Analyse overgang sturen op CO_2

Impact of greenhouse gas emissions reduction-based targets on the investment landscape for renewable transport fuels in the Netherlands

Final report

Trinomics

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1 RED II and its revision proposal (RED III) in the EU and the Netherlands

1.1 Current European legislation: the EU RED II

The Renewable Energy Directive (RED) is the European Commission's (EC) "legal framweork for the development of renewable energy across all sectors of the EU economy" (EC, 2021a), by setting renewable energy use targets and conditions. The current version of the RED (abbreviated as RED II) entered into force in 2018. It replaces the original Renewable Energy Directive from 2009.

A specific target of 14% renewable energy exists for the transport sector (road and rail), that fuel suppliers need to meet in each Member State by 2030. The target is expressed in terms of energy content, meaning that, of all the energy delivered to the road and rail transport sectors in 2030, 14% of it must be energy that is considered renewable under the conditions of the Directive.

In addition to this overall target, the RED II establishes a number of conditions and accounting rules for the renewable energy sources eligible under the framework. In particular, it includes:

- Subtargets and caps, in addition to the 14% overall target, for specific fuels;
- Sustainability conditions and criteria to be met in order to be eligible as a renewable fuel and to be eligible to be accounted towards RED II targets;
- Multipliers that allow certain renewable energy sources and fuels to contribute more than one time their energy content towards the targets;
- A classification of feedstocks for the production of biofuels and biogas in three main categories: 1. food crops, 2. Annex IX.A feedstocks (for the production of biogas for transport and advanced biofuels), 3. Annex IX.B feedstocks (for the production of biogas for transport and biofuels from used cooking oil and animal fats) (see Table 1-1).

Table 1-1 Examples of biogas and biofuel feedstocks under the three main categories considered under the RED

Conventional (food crops)	Feedstocks under RED Annex IX, Part A	Feedstocks under RED Annex IX, Part B
Corn, sugarcane, sugarbeet, wheat, rapeseed, palm, soy	Organic waste, straw, bagasse and other non-food cellulosic and ligno-cellulosic material, animal manure, sewage sludge	Used cooking oil, animal fats[1]

Sources: EC (2018), NEa (2021)

The set of conditions and rules for different renewable energy sources and fuel categories under the RED II are summarized in Table 1-2.

Finally, the maritime and aviation sectors are out of the scope of the RED II for transport, although fuels used in those sectors may opt-in to be counted towards the 14% target (EC, 2019).

1.2 The EU RED II revision proposal (RED III)

1.2.1 *EU policy context for sustainable transport fuels*

In view to deliver on the European Green Deal, which aims at "transform[ing] the EU into a modern, resource-efficient and competitive economy" (EC, 2022), the European Commission presented in summer 2021 a *Fit-for-55* package of policy proposals to reduce greenhouse gas (GHG) emissions by at

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[1] Classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009. In this report, the wording "animal fats" will always refer to these categories.

least 55% by 2030, from 1990 levels (EC, 2021b). The RED II revision proposal (hereafter abbreviated as RED III) was issued in this framework, along with other policy proposals relevant to the transport sector and that, if adopted, will have an impact on the roll-out of more efficient, lower-carbon transport fuels in the period leading to 2030 and beyond. Such other relevant proposals, that will impact the future of transport fuels in various transport sectors, are summarized below:

- The inclusion of transport in the EU Emissions Trading Scheme;
- Stronger CO_2 emission standards for cars and vans and the conversion of the Alternative Fuel Infrastructure Directive (AFID) into a Regulation (AFIR), which will accelerate the penetration of alternative powertrains (e.g. battery and fuel cell electric vehicles) and thus of alternative transport fuels (typically electricity and hydrogen) on the market;
- The aviation and maritime sectors are specifically tackled via the new ReFuelEU Aviation and FuelEUMaritime proposals respectively:
    - ReFuelEU Aviation requires the blending of Sustainable Aviation Fuels (SAF) in aircrafts at EU airports: aircrafts should be fueled with a minimum volume of 5%[2] of SAFs by 2030, and 63%[3] by 2050[4] (EC, 2021c);
    - FuelEU Maritime introduces GHG emissions reduction targets for energy use on-board of ships calling at European ports: -6% by 2030 and -75% by 2050[5]. It also requires zero-emission energy supply while at berth (EC, 2021d).
- The revision of the taxation of energy products (Energy Taxation Directive) in line with EU energy and climate policies.

These policies will also influence the competitiveness landscape for transport fuels, either by supporting alternative vehicle powertrains in different transport modes or by supporting the delivery and use of a variety of alternative, low-carbon transport fuels. As a result, the effect of the RED II revision proposal on various transport fuels should also be considered in the wider context of other EU policies relevant to energy in the transport sector.

1.2.2 Main characteristics and key differences with RED II

In 2021, as part of the European Green Deal and the Fit-for-55 package, a revision proposal of the Renewable Energy Directive was presented by the EC in July 2021. It is expected to be adopted by the end of 2022 (EC, 2021).

For transport, one of the major changes introduced by this revision is the formulation of the 2030 target, which, from being expressed in terms of energy content in the RED II - 14% renewable energy by 2030 – is expressed in terms of greenhouse gas emissions (GHG) intensity reduction in its revision : -13% GHG intensity of transport fuels by 2030[6]. Other major changes in the revised RED framework is the application of the new target to all transport modes,[7] and the end of multipliers.[8] Changes in a number of caps and subtargets are also being proposed (EC News, 2021).

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[2] 0.7 % of which synthetic aviation fuels
[3] 28 % of which synthetic aviation fuels
[4] ReFuelEU Aviation also includes intermediate targets for the years 2025, 2035, 2040 and 2045.
[5] FuelEU Maritime also includes intermediate targets for the years 2025, 2035, 2040 and 2045.
[6] The EC calculated that this new target should be equivalent to an energy-based target of 28% under the RED II framework (EC News, 2021).
[7] vs. road and rail only in RED II – see 1.1
[8] except for advanced biofuels and Renewable Fuels of non-Biological Origin (RFNBOs) in the aviation and maritime sectors.

Table 1-2 presents the major characteristics of RED II and its revision proposal for various renewable transport fuels and energy sources.

Table 1-2 Comparative table of the main characteristics of the RED II and its revision proposal for transport

		RED II		RED II revision proposal (RED III)	
Overall transport target		14% renewable energy by 2030		13% GHG intensity reduction by 2030 (compared to a liquid fossil fuel baseline GHG intensity)	
Scope		Road and rail transport[9]		Entire transport sector	
Fuel	**Feedstock**	**Mandate/Cap[10]**	**Multiplier**	**Mandate/Cap[11]**	**Multiplier**
FAME/ Ethanol/ HVO/Biogas	**Conventional (food crops)**	7% cap	-	7% cap	-
	Advanced biofuels (IX.A)	1.75% mandate	x2	2.2% mandate	-
	UCO and animal fats (IX.B)	1.7% cap	x2	1.7% cap	-
Renewable electricity			x4		-
RFNBOs			-	2.6% mandate	-
Maritime and aviation fuels			x1.2[12]		x1.2[13]

Sources: EC (2019), EC News (2021), ICCT (2021)

Note: In the RED II and its revision proposal, Recycled Carbon Fuels (RCFs) may also contribute towards the targets.

In both the RED II and RED III, renewable fuels need to meet certain GHG emissions reduction thresholds in order to be eligible to count towards the targets. These sustainability criteria remain largely unchanged in the revised version.

Finally, under the RED III, GHG emission intensity reductions are to be calculated against benchmark values. There are two counterfactual values to be considered:

1. 94 gCO_{2eq}/MJ, representative of the GHG emissions intensity of liquid and gaseous fossil fuels, against which the GHG emissions savings of all liquid and gaseous biofuels is to be calculated;
2. 183 gCO_{2eq}/MJ, representative of the GHG emissions intensity of fossil-derived electricity, against which the GHG emissions savings of renewable electricity are to be calculated (ICCT (2021)).

1.3 Dutch policies for renewable energy in transport and links to the RED

1.3.1 *The Jaarverplichting policy*

Principle and scope

In the Netherlands, the EU renewable energy obligations for the transport sector have been transposed into the “Jaarverplichting transportbrandstoffen” (Jaarverplichting). This instrument is one of the key policies in place to ensure the achievement of RED targets for transport. Under the Jaarverplichting, suppliers of liquid transport fuels are obliged to submit a number of renewable energy units (HBEs) for each unit of gasoline and diesel they sell on the domestic market. Renewable electricity in rail

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[9] fuels used in the maritime and aviation sectors may opt-in to be counted towards the 14% target (EC, 2019).

[10] Expressed in energy terms. Exemptions may apply under certain conditions.

[11] Expressed in energy terms. Exemptions may apply under certain conditions.

[12] Applicable to non food-based renewable fuels.

[13] Applicable to advanced biofuels and Renewable Fuels of non-Biological Origin (RFNBOs) only.

transport, which is relatively important in the Netherlands, cannot generate HBEs. It however does count for the achievement of the RED transport target. Finally, renewable energy supplied to the aviation and maritime sectors can opt-in to contribute to the RED II target. The respective scopes of RED II for transport and Jaarverplichting, i.e. the sectors which cumulative energy supplied needs to meet the targets, are presented in Table 1-3.

Table 1-3 Sectoral scopes of the RED II for transport and of the Dutch Jaarverplichting policy

Scope Jaarverplichting	Scope RED II transport target
All gasoline and diesel and their biobased alternatives supplied to the domestic market[14]	Road and rail transport

Generation and submission of HBEs

Even though HBEs only need to be submitted for gasoline and diesel fuels supplied onto the domestic market, HBEs can be generated for all renewable fuels delivered to the transport sector, regardless of where they are used (with the exception of electricity used for rail transport). In 2021, there were three types of HBEs: HBEs for conventional biofuels from food or energy crops;[15] HBEs for advanced fuels;[16] and HBEs for other types of renewable transport energy.[17]

Fuel suppliers that supply fuel to the sectors that fall under the scope of the Jaarverplichting need to submit an amount of HBEs that is equal to the target share set for that year: if a fuel supplier supplies 100 GJ of such liquid fuels and the obligation share is 16.4% (obligation for 2020), the supplier needs to submit an equivalent of 16.4 GJ in HBEs. The supplier can do so by delivering renewable fuels (biofuels, renewable electricity, RFNBOs) for which HBEs are issued or the supplier can buy HBEs from renewable fuel producers. The HBE market is independent from the market for the actual fuels and HBEs can be traded between different transport subsectors. Therefore, for a same subsector, differences between the amount of HBEs submitted and its physical consumption of renewable energy are possible. When this difference becomes too large, the achievement of some targets for which the reporting is based on the physical quantities of renewable energy consumed in certain sectors, such as under the RED, can pose an issue.

When it comes to the multipliers used in the Jaarverplichting, the x2 multipliers for non-conventional biofuels have been taken over directly from the RED. When it comes to the accounting of electricity in the HBE system, only renewable electricity can receive HBEs. Until 2017, renewable electricity would benefit from a multiplier of x2.5, in line with RED I. Since 2018, this evolved to a x5 multiplier. These multipliers are meant to account in particular for the energy efficiency of electric vs. internal combustion engine vehicles. From 2022 onwards the multiplier is changed again, to x4 – in line with RED II.

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[14] Except a fraction of gasoline and diesel that may be supplied to stationary applications, these fuels are supplied to the transport sector. From 2022 onwards, inland shipping is excluded from the scope.

[15] “Type C” HBEs

[16] “Type G” HBEs, including liquid or gaseous biofuels produced with feedstocks listed under Annex IX.A of the RED.

[17] “Type O” HBEs, including renewable electricity used in road transport, biofuels produced from feedstocks listed in Annex IX.B of the RED, biofuels produced from feedstocks not listed in Annex IX.B of the RED which are also not from food or energy crops, and renewable fuels from non-biological origin (RFNBOs) (e.g. hydrogen and other e-fuels). From 2022, Annex IX.B biofuels are included under a new HBE category (“HBE IX.B”).

Jaarverplichting targets

The Jaarverplichting policy requires a renewable energy share of 28% by 2030 for the sectors falling under its scope (Table 1-4). This is significantly more ambitious that the 2030 RED II target (14%), and is expected to be comparable to the target of the revised RED II (see footnote 6). The difference between the ambition level of the Jaarverplichting vs. the RED II may be explained by the fact that the Jaarverplichting was not only designed to achieve EU-level targets but also national climate policy targets, and to a lesser extent because of the difference in scope between the EU and the Dutch policies discussed previously. Indeed, as the maritime sector is allowed to generate HBEs and is particularly significant in the Netherlands, the target under the Jaarverplicthing needs to be higher than the transport renewable energy target under the RED, to ensure sufficient renewable energy use within the road transport sector as well. However, resctrictions over the generation of HBEs for biofuel delivery to the maritime sector have been implemented by the Dutch government and, since 2021, the maritime sector can only generate HBEs for the supply of advanced biofuels and RFNBOs.

Table 1-4 Targets of the EU RED and the Dutch Jaarverplichting policies

Policy target	Type of target	2020	2030
Jaarverplichting	Renewable energy share	16.4%	28%[18]
RED I	Renewable energy share	10%	N.A.
RED II	Renewable energy share	N.A.	14%
RED III	GHG emissions intensity reduction	N.A.	13%

1.3.2 *The Dutch Climate Agreement*

In the national Climate Agreement, multiple ambitions for emissions reductions in the transport sector are outlined. It focuses strongly on the electrification of road transport through the stimulation of electric vehicles (battery electric and plug-in hybrid electric vehicles) and the quick roll-out of charging infrastructure. It has been agreed that on top of the increase in renewable electricity and hydrogen use in road transport projected for 2030 by the National Climate and Energy Projections (KEV 2017), a maximum of 27 PJ of additional renewable energy use (i.e. mostly biofuels) would be stimulated under the Jaarverplichting. However, this means that if the use of electricity (and hydrogen) in road transport grows faster than anticipated in the KEV 2017 projections, the additional amount of renewable liquid fuels required would be lower. A separate target has been set for 5 PJ of renewable energy use in domestic shipping, but a policy instrument to promote this still needs to be developed.

1.3.3 *E10 obligation*

In 2019, a blending obligation to blend at least 8.5% biofuels into gasoline by volume (V/V),[19] has been implemented. This policy measure therefore acts as a parallel driver, next to the targets from the RED and the Climate Agreement, for the use of bioethanol in the Dutch road transport sector. The majority of the bioethanol used in Dutch road transport is imported conventional bioethanol. In Spring 2021, the Dutch parliament has adopted motion *De Hoop*,[20] which requests the cabinet to include a phase out trajectory for conventional biofuels in Dutch Energy for transport legislation (*Besluit energie vervoer*).

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[18] The 2030 target was revised from 27.1% (until 2021) to 28% (from 2022)

[19] Staatsblad (2019) Besluit van 14 juni 2019 tot wijziging van het Activiteitenbesluit milieubeheer en het Besluit brandstoffen luchtverontreiniging in verband met de invoering van E10-benzine en de informatieplicht van leveranciers van brandstoffen.

[20] Motie van het lid De Hoop over een afbouwpad voor biobrandstoffen uit voedsel- en voedergewassen opnemen in het Besluit energie vervoer voor 2023 (2021).

A study commissioned by the Ministry of Infrastructure and Water management[21] concluded that the concerns mentioned in the *De Hoop* motion in relation to direct and indirect land use change associated with the use of sugar crops are relatively low. Nevertheless, future decisions of the parliament on imposing further limitations on the use of food and fodder crops as biofuel feedstock could have substantial implications on the evolution of renewable fuel use in the Dutch transport sector.

1.3.4 Decarbonisation of the aviation sector

Even though the aviation sector currently remains out of scope in most climate policies due the importance of its international component, the Dutch government has intentions to introduce climate policies for this sector as well. First of all, the government supports EU-level initiatives to improve the level playing field between aviation and other sectors through the reform of the fiscal framework for aviation fuels.[22] Next to this, the Netherlands is in favour of introducing a blending obligation for sustainable aviation fuels, preferably at the EU level. The Dutch government intends to lobby at the EU-level for such an obligation in the coming years, but if no obligations are implemented by 2023 the government intends to introduce a national obligation from that year onwards.[23] Lastly, the Dutch government intends to promote the manufacture of synthetic kerosene in the Netherlands and is planning for the country to become a frontrunner in this area.

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[21] Gear Up (2021) Inzet van biobrandstoffen uit voedsel- en voedergewassen in de transportsector.

[22] VVD, D66, CDA & ChristenUnie (2021) Coalitieakkoord 2021 – 2025 – Omzien naar elkaar, vooruitzien naar de toekomst.

[23] Kamerbrief IENW/BSK-2020/24484 - Kamerbrief ontwikkelingen duurzame brandstoffen luchtvaart.

2 Alternative fuel use in Dutch transport

2.1 Historical evolution (2011-2020)

2.1.1 *Liquid biofuels dominate renewable energy use under the Jaarverplichting*

Over the past decade, liquid biofuels have represented the lion's share of the renewable energy consumed in the Dutch transport sector. In 2020, they accounted for 94% of the sector's total renewable energy consumption. Since the early 2010s, biodiesel has been the most important type of biofuel in the Netherlands, more specifically in the form of Fatty Acid Methyl Esther (FAME) which is made by combining vegetable oils with methanol. In 2011, FAME represented roughly two thirds of the total biofuel consumption, with about 70% of it from conventional feedstocks and the rest from residue streams (subject to a x2 multiplier under the RED) (Figure 2-1). In 2020, FAME still represented 69% of the renewable energy consumed in the transport sector, but conventional feedstocks were almost fully replaced by double-counting feedstocks, which accounted for 99.7% of all FAME feedstocks in 2020 - predominantly used cooking oil (UCO) (>75% of all FAME). In 2020, the use of conventional biofuels from feed and fodder only represented 1.8% of the energy consumption within road and rail transport[24] and about 1% of the domestic transport energy use, meaning that the Netherlands remained well below the RED cap of 7% for such fuels.

2.1.2 *The mix of renewable energy carriers in transport is diversifying*

Since 2018, the diversity of renewable fuels and energy sources consumed in the transport sector increased substantially, in particular with Hydrotreated Vegetable Oil (HVO), biomethane, advanced bioethanol and electricity (Figure 2-1). The increase in the use of HVO coincides with the start of operations of the Neste biorefinery in Rotterdam, and comes as a complement to the large quantities of FAME, which can be blended with diesel only up to 7% (V/V), on the Dutch market. The increase in the contribution of electricity to the total renewable energy use in transport has been driven by the strong uptake of electric passenger cars. In 2015, battery electric vehicles only represented 0.1% of the Dutch car fleet,[25] but by 2020 this had already grown to 2%. The total numbers of cars with a plug (battery electric and plug-in hybrid electric cars) on Dutch roads increased from over 43 000 in 2015 to 360 000 at the end of November 2021,[26] representing roughly 4%[27] of the entire car fleet.

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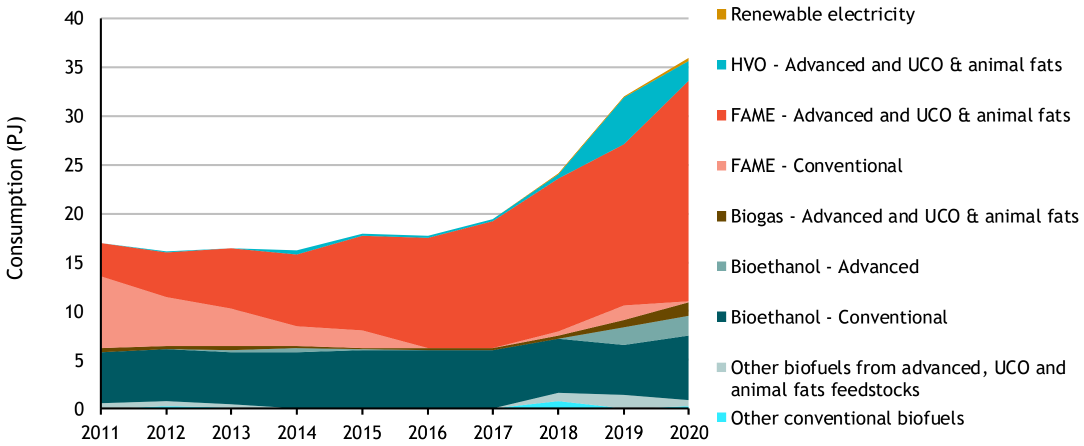
[24] Eurostat (2021), https://ec.europa.eu/eurostat/web/energy/data/shares

[25] 8 967 cars – RVO (2021) Trendrapport Nederlandse Markt personenauto's - out of a total fleet of 7.9 million – CBS (2021) Personenauto's; voertuigkenmerken, regio's, 1 januari.

[26] RVO (2021) Cijfers elektrisch vervoer.

[27] Based on a total car fleet of 8.8 million cars – CBS (2021) Personenauto's; voertuigkenmerken, regio's, 1 januari.

Figure 2-1 Renewable energy use in transport falling under the scope of the Jaarverplichting, 2011-20.



Source: NEa (2021) Rapportage Energie voor vervoer in Nederland 2020.
Note: the renewable energy quantities represented in this graph are real quantities (i.e. multipliers removed) for which HBEs were generated (the figure thus includes a certain quantity of biofuels delivered to the maritime sector and for which HBEs were generated).

2.1.3 Biofuel use in the maritime sector

In the Netherlands, the maritime sector is an important energy-consuming sector within transport (45% of the transport sector's energy use, vs. 11% at EU level).[28] As described in 1.3.1, HBEs can be traded between different transport subsectors, and as a consequence HBEs can be submitted in one subsector while the actual renewable fuel is being used in another. This is has been happening with large fractions of the UCO-based FAME for which HBEs are being submitted. From all biofuels for which HBEs were generated under the Jaarverplichting in 2020, 30% was actually delivered to the maritime sector,[29] with a large share of biofuels delivered going to international shipping, while this sector doesn't fall under the scope of the Jaarverplichting. This is disadvantageous for the achievement of the transport renewable energy target of the RED II (which includes only road and rail energy) as well as for some of the national GHG reduction targets for the domestic transport sector. In addition, the RED II includes a 1.7% cap on Annex IX.B feedstocks (UCO and animal fats) by 2030, while in 2020 UCO-based fuels accounted for over half of all HBEs booked into the system and the volume of HBEs submitted for UCO-based fuels was equivalent to over 4% of liquid fuel energy use in the domestic transport sector in 2020.

In order to better align the HBE system and the use of renewable fuels with the achievement of national targets, the Dutch government has decided to implement several measures aimed at reducing the use of UCO-based FAME in the maritime sector. From 2021 onwards, HBEs can only be issued to the maritime sector for biofuels from advanced (Annex IX.A) feedstocks and for RFNBOs. Therefore, UCO-based biofuels will no longer generate HBEs when used in the maritime sector.[30]

Under the RED II, the renewable energy target for transport applies to road and rail transport, but maritime and aviation fuels have the possibility to opt-in to contribute to the target. In the RED II revision proposal, the maritime and aviation sectors are included. For the Netherlands, the domestic

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[28] Source: "Ramping-up Renewable Fuels" webinar, Platform Hernieuwbare Brandstoffen (30/11/2021)
[29] NEa (2021) Rapportage Energie voor vervoer in Nederland 2020.
[30] Staatsblad 2021, 619 - Besluit van 20 december 2021 tot wijziging van het Besluit energie vervoer in verband met de implementatie van Richtlijn (EU) 2018/2001 van het Europees Parlement en de Raad van 11 december 2018 ter bevordering van het gebruik van energie uit hernieuwbare.

shipping[31] and aviation sectors are projected to account for only 4.7% of the domestic transport energy demand in 2030.[32] If international shipping and aviation were to be counted towards renewable energy or GHG intensity reduction targets, the biofuels delivered to the maritime sector in the Netherlands could make a significant contribution.

2.2 Transport fuel projections to 2030

2.2.1 *EU trends*

At the EU level, shifts in the use of renewable energy carriers for transport are taking place, not only with regards to the uptake of EVs, but also in relation to the types of biofuels and feedstocks used.
In a context of declining liquid fuel demand, the International Energy Agency (IEA) suggests that European biofuel demand may remain relatively weak (+13% growth between 2021 and 2026) in comparison with other regions, even with enabling policies in place such as the RED II (IEA, 2021).
Accounting for the Fit-for-55 package of new or revised policy proposals, among which the main biofuel demand growth drivers are ReFuelEU Aviation and the RED II revision proposal, this biofuel demand growth could be about three times higher. It estimates that HVO (in part thanks to its high blending prospects), FAME and biojet fuels would be the primary drivers of the demand growth, and that there is scope for FAME production growth in Europe to replace imports.
The Netherlands being among the top five biofuel net exporting countries globally, the IEA expects the country to maintain its position within the next five years, although with lower net exported volumes to satisfy in-country demand.

According to a study by CE Delft specifically looking at UCO as a feedstock, at the EU level, the demand for UCO and UCO-based fuels is expected to grow substantially, from 2.8 Mt in 2019, to over 6 Mt in 2030.[33] The increase in demand for UCO is driven by two main changes in EU policy:

- The use of conventional biofuels is capped and needs to decline towards 2030, increasing the need for Member States to look for alternative biofuel feedstocks[34];
- In response to heavy debates on indirect land-use change (ILUC) (caused by the use of palm oil in particular) for biofuel production, the EU has adopted a delegated act in 2019 capping biofuel production from feedstocks with high ILUC risk at 2019 levels and imposing a gradual phase out for the period 2023-30.

As the use of Annex IX.B feedstocks is in most countries below the 1.7% cap, many Member States could seek to replace part of their declining feedstock supply with UCO.[35]

2.2.2 *Projected evolution of renewable energy in transport in The Netherlands*

According to the national projections for the Netherlands based on existing policies, liquid fuel demand in transport is expected to decline marginally in the period leading to 2030, from 437 PJ in 2020 to 432 PJ in 2030, whereas the overall energy consumption in the sector is expected to grow slightly (Figure 2-2).[36] Towards 2030, renewable energy obligations for transport fuels as well as a new renewable energy mixing obligation for aviation will contribute to continued growth of biofuel use in the Dutch transport sector. By 2030, the estimated consumption of biofuels in domestic transport lies at around

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[31] Including fishing ships

[32] PBL (2021) Klimaat en energieverkenning 2021.

[33] CE Delft (2021) Used Cooking Oil (UCO) as biofuel feedstock in the EU. https://cedelft.eu/wp-content/uploads/sites/2/2021/04/CE_Delft__200247_UCO_as_biofuel_feedstock_in_EU_FINAL-v5.pdf

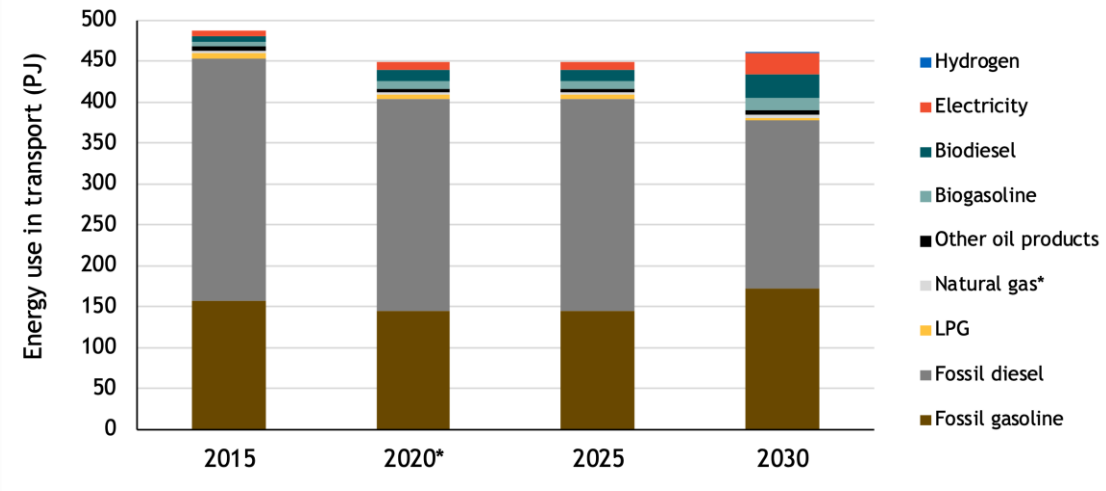
[34] *Ibid.*

[35] *Ibid.*

[36] PBL (2021) Klimaat en energieverkenning 2021.

44 PJ, compared to 26 PJ in 2020. Within domestic transport, road transport is bound to remain by far the largest energy consumer (Figure 2-3). In road transport, electrification is expected to continue, especially in the passenger car segment, but also in the vans and trucks sectors. It is estimated that the electricity consumption of the transport sector will increase from roughly 7 PJ in 2020 (of which 75% is used by rail) to 26 PJ in 2030, with 11 PJ for electric cars and 19 PJ for road transport overall. As a consequence of the increasing role of electricity in road transport (Figure 2-3), electricity is expected to account for 35% of the HBEs that will be issued in 2030 compared to a projection of 2% for 2022.[37,38]

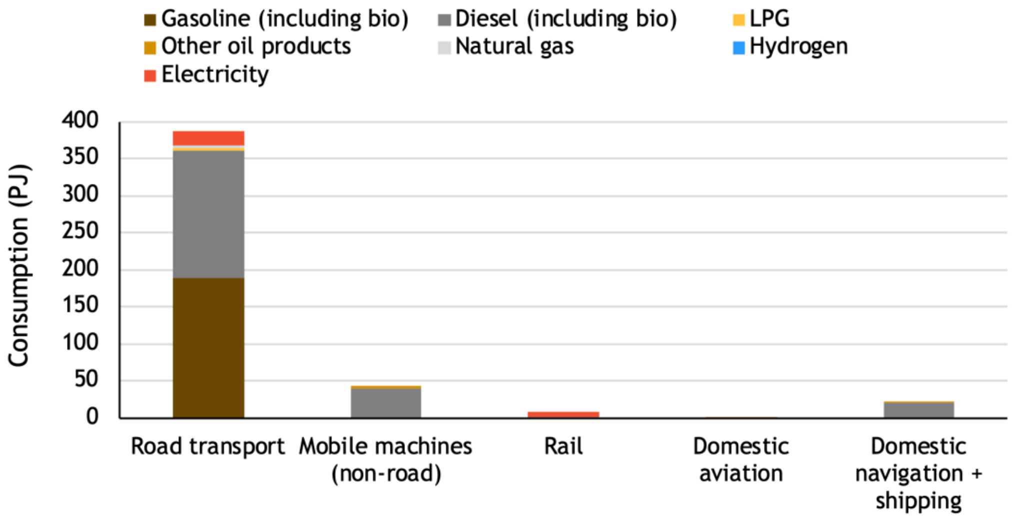
Figure 2-2 Historical and projected final energy use in domestic transport in the Netherlands, 2015-30



*The figures for 2020 are based on preliminary data.

Source: PBL (2021) Klimaat en energieverkenning 2021.

Figure 2-3 Projected energy consumption in domestic transport in the Netherlands by transport mode, 2030



Source: PBL (2021) Klimaat en energieverkenning 2021.

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[37] PBL (2021) Klimaat en energieverkenning 2021.
[38] See also section 3.3.1.

3 GHG emissions accounting under the RED III and impacts

3.1 GHG emissions savings of renewable fuels and energy sources

With the new target of the RED III, which is based on GHG emissions intensity reductions, the contributions of the various renewable fuels and energy vectors delivered to the transport market towards the target will be based on their specific GHG emissions per unit energy, along with different GHG emissions savings accounting rules for electricity on the one hand, and for liquid and gaseous biofuels on the other hand. The savings calculated for the various renewable fuels and energy vectors are to be compared to an all-liquid fossil fuel baseline to derive the final GHG emissions intensity reduction for transport, which needs to reach 13% in 2030 (Table 1-2). Table 3-1, Figure 3-1 and Figure 3-2 present current GHG emission factors and associated GHG emission savings for a variety of biofuel-feedstock pairs, for electricity and for RFNBOs, in 2020 (unless otherwise mentioned). Figure 3-3 shows how renewable electricity savings compare to biofuels under both the RED II and the RED III.

Table 3-1 GHG emissions and savings as per RED III accounting rules, for selected renewable fuels and electricity mixes

	GHG emissions (gCO_{2eq}/MJ)	Counter-factual (gCO_{2eq}/MJ)	GHG emission savings (gCO_{2eq}/MJ)	GHG emission savings (%)
Ethanol - Conventional	30.5	94	63.5	68%
Ethanol – Advanced (Annex IX.A)	14.1	94	79.9	85%
FAME - Conventional	34.1	94	59.9	64%
FAME – Advanced (Annex IX.A)	13.3	94	80.7	86%
FAME – UCO and animal fats (Annex IX.B)	11.9	94	82.1	87%
HVO – Advanced (Annex IX.A)	14.6	94	79.4	84%
HVO – UCO and animal fats (Annex IX.B)	8	94	86	91%
Bionafta - UCO and animal fats (Annex IX.B)	6.3	94	87.7	93%
Biogas - Advanced (Annex IX.A)	19.3	94	74.7	79%
Biogas - UCO and animal fats (Annex IX.B)	18	94	76	81%
Renewable electricity	0	183	183	100%
Electricity mix with 26% renewables (representative of 2020 Dutch electricity mix[39])	135	183	48	26%
Electricity mix with 74% renewables (representative of projected 2030 Dutch electricity mix[40])	48	183	135	74%
RFNBO with minimum GHG savings threshold (70%)	-	-	-	70%
RFNBO with 100% GHG savings	-	-	-	100%

Methodological notes:
Column "GHG emissions": The data displayed for biofuels was provided by RVO and NEa on 16/12/2021 and represent 2020 values. For electricity, the numbers (in grey) were calculated from the renewable energy share of the electricity mix considered, against a GHG emission factor of fossil-based electricity of 183 gCO_{2eq}/MJ (the numbers displayed therefore do not represent the actual GHG emissions of the Dutch electricity mixes).
RFNBOs: In the absence of representative GHG emission data for RFNBOs for the Netherlands, and of an explicit counterfactual value against which to calculate absolute savings,[41] two indicative GHG emissions savings for RFNBOs were considered: 70% (being the GHG savings threshold for RFNBOs to be eligible as a renewable fuel under the RED (JEC, 2019)) and 100%.

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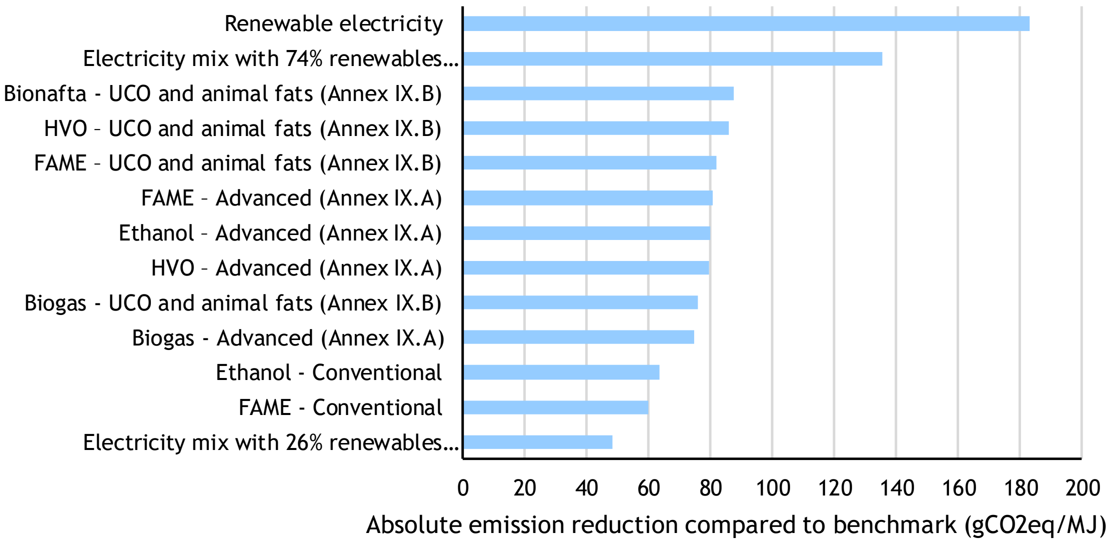
[39] PBL (2021) Klimaat en energieverkenning 2021.

[40] PBL (2021) Klimaat en energieverkenning 2021.

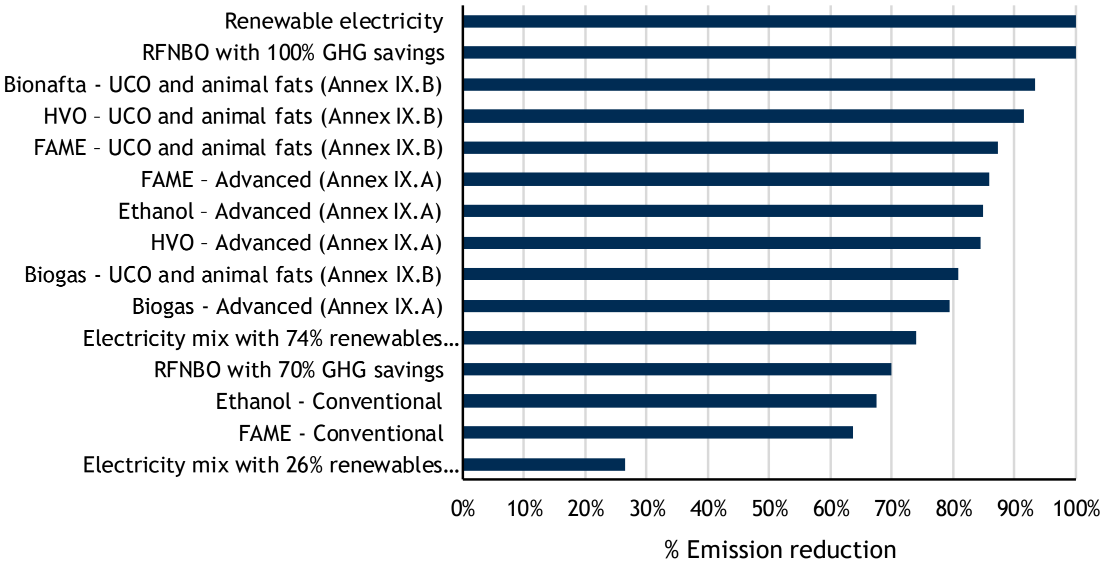
[41] The release of EC proposals for delegated acts relative to the GHG methodology for RFNBOs is pending (T&E (2021), EC (2022)).

Figure 3-1 Absolute GHG emission savings as per RED III accounting rules for selected biofuels and electricity mixes



Methodological notes: see notes to Table 3-1 (in particular regarding the absence of RFNBOs from this figure).

Figure 3-2 Relative GHG emission savings as per RED III accounting rules for selected renewable fuels and electricity mixes



Methodological notes: see Table 3-1 and notes to Table 3-1.

3.1.1 *Biofuels and biogas*

All biofuels or biogas from Annex IX.A or Annex IX.B feedstocks (comprising advanced feedstocks, UCO and animal fats) have GHG emission savings against their liquid fossil fuel benchmark (94 gCO_{2eq}/MJ) of around 80-90% (Figure 3-2 and Table 3-1). Conventional feedstocks (to produce bioethanol or FAME) have GHG emissions savings of 64-68%.

Under the RED II, which applies a x2 multiplier for Annex IX.A and Annex IX.B biofuels and no multiplier for conventional biofuels, there is a factor two between the contribution of both types of biofuels per unit energy towards the renewable energy target. With the GHG-based accounting system and target of the RED III, and because the specific GHG emissions savings from conventional biofuels are relatively close (closer than a factor 2 difference) to those of advanced and Annex IX.B biofuels (Table 3-1 and

Figure 3-1), the difference in their respective contributions to the target per unit energy is narrower under the RED III than under the RED II.

3.1.2 Electricity

Absolute GHG emissions savings per unit energy

As shown in Table 3-1 and Figure 3-2, under the conditions of the RED III, at equal quantities, renewable electricity is the renewable energy source allowing for the highest GHG emissions abatement[42] as is it considered to be fully zero-emission and its savings are calculated against a higher counterfactual than for liquid and gaseous fuels.

Considering that the Dutch electricity mix will contain 74% of renewables in 2030,[43] a vehicle charging from such a grid would allow the realisation of 74% GHG emission savings per unit energy fuelled, which corresponds to an absolute GHG emissions reduction of 135 gCO_{2eq}/MJ (against electricity's fossil counterfactual value of 183 gCO_{2eq}/MJ). This value surpasses any absolute emissions savings from biofuels, which reach a maximum of 88 gCO_{2eq}/MJ (for bionafta produced from Annex IX.B feedstocks) (Figure 3-1). Under the RED III accounting method for liquid and gaseous biofuels, the GHG emissions savings of the latter cannot exceed 94 gCO_{2eq}/MJ, which represents their liquid fossil fuel counterfactual aginst which their emissions savings are to be calculated.

The absolute GHG emissions savings per unit energy from an electricity mix with 26% renewables (as the Dutch electricity mix in 2020)[44] are lower than those of any biofuels present on the Dutch transport market in 2020 (Table 3-1 and Figure 3-1).

Contribution to renewable energy and to GHG emissions reduction vs. biofuels

As shown in Figure 3-3 (light green bars), there is, under the RED II accounting mechanism, a x4 factor in the contribution of one energy unit of renewable electricity vs. one energy unit of conventional biofuels towards the renewable energy target, due to the mulitpliers in place (Table 1-2). For renewable electricity vs. advanced and Annex IX.B biofuels, this factor is x2.[45]

With the RED III and the emission factors for biofuels in the Netherlands used across this chapter (Table 3-1), the differences in absolute GHG emissions savings for renewable electricity vs. biofuels (against their respective counterfactuals), remains close to a factor 2 when considering advanced and Annex IX.B biofuels, and is around 3 when considering conventional biofuels (dark green bars). It is worthwhile to note that, accounting for the better energy efficiency of electric vehicles (EVs) vs. internal combustion engine vehicles (ICEVs), more units of biofuel per vehicle and per unit distance are needed to achieve same final GHG savings in ICEVs as for renewable electricity in EVs.

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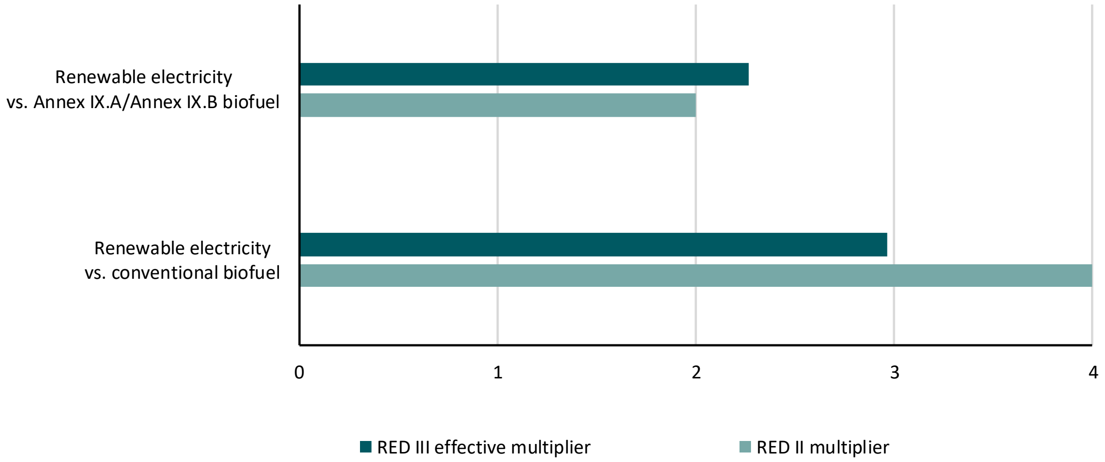
[42] Along with 100% renewable RFNBOs, see discussion on RFNBOs in the next section.

[43] PBL (2021) Klimaat en energieverkenning 2021.

[44] PBL (2021) Klimaat en energieverkenning 2021.

[45] Because of a x4 multiplier for renewable electricity and a x2 multiplier for advanced and Annex IX.B biofuels.

Figure 3-3 Effective multipliers per unit energy for renewable electricity against conventional and Annex IX.A/Annex IX.B biofuels, under RED II and RED III methodologies



Methodological notes:
RED II multipliers are derived from Table 1-2.
RED III effective multipliers are calculated from the difference in absolute emissions savings between renewable electricity and the average emission savings of conventional biofuels, and from the difference in absolute emissions savings between renewable electricity and the average emission savings of Annex IX.A and Annex IX.B biofuels (Figure 3-1).

In addition, the contribution of renewable energy towards GHG emissions reductions is to be calculated against a liquid fossil fuel baseline GHG intensity (Table 1-2), which enhances the contribution of renewable electricity savings vs. a case where the contribution of renewable electricity savings would be calculated against a fossil electricity baseline (which is higher than a liquid fossil fuel baseline). An illustrative example is provided in Table 3-2, based on the calculation of the GHG emissions intensity savings of 5 MJ of renewable electricity within a total energy mix of 50 MJ of electricity plus 50 MJ of liquid fossi fuels (100 MJ in total). In case A, the renewable electricity's contribution to GHG emissions intensity reduction is calculated against a liquid fossil-fuel baseline of 94 gCO_{2eq}/MJ, in line with the RED III methodology. In case B, the baseline considered is that of the respective counterfactuals for electricity and for liquid fuels (183 gCO_{2eq}/MJ and 94 gCO_{2eq}/MJ respectively), applied proportionally to the total electricity and total liquid fuels used in the system. The comparison between both cases shows that the methodology applied under case A allows for a higher contribution of the 5 MJ of renewable electricity in the 100 MJ system (-9.7% GHG emissions intensity), than the methodology under case B (-6.6% emissions intensity). Varying the proportions of electricity and liquid fuels in the overall energy system or varying the quantities of renewable electricity in both cases lead to similar outcomes, with the GHG emissions intensity reduction in case A being higher than in case B.

Table 3-2 Illustrative comparative example of GHG emissions intensity savings in an energy system made of 50 MJ liquid fuels and 50 MJ electricity, as per two baseline calculation methodologies.

Baseline methodology :	A. All-liquid fossil fuel (in line with RED III methodology)	B. Liquid fossil fuel and fossil electricity (proportionally to liquid fuels and electricity in the system)
Liquid fossil fuel emission factor (gCO_{2eq}/MJ)	94	
Fossil electricity emission factor (gCO_{2eq}/MJ)	183	
GHG emissions savings from 5 MJ renewable electricity in the system (gCO_{2eq})	915	
Baseline GHG emissions intensity (gCO_{2eq}/MJ)	94	138.5
GHG emissions intensity of the system (gCO_{2eq}/MJ)	85	129
GHG emissions intensity reduction from the baseline (%)	**9.7%**	**6.6%**

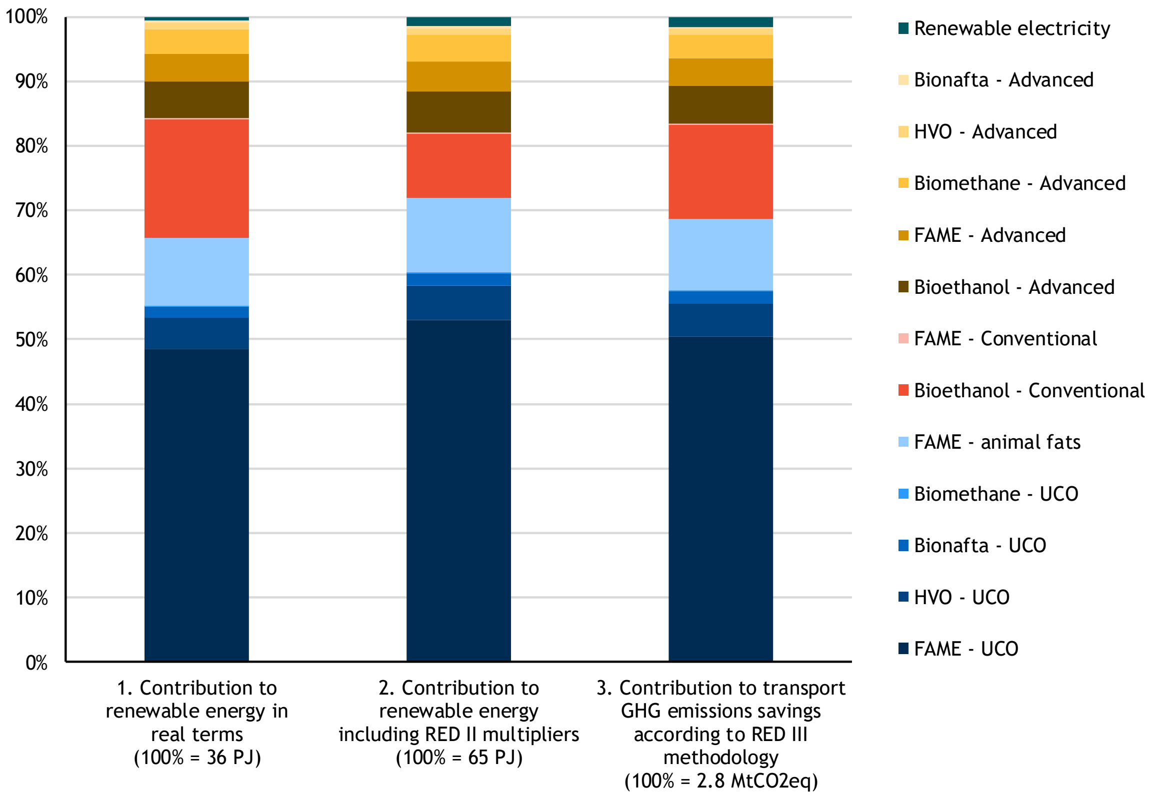
3.1.3 RFNBOs

The RED II revision proposal explicitly suggests to introduce a 2.6% mandate for RFNBOs in addition to the transport GHG emissions intensity reduction target, and the RED II provisions a 70% GHG emissions savings threshold for RFNBOs to be eligible as a renewable fuel. However there is no available representative GHG emission factor for RFNBOs at the Dutch level (no HBEs for RFNBOs were registered in 2020), and the counterfactual and methodology to estimate the emissions savings and contributions towards RED III targets of RFNBOs are still to be defined (see Table 3-1 and its notes).

3.2 Calculated impact of the RED III accounting mechanism for renewable fuels in the Netherlands in a 2020 timeframe

In order to estimate the respective impact of the RED II and the RED III methodologies (based on quantities of renewable energy and multipliers for the former, and on GHG emissions reductions for the latter) on renewable fuels and energy sources for transport, we calculated the relative contributions of the renewable fuels in use in 2020 in the Netherlands[46] (Figure 2-1) to transport renewable energy or GHG emissions reductions. The results are presented in Figure 3-4.

Figure 3-4 Contribution of the renewable transport fuels and energy sources in use in the Netherlands to total transport renewable energy (without and with mulitpliers - 1 & 2) and to transport GHG emissions reductions (3), 2020



Sources: NEa (2021) Rapportage Energie voor vervoer in Nederland 2020 (Tabel I and Tabel II).
Methodology note on multipliers applied: Conventional fuels - no multiplier; Renewable electricity - x4 multiplier; all others - x2 multiplier.
Methodology note on GHG emissions reductions: the GHG emissions factors and counterfactuals applied are those presented in Table 3-1.

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[46] For which HBEs were submitted

Methodology note on abosulte figures: 36 PJ represent the real quantity of renewable energy use in transport falling under the scope of the Jaarverplichting (see Figure 2-1). 65 PJ represent the quantity of renewable energy use in transport falling under the scope of the Jaarverplichting, including multipliers. 2.8 $MtCO_{2eq}$ represent the GHG emissions savings from the renewable energy use in transport falling under the scope of the Jaarverplichting, calculated against a liquid fossil fuel baseline of 94 gCO_{2eq}/MJ.

1. In 2020, UCO-based fuels contributed, by their actual quantities supplied to the market (case 1), to 55% of all transport renewable energy for which HBEs were submitted. The share of Annex IX.B biofuels goes up to 66% when including FAME produced from animal fats. 18% of the renewable energy supplied to the transport sector was fuels from conventional feedstocks, while advanced biofuels contributed to 15%. Renewable electricity, with less than 1%, was the smallest contributor to transport renewable energy use.
2. When applying the RED II multipliers to the renewable fuels and energy sources delivered to the transport sector, Annex IX.B biofuels reach a relative contribution of 72% (+6 percentage points from case 1). The increase of the relative contribution of advanced biofuels is marginal (+1 percentage point) and renewable electricity's contribution grows to 1.4%. The contribution of these fuels is inflated from the real quantities that are used thanks to the multipliers applied (x2 for Annex IX.A and Annex IX.B biofuels, and x4 for renewable electricity). The relative contribution of conventional biofuels, which do not benefit from a multiplier, shrinks to 10% (-8 percentage points from case 1).
3. Applying the RED III methodology and calculating the relative contribution of the various renewable fuels and energy sources towards the total GHG emissions saved from transport renewable energy in 2020, the relative contributions resemble more those of the real renewable energy quantities (case 1) than those of the energy quantities as calculated under the RED II (case 2). This is because the GHG emissions savings of conventional biofuels and of Annex IX.A and Annex IX.B fuels (Figure 3-2) are closer to each other than the gap generated by double-counting Annex IX.A and Annex IX.B fuels under RED II while not applying any multiplier to conventionals (as mentioned in 3.1.1). Only the contribution of renewable electricity would roughly double from case 1 - as in case 2 - to 1.5%.

In conclusion, based on the renewable fuel mix in the Netherlands in 2020 and with the GHG emission factors given for each renewable (Table 3-1):

- UCO-based fuels broadly maintain their relevance towards contributing to GHG emissions reductions from renewable transport fuels compared to their contribution in real terms and under RED II mutlipliers, given the large quantities in use and their high GHG emissions savings compared to other renewable fuels.
- Conventional biofuels are more favoured under the RED III accounting mechanism than under the RED II, as their difference in GHG emissions savings with regards to other altneratives is lower than their difference of treatment under RED II (no multiplier for conventional biofuels vs x2 multiplier for other biofuels – see 3.1.1).
- The use of renewable electricity is favoured under both RED II and RED III methodologies compared to real terms, without a significant difference between the RED II and RED III cases shown in Figure 3-4, given the small amount of renewable electricity submitted in the HBE system in 2020 and somewhat limited difference in effective multipliers between electricity and biofuels under the RED III accounting methodology compared to RED II (Figure 3-3, green bars).

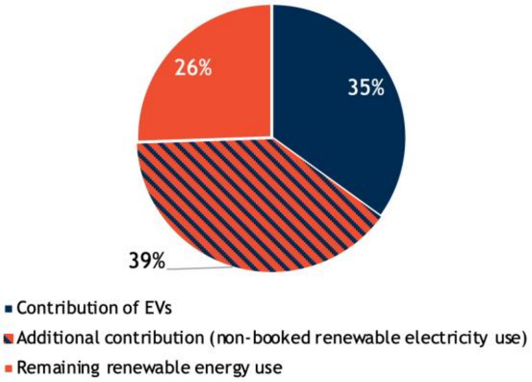
3.3 Calculated impact of the RED III accounting mechanism for renewable fuels in the Netherlands in a 2030 timeframe

3.3.1 *Impact of electric vehicles*

Contribution of EVs towards the 2030 Jaarverplichting target

It is projected that 1.1 million electric cars will be on the Dutch roads by 2030. Next to this, roughly 100 000 light commercial vehicles and 7 000-29 000 trucks are expected to be zero-emission that year, along with around 5 000 zero-emission public buses.[47] Even though renewable electricity only made a rather modest contribution to reaching the Jaarverplicthing obligations in 2020, renewable electricity use in road transport (including the relevant multipliers for renewable elctricity) would be sufficient to achieve 35% of the Jaarverplichting target for 2030, according to national projections.[48] This is a substantial contribution, especially when accounting for the fact that roughly only half (47%) of the electricity use by passenger cars is booked into the HBE system, due to high administrative burdens making it not worthwhile for small users to book in their electricity use.[49] If the rest of road transport electrity projected for 2030 was also accounted for, the contribution of EVs to meeting the 27.1% renewable energy target of the Jaarverplichting in 2030 would reach 73% (Figure 3-5). This leaves 26% to 65%, depending on whether only part or all renewable electricity in use in road transport will be counted towards reaching the target, to other types of renewable fuels.

Figure 3-5 Relative contribution of electric road transport towards the 2030 Jaarverplichting target



Note: The Jaarverplichting target considered in this figure in 27.1%. From 2022, this target was updated to 28%.

Source: PBL (2021) [Klimaat en energieverkenning 2021](#).

EV emissions savings under the RED III accounting methodology

Applying the RED II revision proposal methodology in calculating the GHG emissions savings from the road transport electric vehicles projected for 2030, assuming they are fuelled from grid electricity that is composed of 74% renewable electricity, electric vehicles, responsible for 19 PJ energy use according to national projections, would allow for 2.6 $MtCO_{2eq}$ savings. This corresponds to a GHG emissions intensity reduction for all domestic transport of 5.6 gCO_{2eq}/MJ,[50] representing a 6% reduction of all domestic transport GHG emissions intensity (this reduction is calculated against a liquid fossil fuel GHG emissions intensity benchmark of 94 gCO_{2eq}/MJ, in line with the RED III methodology). Therefore, around half (46%) of the 13% GHG emission intensity reduction target under the RED II revision proposal,

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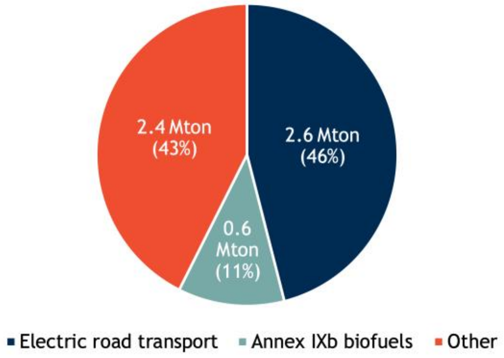
[47] PBL (2021) Klimaat en energieverkenning 2021.
[48] PBL (2021) Klimaat en energieverkenning 2021.
[49] For further information, see Trinomics report "Onderzoek kleine spelers elektrisch vervoer" for RVO, forthcoming.
[50] Calculated from 458 PJ domestic transport energy use in 2030 (KEV 2020).

applied to the entire Dutch domestic transport energy use, is met thanks to the EVs on the road by 2030 (Figure 3-6).

3.3.2 *Impact of a cap on the use of used cooking oil and animals fats as feedstocks*

In 2020, UCO-based FAME accounted for 53% of the renewables under the Jaarverplichging (including double-counting) (Figure 3-4, case 2), or 49% on an energy basis (Figure 3-4, case 1). Its use is also equivalent to over 4% of the total liquid fuel delivered to the domestic transport sector (section 2.1.3). However, if the 1.7% cap on Annex IX.B biofuels applied, the physical volume of such fuels (of which UCO-based FAME) counting towards the RED III target could only be 7.8 PJ in 2030,[51] compared to 23 PJ of Annex IX.B biofuels (of which 17 PJ of UCO-based FAME) counting under the Jaarverplichting targets in 2020. When combining the impact of renewable electricity in road transport and the cap on Annex IX.B biofuels by 2030, these energy carriers together can achieve 57% of a GHG emission intensity reduction of 13% within the domestic transport sector (Figure 3-6). The remaining 43% of the total GHG emission savings required therefore need to come from other renewable options. Part of the target will be met by the already-existing, and increasing, renewable electricity use in rail transport as this sector is under the scope of the RED III, complemented by advanced biofuels and RFNBOs which are subject to mandates of 2.2% and 2.6%, respectively, under the RED III, and by conventional biofuels up to the 7% cap of the RED (in 2020, HBEs submitted for advanced biofuels represented just over 1% of liquid fuel use in the domestic transport sector in 2020, and HBEs submitted for conventional biofuels around 1%).

Figure 3-6 Contributions of renewable electrity use in road transport and Annex IX.B biofuels to an emissions intensity reduction of 13% within the domestic transport sector in 2030, according to the RED III methodology.



Notes: For precisions on the methodology used for the calculations, see text in section 3.3.1 (for electric vehicles) and 3.3.2 (for UCO).

Should international transport energy use be included in the scope of a 13% GHG emissions intensity reduction target by 2030, a larger contribution from liquid or gaseous fuels (likely to be needed in large quantities to decarbonise the international maritime and aviation sectors, as these are harder to electrify) should be envisaged, compared to renewable electricity, than shown in Figure 3-6. This would also theoretically imply more room for Annex IX.B biofuels than the 7.8 PJ mentioned above that result from a 1.7% cap within domestic transport, should Dutch legislation allow them again in those sectors (see section 2.1.3).

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[51] Assuming the 1.7% cap is applied to the projected energy use of the entire domestic transport sector in 2030 (458 PJ).

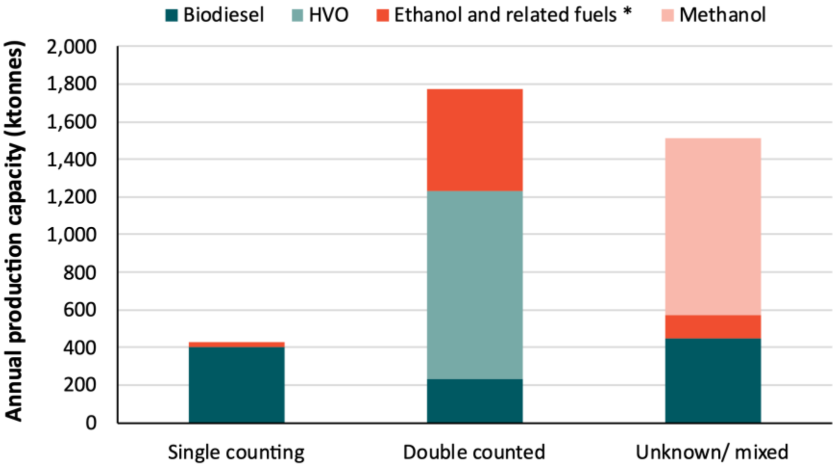
4 Dutch landscape for renewable fuel production

4.1 Domestic production

4.1.1 Liquid biofuel production in the Netherlands

There are around 12 large biofuel producers in the Netherlands with annual production capacities exceeding 10 kilotonnes. Six of these facilities produce biodiesel (FAME), one produces HVO, two produce bioethanol, one produces methanol and two produce other ethanol-related fuels. Figure 4-1 provides an overview of the production capacities for different biofuel types in the Netherlands divided by feedstock type. HVO, FAME and methanol benefit from the largest production capacities. The HVO is produced at NESTE's biorefinery in Rotterdam. With its current production capacity, this facility is already capable of covering 100% of the projected biofuel use in the Dutch transport in 2030 on its own.[52] Currently, the company produces 100 kilotonnes of renewable aviation fuels annually but is planning to do an investment of 190 million EUR to increase its production capacity to 500 kilotonnes by 2023.[53] Another large player is BioMCN, which produces biomethanol from glycerin. This plant has recently expanded its production capacity from roughly 500 kilotonnes per year to 940 kilotonnes.[54] The company is considering to further develop renewable methanol production capacity in cooperation with Nouryon, via synthetic methanol produced from renewable hydrogen and CO_2.[55]

Figure 4-1 Overview of biofuel production capacity in the Netherlands by feedstock catergory and fuel type



Source: NVDB (2018) Overzicht productie capaciteit[56] *(production facilities marked as 'production on hold' were not included in this figure).*
Note: *"Ethanol-related fuels" include MBTE and ETBE.*

The Dutch government has been actively stimulating the use of UCO as a feedstock by allowing for double-counting under the Jaarverplichting. Due to this possibility, significant production capacity for UCO-based FAME has been developed in the Netherlands. In 2018, the RED II made the future of UCO-

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[52] The annual production capacity of the NESTE facility in Rotterdam is around 1 million tonnes, which is equivalent to 44 PJ. According to the KEV 2020, the projected volume of biofuel consumption is also 44 PJ.
[53] Neste (2021) Neste to enable production of up to 500,000 tons/a of Sustainable Aviation Fuel at its Rotterdam renewable products refinery.
[54] TerraTechMedia (2017) 100 miljoen euro voor tweede methanolfabriek van bioMCN.
[55] Nouryon (2019) BioMCN gaat hernieuwbare methanol produceren met groene waterstof.
[56] Obtained from personal exchange with the NEa. Data for 2 producers were updated by Trinomics.

based biofuel production in the Netherlands uncertain as a cap of 1.7% was introduced for Annex IX.B biofuels towards the renewable energy target for transport. In order to cushion the impact of this policy change on Dutch FAME producers, the Dutch government decided to cap the UCO-based FAME levels at 10% from 2022 onwards.[57] Even though not all UCO-based FAME delivered to the transport sector may count towards the RED II and RED III targets due to this cap, the fuel can also be used in other sectors or be exported. Before 2025, the Dutch cap for UCO-based FAME production will be re-evaluated. However, given the scarcity of biobased waste and byproducts (the majority of UCO being imported from outside Europe, see section 4.2) it is not unlikely that other uses of UCO, e.g. for the production of HVO or sustainable aviation fuels, will push UCO-based FAME out of the market. On the other hand, due to several changes in feedstock caps and phase-outs at the EU level, the demand for UCO is expected to grow at EU level, meaning that demand for UCO-based FAME might remain in other countries, giving Dutch producers the possibility to export this fuel if the Jaarverplichting reduces its support.

4.1.2 *Green gas production for transport*

In 2019, roughly 15% of the biomethane produced in the Netherlands was used as bio-CNG in transport.[58] For a limited number of refuelling stations there is a direct connection between the biogas upgrading plant and the station, but in most, the gas is supplied from the grid. In the latter case, refuelling stations can still supply green gas to their clients as they back up their supplies by Guarantees of Origin for Green gas.

4.2 Imports and exports

The Netherlands has significant trade flows when it comes to liquid biofuels. The country is a net importer of bioethanol/biogasoline and a net exporter of biobased alternatives to diesel. However, the export volumes for the latter are much higher than imports of the former, making the Netherlands a net exporter of liquid biofuels (Figure 4-2). In 2019, a total of 51 PJ of pure and blended biodiesel (including both FAME and HVO) was exported, compared to a volume of 23 PJ supplied to the Dutch market under the Jaarverplichting, showing that two thirds of the biodiesel produced in the Netherlands is exported. From the annual production figures for HVO (44 PJ) and the volume of HVO supplied under the Jaarverplichting (2 PJ), it can be derived that most of the biobased alternatives for diesel that is exported is in the form of HVO. It should be noted though that the feedstock for HVO and FAME production is imported for a large part from outside the EU, especially from Asia. UCO for instance originated for more than 50% from imports from Asian countries in 2020.[59]

Whereas the Netherlands is a net exporter of biodiesel, the story is the other way around for bioethanol, where the demand is virtually completely supplied by imports. The recently introduced E10 obligation has led to a further increase in bioethanol imports. For bioethanol, the largest part of the feedstocks is derived from food crops or other food-related feedstocks, with corn, low-quality starch slurry, wheat and sugarcane being the main feedstocks used. Among the various feedstocks for bioethanol, corn mostly comes from the United States,[60] sugarcane from South America, and wheat-based ethanol from Europe.

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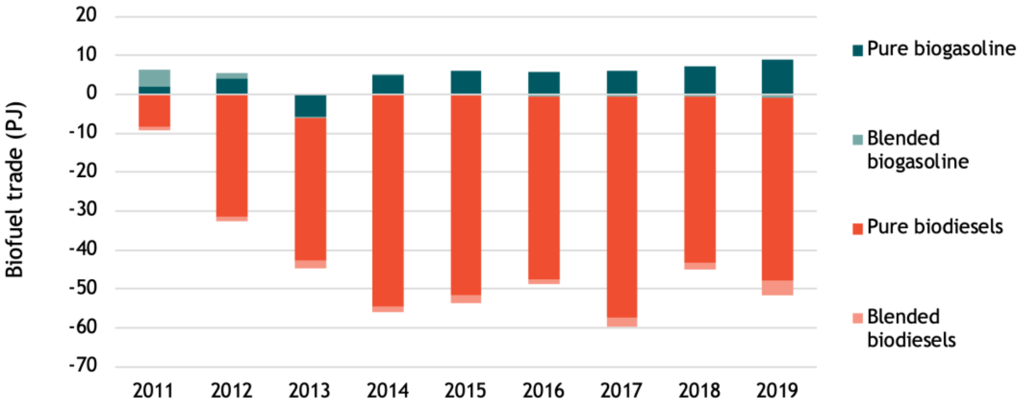
[57] Staatsblad 2021, 619 - Besluit van 20 december 2021 tot wijziging van het Besluit energie vervoer in verband met de implementatie van Richtlijn (EU) 2018/2001 van het Europees Parlement en de Raad van 11 december 2018 ter bevordering van het gebruik van energie uit hernieuwbare.

[58] GasTerra (2021) Panorama Groen Gas 2021.

[59] NEa (2021) Rapportage Energie voor vervoer in Nederland 2020.

[60] NEa (2021) Rapportage Energie voor vervoer in Nederland 2020.

Figure 4-2 Trade balance of liquid biofuels for the Netherlands with positive flows reflecting imports and negative flows reflecting exports



Source: Eurostat - Complete Energy Balances

5 Discussion and conclusions

By revising the scope and target formulation for renewable energy in transport, the RED II revision proposal (RED III) potentially modifies the playing field in place in the Netherlands for various renewable energy vectors stemming from the previous versions of the RED and the national Jaarverplichting policy.

Table 5-1 presents GHG emission factors and associated GHG emission savings for a variety of biofuel-feedstock pairs, for electricity and for RFNBOs, in 2020 (unless otherwise mentioned). This table is complemented by Figure 3-1 and Figure 3-2 which illustrate the relative emissions performance of these various fuels, and are discussed in detail in Chapter 3. With the GHG-based system of the RED III rewarding the lowest-carbon fuels by allowing them a greater contribution towards the target, the relative emissions performance of the fuels presented in Table 5-1 may be modified with producers striving to further improve the GHG emissions performance of their product to increase their GHG-competitiveness and thus their relevance in contributing to the RED III transport target.

Table 5-1 GHG emissions and savings as per RED III accounting rules, for selected renewable fuels and electricity mixes

	GHG emissions (gCO_{2eq}/MJ)	Counter-factual (gCO_{2eq}/MJ)	GHG emission savings (gCO_{2eq}/MJ)	GHG emission savings (%)
Ethanol - Conventional	30.5	94	63.5	68%
Ethanol – Advanced (Annex IX.A)	14.1	94	79.9	85%
FAME - Conventional	34.1	94	59.9	64%
FAME – Advanced (Annex IX.A)	13.3	94	80.7	86%
FAME – UCO and animal fats (Annex IX.B)	11.9	94	82.1	87%
HVO – Advanced (Annex IX.A)	14.6	94	79.4	84%
HVO – UCO and animal fats (Annex IX.B)	8	94	86	91%
Bionafta - UCO and animal fats (Annex IX.B)	6.3	94	87.7	93%
Biogas - Advanced (Annex IX.A)	19.3	94	74.7	79%
Biogas - UCO and animal fats (Annex IX.B)	18	94	76	81%
Renewable electricity	0	183	183	100%
Electricity mix with 26% renewables (representative of 2020 Dutch electricity mix[61])	135	183	48	26%
Electricity mix with 74% renewables (representative of projected 2030 Dutch electricity mix[62])	48	183	135	74%
RFNBO with minimum GHG savings threshold (70%)	-	-	-	70%
RFNBO with 100% GHG savings	-	-	-	100%

Methodological notes:
Column "GHG emissions": The data displayed for biofuels was provided by RVO and NEa on 16/12/2021 and represent 2020 values. For electricity, the numbers (in grey) were calculated from the renewable energy share of the electricity mix considered, against a GHG emission factor of fossil-based electricity of 183 gCO_{2eq}/MJ (the numbers displayed therefore do not represent the actual GHG emissions of the Dutch electricity mixes).
RFNBOs: In the absence of representative GHG emission data for RFNBOs for the Netherlands, and of an explicit counterfactual value against which to calculate absolute savings, [63] *two indicative GHG emissions savings for RFNBOs were considered: 70% (being the GHG savings threshold for RFNBOs to be eligible as a renewable fuel under the RED (JEC, 2019)) and 100%.*

Important trends for the country for the 2020 decade that need to be taken into account in the context of a revised RED target for 2030, along with other relevant policies for renewable energy in transport from the Fit-for-55 package, are the following:

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[61] PBL (2021) Klimaat en energieverkenning 2021.
[62] PBL (2021) Klimaat en energieverkenning 2021.
[63] The release of EC proposals for delegated acts relative to the GHG methodology for RFNBOs is pending (T&E (2021), EC (2022)).

- Road transport electrification;
- The dominance of Annex IX.B biofuels, especially UCO-based biofuels, on the Dutch biofuel market in 2020;
- The importance of exports of liquid biofuels by the Netherlands over the past decade.

In light of the analysis carried out in the previous chapters, these aspects and the potential effects of the RED II revision proposal (with insights relative to the other relevant Fit-for-55 policy proposals) are specifically discussed in the following subsections, while opening the discussion to the new avenues for transport renewable energy in the Netherlands.

5.1 Transport electrification

By 2030, 1.1 million electric cars are projected on Dutch roads. Road transport electricity use would amount to 19 PJ[64] (see section 3.3.1). The penetration of electric vehicles on the Dutch market will mechanically drive up electricity consumption in the transport sector and with it, that of renewable electricity (by 2030, the Dutch electricity grid is projected to include 74% renewables (Table 3-1)). Under the RED III, renewable electricity (which was subject to a x4 multiplier under the RED II), is considered zero-emission and still competes in a similar way as under the RED II with advanced and Annex IX.B biofuels (which are subject to a x2 multiplier under the RED II and which represent the vast majority of biofuels in the Netherlands). Renewable electricity's contribution per unit energy to the RED III GHG emissions reduction target is about three times larger than for conventional biofuels (Figure 3-3). As a result, it is mostly drivers other than the RED III and its change in methodology from the RED II that may affect the respective shares of renewable electricity and renewable liquid or gaseous fuels in transport in the future, namely policies targeting a shift in vehicle powertrains and the greening of the electricity grid (a decline in liquid fuel demand for transport in Europe by 2026 is projected by the IEA, and national projections for the Netherlands suggest a similar trend to 2030 (sections 2.2.1 and 2.2.2)). With the projected EV uptake by 2030, renewable electricity from the grid would suffice to meet nearly half of a 13% GHG emissions intensity reduction in the Dutch domestic transport sector (Figure 3-6), compared to nearly all of the Jaarverplichting target for 2020 being met by liquid or gaseous biofuels (Figure 3-4). Only the second half of GHG emissions reductions would therefore need to be met by liquid or gaseous renewable fuels (biofuels, biogas or RFNBOs). However, national projections suggest a growth in the absolute demand for liquid biofuels for domestic transport by 2030, to around 44 PJ (vs. 26 PJ today, i.e. +70%) (section 2.2.2), to which any new demand for the international aviation and maritime sectors are to be added.

5.2 UCO-based fuels

One characteristic of the Dutch renewable fuel market is the dominance of Annex IX.B biofuels, and in particular UCO-based biofuels, in the total renewable fuel supply to the transport sector (Figure 2-1, Figure 3-4). Production facilities for such fuels have also been built in the country (section 4.1.1).

In 2020, the volume of HBEs submitted for UCO-based fuels was equivalent to over 4% of liquid fuel energy use in the domestic transport sector (section 2.1.3).

Several (sometimes contradictory) trends and elements may play a role in the continued relevance of UCO-based fuels among other renewable alternatives in the future, in particular :

- **GHG emissions intensity**: The GHG emissions intensity of Annex IX.B-based liquid fuels (84% of which were UCO-based fuels) in 2020 was low in comparison to other renewable options

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[64] This includes electric cars, but also commercial vehicles and buses.

(6-11.9 gCO_{2eq}/MJ), leading to GHG emissions savings against their liquid fossil fuel counterfactual of 87% to 93%, under the RED III methodology. These are the largest savings per unit energy of all types of biofuels considered in Table 3-1. This provides Annex IX.B biofuels a competitive advantage when it comes to emissions savings per unit energy with regards to other biofuel options.

- **RED cap on Annex IX.B biofuels**: In both the RED II and its revision proposal, Annex IX.B biofuels are capped to 1.7% of total transport energy. Given the high volumes and shares of such fuels in the Netherlands in 2020 and their relevance in meeting the 2020 Jaarverplichting target, the role of UCO-based fuels in the Dutch transport sector by 2030 could be weakened for the purpose of not exceeding the RED cap, unless the Netherlands requests an exemption (see section 4.1.1).
- **Exports of UCO-based fuels:** If the demand for UCO-based fuels within the Netherlands would decline because of the above-mentioned cap, it is likely that Dutch production capacity would not need to suffer as the demand for UCO-based fuels in the EU as a whole is still expected to grow, many other EU countries being far from the 1.7% cap for this biofuel (see section 2.1.1). Nevertheless, FAME producers might see increasing competition from market players that want to use UCO for producing higher-quality biofuels fit for road transport or aviation.
- **UCO feedstock availability:** Over half of the UCO feedstock used in transport fuels in the Netherlands in 2020 was imported from Asian countries, in particular China (see section 4.2). Risks regarding the continuous feedstock availability throughout the next decade or more to supply the Dutch market may therefore exist, in case the feedstock is prioritised for domestic use (China and other Asian countries may scale-up UCO use domestically to reach their own sustainability targets), or in case of any other physical, market-related or policy-related cross-continental supply disruption arises.

Table 5-2 summarises the risks and opportunities identified in this study and discussed above for the UCO-based fuels industry in the context of the RED III, other relevant policies and trends in transport energy demand.

Table 5-2 Opportunities and risks for Dutch UCO-based fuels towards 2030

Opportunity	Risk
Low specific GHG emissions intensity and competitiveness within the framework of the RED III GHG-based targets	1.7% RED cap on Annex IX.B biofuels
Prospects for exports to other EU Member States	Declining liquid fuel demand prospects
	UCO feedstock availability

5.3 Other renewable fuels and energy vectors

5.3.1 Conventional biofuels

The use of conventional biofuels in the Netherlands in 2020 was well-below the RED cap of 7% (see section 2.1.1). There could therefore be room for additional conventional biofuels towards 2030 and their competitiveness with regards to other renewable transport energy vectors (advanced and Annex IX.B biofuels, and renewable electricity) is somewhat increased under the RED III GHG-based methodology and target than with the energy target and mutlipliers in place under the RED II (Figure 3-1 and Figure 3-3). However, other renewable energy vectors may be prioritised in contributing to the

RED III target, namely because of the importance of UCO-based fuels in the Netherlands (see section 5.2), the electrification of the road transport sector and the high electricity shares in the rail sector, the 2.6% RFNBO mandate and the 2.2% advanced biofuels mandate (see section 3.3.2, Figure 3-6 and Table 1-2). In addition, future decisions of the Dutch parliament on imposing further limitations on the use of food and fodder crops as biofuel feedstock could have substantial implications for the future of conventional biofuels (see section 1.3.3).

5.3.2 Advanced biofuels

In 2020, HBEs for advanced biofuels were equivalent to just over 1% of liquid fuel use in the domestic transport sector. By 2030, the mandate for advanced biofuels may increase from 1.75% (in the RED II, without the x2 multiplier applicable to advanced biofuels)[65] to 2.2% as per the RED III. There is therefore scope for further advanced biofuels supply growth to the transport sector, as is being observed for example for advanced bioethanol over the past couple of years (Figure 2-1).

5.3.3 RFNBOs

Although estimating the potential competitive advantage of RFNBOs vs. other transport renewable energy vectors (biofuels or electricity) in the framework of the RED III is difficult (the methodology to account for RFNBOs towards the GHG emissions intensity reduction target still needs to be clarified) (see section 3.1.3), the proposal introduces a 2.6% mandate for these fuels (Table 3-1). From virtually no or very marginal use in transport in 2020, RFNBOs will definitely need to be scaled-up by 2030 if the mandate is to be met. There is currently a limited uptake of RFNBOs in a 2030 timeframe in national projections for domestic transport (Figure 2-2).

The particularity of RFNBOs being that they encompass both hydrogen and liquid fuels, the future growth of fuel-cell electric vehicles on the one hand, and the possible phase-out of certain types of internal combustion engine vehicles on the other hand, will play an important role in investment decisions to scale-up renewable hydrogen for fuel cell electric vehicles and/or liquid electrofuels directly substituting other liquid fuels in internal combustion engine vehicles. Policies and industry commitments for growing renewable fuel demand in harder-to-electrify sectors, such as aviation, should also open new markets for RFNBOs aside of road transport.

5.4 Prospects in the maritime and aviation sectors

The maritime and aviation sectors are included in the scope of the RED III, which is not the case under the current RED II, although maritime and aviation fuels can opt-in to contribute towards the RED II energy target. Should the international component in both sectors be included in the RED III scope, the total quantity of transport fuels subject to the GHG emissions intensity reduction target could be significantly increased, as would therefore be the volumes of renewable energy needed to meet the targets, given the importance of the maritime and aviation sectors in the Netherlands, in particular for international maritime transport (see section 2.1.3). In addition, these sectors are the only ones for which a mulitplier (x1.2) would be maintained under the RED III, albeit for advanced biofuels and RNFBOs only. Encouraging this trend further, the new ReFuelEU Aviation and FuelEU Maritime proposals, part of the Fit-for-55 package, suggest blending mandates of Sustainbale Aviation Fuels in the aviation sector, and GHG emissions reductions targets in the maritime sector (see section 1.2.1).

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[65] Accounting for the multiplier, the advanced biofuel mandate under the RED II is 3.5%.

The significant quantities of biofuels existing in the maritime sector (that generated HBEs and contributed to meeting the Jaarveplichting targets for 2020, in particular (see section 2.1.3)) could therefore also contribute in the future towards the RED III targets and the FuelEU Maritime proposal and continue growing, however bearing in mind the limitations recently introduced towards Annex IX.B biofuels from the maritime sector in generating HBEs and contributing to the Jaarverplichting targets (see section 2.1.3), and the exclusion of Annex IX.B fuels from the RED III multiplier for maritime and aviation. The significant domestic production of biofuels and the extent of its exports over the past decade could constitute an opportunity for the industry to leverage on its existing capacity and know-how to adapt and/or further scale-up renewable fuels production in those sectors, in particular regarding high-grade aviation biofuels.

5.5 Domestic consumption and exports

The Netherlands are a net exporter of biofuels, in particular HVO (see section 4.2). In order to meet future domestic biofuel demand (as mentioned in section 5.1, national projections suggest a 70% growth in the absolute demand for liquid biofuels for domestic transport by 2030, to which any new demand for the international aviation and maritime sectors are to be added), part of the currently-exported HVO could be delivered to the domestic market, for its high blending prospects with diesel or to supply the aviation sector. However renewable transport fuel demand, and within it biofuel demand, is bound to continue growing in the road transport, maritime and aviation sectors across Europe. In this context, as also mentioned in section 2.2.1, there is a large scope for FAME demand in particular to continue growing in Europe over the next few years, of which the Netherlands has significant production capacity (Figure 4-1). Many EU Member States do not yet reach the 1.7% cap on Annex IX.B-based biofuels (which was the primary feedstock of FAME in the Netherlands in 2020), while the use of this feedstock in the Netherlands is already high (see section 5.2). Finally, the Netherlands are a frontrunner when it comes to transport electrification.[66] Should other EU Member States reach a lower transport electrification rate than the Netherlands by 2030, they may need to rely to a greater extent on renewable liquid fuels for meeting their renewable transport targets, which could be partly supplied thanks to Dutch-based production capacity (Figure 4-1).

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[66] IEA (2021) https://www.iea.org/reports/global-ev-outlook-2021

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