] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU
[64] Ibid.

	feedstock usually used on site or transported further distances?	and uses are comparable to other countries in the EU.[65] • Can be easily transported with tank wagons. • No indication of left over supply was found.	
Potential to increase supply – production	Is the supply elastic? Could more be produced without other negative effects, e.g. environmental?	• Soapstock and derivatives production will likely grow with the growing vegetable oil market (side-product of vegetable oil production). • Concerns potentially apply to land-use needs of vegetable oils (see replacement alternatives above). • As a by-product of vegetable oil production, the feedstock is often not counted as waste-product (e.g. in the SAF debate), and hence an increase of supply could carry sustainability concerns.	Medium - Indication of potentially increasing supply in the long term, but land use / sustainability concerns exist.
Potential to increase supply – import	Could more feedstock be imported from outside NL?	• In 2019/2020, global production of vegetable oils was 207.26 million tons, with soapstock being estimated to make up about 6% of this.[66] • The global acidulated soapstock market is growing, with significant production in regions like Asia Pacific, North America, and Latin America.[67] • The EU has strict import regulations to ensure food and feed hygiene, consumer safety, and animal health. As long as soapstock meets these standards, it can be imported into the EU.[68]	Low - International potential for increased imports into the EU may exist.

Table 13 GHG intensity reduction potential

Factor	Guiding questions	Information	Assessment

[65] Zaanlandse Olieraffinaderij. ZOR Toll-refining | ZOR.
[66] Statista. (2021). Global production of vegetable oils from 2000/01 to 2020/21 (in million metric tons). Retrieved from https://www.statista.com/statistics/263978/global-vegetableoil-production-since-2000-2001/
[67] Cognitive Market Research (2025). The Global Acidulated Soapstock market is Growing at Compound Annual Growth Rate (CAGR) of 5.6% from 2023 to 2030..
[68] European Commission. https://food.ec.europa.eu/horizontal-topics/official-controls-and-enforcement/imported-products_en

GHG Savings	What are the associated GHG savings?	• Emissions factor ? CI gCO2/MJ – no value found • According to the Annex IX assessment, soapstock and derivatives are essentially a type of residual oil, and so the GHG emissions for biofuel produced from this feedstock are likely similar to those of biodiesel produced from used cooking oil or animal fats. The REDII default values for GHG savings from used cooking oil and animal fats biodiesel are 84% and 78%, respectively. It is thus likely that biodiesel produced from soapstock and derivatives would meet the GHG savings criteria of the RED II.[69] • Nevertheless, soapstock and derivatives are excluded from SAF targets due to high indirect GHG emissions associated with the feedstock.[70]	
GHG in comparison	How do they fare compared to other feedstocks?	• Likely similar to other waste / advanced feedstocks; but the concern for indirect emissions exists.	Medium - Average, with some increased concern for indirect emissions.

Table 14 Price information

Factor	Guiding questions	Information	Assessment
Price	What is the current market price?	• Soapstock and derivatives appears to realise lower value than refined vegetable oil, although there is limited price evidence available.	
Price competitiveness with other feedstocks	Is the feedstock competitive compared to other feedstocks with similar GHG savings?	• Soapstock realises lower-value end-uses compared to vegetable oils, and hence would be cheaper (additionally containing about 50% of water, hence lower fatty acid contents). • A full comparison is not possible due to lack of publicly available data.	Medium - Data not widely available.
Price competitiveness	Can the other sector pay more than the	• Unsure due to lack of full pricing information.	Medium - Other sectors might have an

[69] Publications Office of the European Union (2022). Assessment of the potential for new feedstocks for the production of advanced biofuels - Publications Office of the EU

[70] TNO (2023). Renewable fuels up to 2030 - Assessment of REDIII.

of other sector uses	biofuel sector for the same feedstock?	• Generally, the willingness to pay for feedstocks in the oleochemical industry is generally higher than in the biofuel industry: E.g. due to higher-cost end products.	increased willingness to pay, depending on the end product and fuel prices.

C.2 Fraud

Table 13 Fraud[71]

Factor	Guiding questions	Information	Assessment
Physical characteristics	Could the feedstock be altered either through the physical similarities of a substitute or due to deliberate alteration of the production process?	• The chemical composition of soapstock varies depending on the initial feedstock used. • There is currently no uniform industry standard on the composition of soapstock. • Due to the variety in composition of soapstock, it is possible to make another feedstock with high fatty acid content appear as soapstock, such as UCO. • It is possible to contaminate virgin vegetable oil to make it appear as soapstock. However the value of soapstock is much lower, there is little economic incentive to blend. • It is possible to deliberately alter the refining process of vegetable oil to generate more soapstock.	Medium-high risk – it is possible to distinguish soap stock, although it is quite varied and there are similarities with other feedstocks. It is also possible to alter the production process to generate more, although there is little economic incentive to.
Feedstock definition characteristics	Is the feedstock consistently defined internationally and does it have consistent classification?	• There is no uniform definition and no uniform classification. Some sources classify soapstock as a residue, a waste, a by-product or a co-product. This increases the risk of mislabelling.	High – there is no uniform definition of soap stock and no uniform classification.
Supply chain characteristics	How long are the trade patterns and how is the Rule of Law in the producing countries?	• Soapstock is produced all across the world, anywhere where vegetable oil is produced. Also in countries with a weaker rule of law. • It is likely that there is a higher number of intermediaries, as there are multiple industries currently involved with soapstock (soapmaking, animal feed, oleochemicals etc.) • Soapstock is most often not traded internationally.	Medium – although there are significant concerns regarding the countries of origin and the supply chain, it is not a widely traded feedstock.

[71] Source: "Annex IX study" ('Assessment of the potential for new feedstocks for the production of advanced biofuels') unless stated otherwise

Assurance	Can assurance providers establish the exact origin of the feedstock?	• Soapstock and derivatives are produced globally and there is no standardized way to tell what feedstock they are produced from, so any particular batch of soapstock and derivatives could not be easily tied to a particular origin. • Different batches of soapstock could be aggregated before being shipped to a biofuels facility, which makes tracking the point of origin more difficult.	High – due to the broad nature of this feedstock, tracking points of origin and verifying feedstocks is tricky.

DON'T DELETE SECTION BREAK

guidehouse.com