Projected biofuel consumption in the Dutch transport sector for 2020 and 2030

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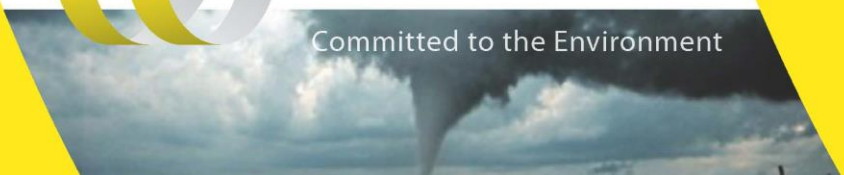

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Summary

In 2014 PBL, ECN, CBS and RVO have published the *Nationale Energie-verkenning* (NEV, National Energy Exploration) for the first time. The NEV, commissioned by the Ministry of Economic Affairs, describes current trends in energy supply and consumption in the Netherlands and the developments to be expected until 2030. This projection is based on implemented and planned policy measures and agreements laid down in the *Nationaal Energieakkoord* (National Energy Agreement) (Hekkenberg & Verdonk, 2014).

For the 2015 update PBL has commissioned CE Delft to provide a projection of biofuel consumption in the Dutch transport sector for the years 2020 and 2030. This paper provides the assessment for 2020 and projections for 2025/2030.

Biofuel consumption in the Dutch transport sector

Biofuel consumption in the Netherlands is mainly driven by the 10% target of the EU Renewable Energy Directive. Due to the double-counting provision for waste and residues, the physical share of renewable energy for meeting this target can be less than 10%.
The physical shares of biofuels in the Dutch fuel mix depend on multiple developments. The main developments up to 2020 are:

- the developments in the use of double-counting biofuels;
- the Dutch implementation of the ILUC Directive (cap on food-based biofuels and sub-target for advanced biofuels).

The post-2020 development in biofuel shares depend on the EU Energy and Climate package and in particular whether a separate sub-target for transport will still exist. Due to current lack of political decisions, these developments are highly uncertain. For this reason, several scenarios have been developed to estimate biofuel consumption in the Netherlands in 2020 and 2030.

Biofuel use in 2020

Within this paper we have assumed the Dutch government to implement either a 5% (intended policy) or a 7% (current policy) cap on land-based biofuels, in combination with a 0.5% indicative target for advanced biofuels. As result of the double-counting provision a 7.4% (for 5% cap) and 8.4% (for 7% cap) share will be sufficient to meet the 10% target. The impact of the Fuel Quality Directive is hard to determine, because it could result either in an increase or decrease of biofuel consumption.

Table 1 **Physical biofuel volumes required to meet the 10% target of the RED**

	Intended policy scenario	Current policy scenario
Cap on food-based (single-counting biofuels)	5%	7%
Double-counting biofuels	2.1%	1.1%
Advanced	0.25%	0.25%
Total	7.4%	8.4%

This study has estimated the biofuel shares per transport mode based on Table 1 and the blending limits as laid down in the FQD. These estimations are presented in Table 2.

Biofuel use in 2030

Because of a lack of knowledge on the details of a post-2020 EU policy framework, Member States cannot work on their national implementation plans yet. Therefore, three scenarios have been developed to estimate the impact of the Energy and Climate Package in 2030. The shares per transport mode for each scenario are presented in Table 2.

Scenario A - Currently adopted policy scenario

In this scenario only at the time of writing adopted policies are taken into account. Biofuel consumption will drop significantly as a result of a lack of incentives for these more expensive fuels.

Scenario B - 10% physical share of biofuels in 2020

This scenario is based on the outcomes of various studies predicting the share of biofuels in transport in 2030 and assuming a modest growth in the use of biofuels for transport between 2020 and 2030. Biofuel consumption will reach a 10% share in 2030 without administrative contributions.

Scenario C - Ambitious growth path based on technical potential

This scenario is based on the ambitions laid down in 'A vision on sustainable fuels for transport' (*de Brandstofvisie*). (Ministry of Infrastructure and the Environment, 2014) The ambitious growth path in this scenario will result in an overall biofuel share of about 13.6% (double-counting not included).

Table 2 Share of biofuels per transport mode (based on energy content)

			2020		2030		
			Intended policy scenario	Current policy scenario	Scenario A	Scenario B	Scenario C
Road	Passenger cars	Petrol	6.1%	6.5%	0.0%	10.2%	13.6%
		Diesel	7.0%	8.5%	0.0%	8.9%	13.3%
		LPG	10%	-	5.0%	10.0%	10.0%
		Electric	-	-			
		PHEV petrol	5.3%	5.6%	0.0%	7.8%	10.4%
		PHEV diesel	6%	8%	0.0%	6.8%	10.2%
		CNG*	100%	100%	50.0%	100.0%	100.0%
	Vans	Petrol	6.1%	6.5%	0.0%	10.2%	13.6%
		Diesel	7.0%	8.5%	0.0%	8.9%	13.3%
		LPG	10%	-	5.0%	10.0%	10.0%
		Electric	-	-			
		PHEV diesel	6%	8%	0.0%	6.8%	10.2%
		CNG*	100%	100%	50.0%	100.0%	100.0%
	Trucks	Diesel	7.4%	9.4%	0.3%	9.3%	14.6%
	Busses	Diesel	7.0%	8.5%	0.3%	8.9%	13.3%
	Special vehicles	Petrol + LPG	6.1%	6.5%	0.0%	10.2%	13.6%
		Diesel	7.0%	8.5%	0.0%	8.9%	13.3%
	Two-wheelers	Petrol	6.1%	6.5%	0.0%	10.2%	13.6%
Non-road	Inland shipping	Diesel	-	-	-	8.9%	13.3%
	Recreational shipping	Petrol	-	-	-	8.9%	13.3%
		Diesel	-	-	-	10.2%	0.0%
	Mobile machinery	Petrol	3.1%	3.2%	-	5.1%	6.8%
		Diesel	3.5%	4.3%	-	4.5%	6.7%
		LPG	10%	-	-	10.0%	10.0%

* Note that this percentage cannot be applied for calculating the TTW CO_2 emission factor of CNG; for that the average share of biogas in all CNG used in all sectors in the Netherlands should be applied (so including built environment).

1 Introduction

In 2014 PBL, ECN, CBS and RVO have published the Nationale Energie-verkenning (NEV, National Energy Exploration) for the first time. The NEV, commissioned by the Ministry of Economic Affairs, describes current trends in energy supply and consumption in the Netherlands and the developments to be expected for 2030. This forecast is based on implemented and planned policy measures and agreements laid down in the Nationaal Energieakkoord (National Energy Agreement) (Hekkenberg & Verdonk, 2014).

After the first publication in 2014 the NEV will be updated annually. For the 2015 update PBL has commissioned CE Delft to provide a projection of biofuel consumption in the Dutch transport sector for the years 2020 and 2030.
This paper provides the assessment for 2020 and projections for 2025/2030.

Content of this paper

This paper includes two parts: a projection of biofuel consumption for 2020 and a projection of biofuel consumption for 2025/2030.

Part 1 on projections for 2020 is structured as follows:
- EU policies up to 2020;
- national implementation in the Netherlands;
- assumptions for 2020;
- results for 2020.

The structure of Part 2 is:
- European policy framework up to 2030;
- EU-wide expectations based on literature study;
- national implementation up to 2030;
- scenario descriptions;
- results for 2030;
- conclusions and recommendations.

2 EU policies up to 2020

Due to the higher prices of biofuels compared to fossil fuels, biofuel consumption in the Netherlands is almost completely policy driven.
The main drivers for these policies are the Renewable Energy Directive (RED) and Fuel Quality Directive (FQD) at the EU level. The ILUC Directive (EC, 2015) containing provisions to limit indirect land use change (ILUC) will have a large influence on the type of biofuels consumed. All three policies are described in more detail below.

2.1 Renewable Energy Directive (RED)

Objective

The main aim of the Renewable Energy Directive of 2009 is to realise a 20% share of renewable energy in final energy consumption by 2020 (European Commission, 2009). Besides the 14% target for the overall consumption of renewable energy in the Netherlands, the RED obliges each Member State to realise a share of 10% of renewable energy of final energy consumption in transport by 2020.

Scope

According to the calculation methodology as laid down in Article 3(4) of the RED the contribution to the 10% share should be calculated by using the following equation:

$$\frac{\textit{'all types of renewable energy consumed in all modes of transport'}}{\textit{energy consumption of 'only petrol, diesel, biofuels consumed in road and rail transport, and electricity'}}$$

The nominator includes all modes in transport, so also non-road transport modes, like inland shipping and NRMM. The denominator excludes transport energy consumed in other sectors than road and rail (except electricity). Because not all energy consumed in transport is taken into account in the denominator less than 10% renewable energy is required when some renewable energy is used in other transport modes than road and rail transport.

Multipliers

The RED currently includes two multipliers, which enable the realisation of the target partly in an administrative way. These factors are:

- **A multiplier to correct for the higher efficiency of electric road vehicles.** Originally a multiplier of 2.5 was included in the RED for renewable electricity used in road transport, but the recent ILUC decision increases this multiplier from 2.5 to 5, and introduces a multiplier of 2.5 for renewable electricity in rail. These multipliers are only included in the nominator. In this way, these factors not only correct for efficiency differences, but also provide an additional incentive for the electrification of transport.
- **A multiplier to provide an incentive for the consumption of biofuels from waste and residues.** 'The contribution made by biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels'. (also known as double-counting).

Because these multipliers enable administrative contributions towards the target, these multipliers may result in a significant difference between actual renewable energy consumed in 2020 for transport in the Netherlands and the level of renewable energy counting towards the biofuels obligation.
The multipliers do not count towards the overall RED target. For example, the 10% target could be met by 5% double-counting biofuels, or by 5% single-counting and 2.5% double-counting biofuels (resulting in a total, actual share of 5 and 7.5%, respectively).

2.2 Fuel Quality Directive (FQD)

Objective

The FQD obliges Member States to reduce the average GHG intensity of road transport fuels by 6% by 2020 compared to 2010 levels (European Commission, 2009).

Scope

The scope of the FQD is limited to 'the supply of energy for transport supplied for use in any type of road vehicle, non-road mobile machinery (including inland waterway vessels), agricultural or forestry tractor or recreational craft'. Compared to the scope of the RED, rail transport, maritime shipping and aviation are excluded from the scope of the FQD. This implies that the targets of the FQD only cover road transport, NRMM and inland shipping.
The RED takes into account all types of renewables in all modes of transport, so also from the sectors excluded from the FQD. These differences in scope

could result in difficulties in meeting the FQD target: biofuel quantities sufficient for the RED target might be insufficient to meet the FQD target, because certain biofuel shares are excluded. For this reason, the biofuel quantities required to meet the FQD will be leading in meeting both objectives.

Multipliers

Note that the FQD contains a factor to correct for the higher efficiency of electric vehicles (factor 2.5). While this factor will be increased to factor 5 under the RED, this factor will remain 2.5 under the FQD. This increase provides an additional incentive for electric transport. The scope of the FQD does not contain the double-counting provision for biofuels as well. This may increase the difficulties in meeting the FQD target with the biofuel use required for meeting the RED target.

Blending limits

With respect to biofuels, the FQD also contains blending limits for the biofuel content of fuels. According to Article 3 and 4 of the FQD:

- a maximum ethanol content of 5% (by volume) in case of petrol;
- a maximum FAME content of 7% (by volume) in case of diesel.

These blending limits are important to ensure that fuels are compatible with the existing vehicle fleet and to contribute to the level of harmonisation on the fuel and vehicle market. Blending limits are mentioned here, because of the link between the biofuel shares required to meet the RED and FQD and the different marketing options to bring these quantities on the market. In other words, the blending limits might form a barrier for realisation of the FQD and RED targets.

2.3 ILUC Directive

In October 2012 the European Commission published the so-called ILUC proposal including policy measures to reduce or even prevent indirect GHG emissions resulting from indirect land use change (ILUC) caused by biofuel production and consumption. This proposal has been heavily debated in the last two years. Main points of discussion have been the height of the cap on land-based biofuels and the inclusion of ILUC factors in GHG accounting. On April 28, 2015 the European Parliament gave its final approval and the Directive has been published on September 9, 2015. Member States must enact the legislation at the national level by 2017 (European Commission, 2012).

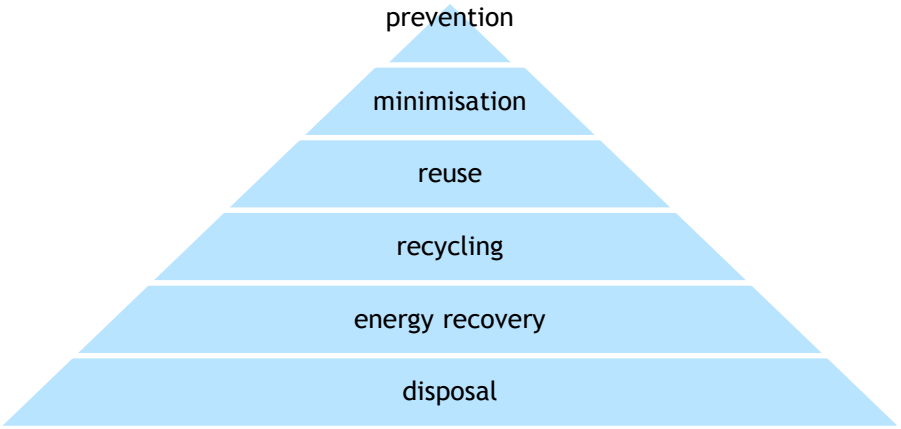
This ILUC decision will mainly affect the share of double-counting biofuels in 2020 by:

- The **7% cap on food-based biofuels**[1] (including energy crops) in the RED with the option for Member States to implement a lower cap at the national level. This means that at least 3% renewable energy in transport should come from other sources, i.e. non-land-based biofuels or electricity or hydrogen.

[1] In principle, the cap includes land-based biofuels, including food-based biofuels and energy crops). There are, however, some exceptions which makes that some land-based fuels are excluded from the cap. For this reason, we speak of food-based biofuels. Because of these exceptions we also cannot conclude that all currently single-counting biofuel fall under the cap.

- The indicative **sub-target for advanced biofuels of 0.5%** each Member State has to set (Member States that do have good reasons for not setting this target might be exempted from this obligation (for example limited potential for the sustainable production of these biofuels, cost-efficiency reasons, national vehicle fleet composition or focus on energy efficiency and electrification of transport instead). Note that advanced biofuels should be seen as a subcategory of double-counting biofuels: these biofuels count double and contribute to the sub-target at the same time. Advanced biofuels will be listed in the new Annex IX of the RED which contains the feedstocks for advanced biofuels that count double towards the targets (Maniatis, 2015). A good example is biofuels from algae.
- The provision that Member States have to take into account the **waste hierarchy of the Waste Framework Directive** in the case of biofuels from waste and residues. This implies that in case waste and residues can be recycled, these waste and residues should not be burnt as biofuel (because energy recovery has a lower ranking in the waste hierarchy (see Figure 1). The Netherlands have already regulated this at the time of the double-counting implementation.

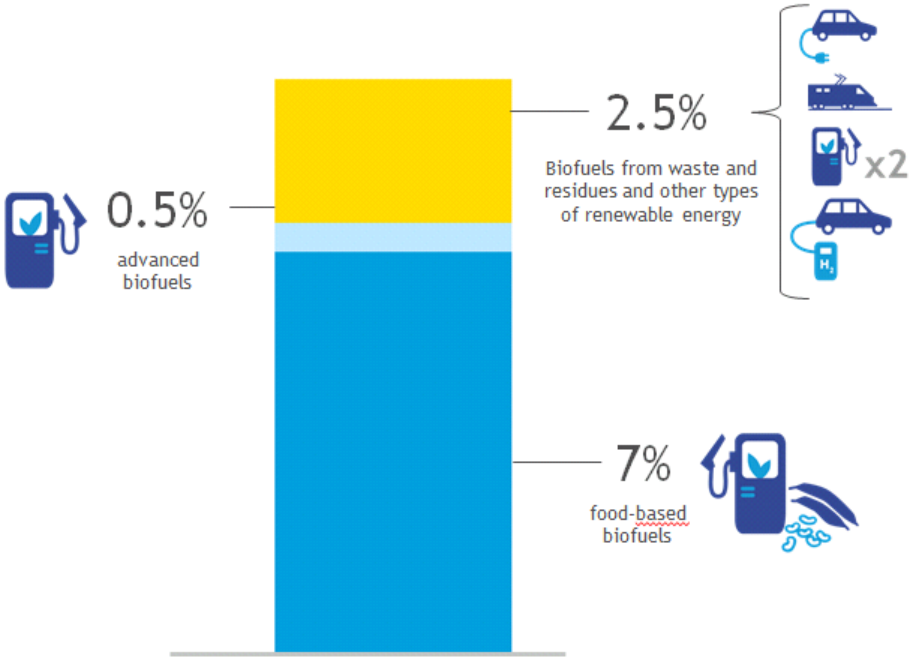
Figure 1 **Waste hierarchy**



- The **exclusion of the double-counting of advanced biofuels for the overall renewable energy target**. This may reduce the incentive to consume those biofuels (European Parliament, 2015).

Figure 2 shows the relation between the different types of biofuels in the realisation of the 10% target. If the cap will be fully used the cap and sub-target will together result in 7.5% renewable energy. The other 2.5% needs to be reached by biofuels from waste and residues, not classified as advanced, and renewable electricity and hydrogen in transport. This includes the administrative contribution from the multipliers.

Figure 2 How the 10% transport target of can be met



3 National implementation in het Netherlands

3.1 Current situation

The Dutch government aims to realise both the RED and FQD targets by the introduction of an annual obligation for renewable energy: an obligation for fuel suppliers to bring a certain share of renewable energy on the Dutch market (6.25% in 2015). In practice, this obligation is mainly fulfilled with biofuels. The RED has been implemented by the Dutch Decree on Renewable Energy in Transport of 18 April 2011 (retroactive to 1 January 2011). In the Dutch law Fuels and Air Pollution Decree of 8 April 2011, the FQD has been implemented in Dutch legislation (CE Delft, 2013).

Until this year the height of the blending obligation was only known for the next year. The Remco Dijkstra/Jan Vos motion (Parliamentary paper 32 000 XII, no. 23) as published on October 30, 2014, proposed to decide on the overall growth path until 2020 to provide industry and fuel suppliers with higher investment security. This motion has been accepted and the growth path is included in new national legislation (Besluit Hernieuwbare Energie Vervoer, 2015) as published on 2 December 2014 (Rijksoverheid, 2014).
As depicted in Table 3 the growth path consists of annual steps of 0.75% until the 10% share will be reached in 2020. Until 2014, separate sub-targets were set for biofuels shares in petrol and diesel, but these were discontinued from 2015 onwards (NEa, 2015); (Ministerie van Infastructuur en Milieu, 2015); (Dijkstra & Vos, 2014).

Table 3 Obligatory share of renewable energy in transport in the period 2015-2020 (NEa, 2015)

Year	2015	2016	2017	2018	2019	2020
Share of renewable energy	6.25%	7%	7.75%	8.5%	9.25%	10%

These obligatory shares of renewable energy are imposed on fuel suppliers that (physically) bring transport fuels on the Dutch market. The targets are mainly aimed to be incentives for increasing shares of biofuels in diesel and petrol, but biogas and renewable electricity may also count towards the target via the opt-in option. Renewable electricity in rail is not included in the scope (Ministerie van Infrastructuur en Milieu, 2014).

With this policy, until now the annual targets in the first years of implementation have been met and also the 10% transport target of the RED in 2020 is expected to be met.

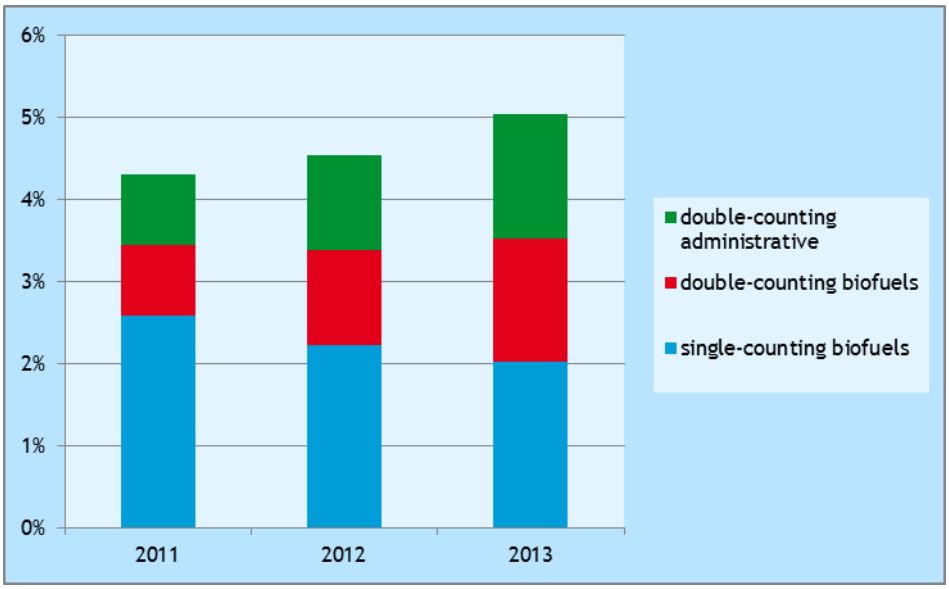
The FQD implementation requires fuel suppliers to reduce the average GHG intensity of their fuels by 6% by 2020, but without a growth path.
The Dutch law also obliges fuel suppliers to report on the average GHG intensity of their fuels annually. In general, the FQD will be partly met by the biofuels as result of the annual obligation. Other contributions might come from upstream emission reductions in the fossil fuel chain, but because the calculation of these reductions has only been defined in the Directive published in April 2015, this option has not been implemented by the Dutch government yet.

Because the target of the FQD is defined as a CO_2 target, the realisation of the target depends not only on the share of biofuels on the market, but also on their GHG intensity. At the same time the FQD does contain less multiplier provisions than the RED. According to the Dutch Sustainable Biomass Commission, the FQD will become leading in the consumption of biofuels in the transport sector rather than the RED target (Commissie Duurzaamheidsvraagstukken Biomassa, 2013).

Type of biofuels on the market

For the actual share of physical biofuels on the Dutch market it is therefore relevant to know the share of double-counting biofuels and the share of renewable electricity in EVs and rail counting towards the target. Figure 3 shows the developments in the shares of single and double-counting biofuels in the period 2011-2013 and illustrates that despite an increase of the biofuels obligation from 4.25% in 2011 to 5% in 2013, the actual growth in biofuels is very small due to the shift from single- to double-counting biofuels and the related administrative contribution from this last category: the physical contribution is constant at about 3.3-3.5%.

Figure 3 Developments in single and double-counting biofuels in the period 2011-2013 (based on annual reports NEa)



3.2 Future situation up to 2020

Especially, the implementation of the ILUC decision will be decisive for the national biofuel policy in the coming years.

Cap on land-based biofuels and sub-target advanced biofuels

The motion Van Veldhoven/Van Tongeren (Parliamentary paper 32 813, no. 97) (Veldhoven & Tongeren, 2014) of December 2014 already proposed to implement a cap on land-based biofuels of 5%. Because the final decision on ILUC was yet not taken at that time, this motion was not discussed further at that time. With the final decision on ILUC now in place, including the option for Member States to set a lower cap than the proposed 7%, all legal barriers for implementing this motion have been removed. State Secretary Mansveld has stated to reassess the motion again after the final decision of last spring. (Ministerie van Infastructuur en Milieu, 2015). The Dutch government is currently assessing the various implementation options.

In (Ministerie van Infrastructuur en Milieu, 2015) the Dutch government expressed its positive opinion on the option to also set a cap on the consumption of land-based biofuels counting towards the FQD target. Based on this expression we assume the Dutch government to implement the cap on land-based biofuels for both Directives. The Dutch government also mentioned the indicative sub-target for advanced biofuels of 0.5% (Ministerie van Infrastructuur en Milieu, 2014). Therefore we assume this sub-target to be implemented as well.

Scenarios within this study

Because the various potential ways to implement the ILUC Directive might result in various levels of consumption, we will work with two scenarios to estimate the level of biofuel consumption in 2020 and 2030: the current policy scenario and the intended policy scenario.

- in the **current policy scenario**, we assume that no more than 7% of the energy content in transport in 2020 will be land-based biofuel;
- in the **intended policy scenario**, we assume that no more than 5% of the energy content will be land-based biofuel.

4 Assumptions for 2020

Implementation of the ILUC decision

For the quantitative assessment in this paper we assume the Dutch government to implement either a 5% (intended policy) or a 7% (current policy) cap on land-based biofuels, in combination with a 0.5% indicative target for advanced biofuels (0.25% without double-counting, 0.5% including double-counting).

Renewable electricity in transport

For renewable electricity in road transport we assume:

- 0.9 PJ consumption of electricity in road transport in line with the calculations of the Brandstofvisie (Ministerie van Infrastructuur en Milieu, 2014).
- 35% share of renewable electricity in the Dutch electricity mix (based on RED implementation.
- The administrative contribution of this renewable electricity is the result of the multiplier of 5 for renewable electricity in road transport (only valid for the 10% transport target of the RED).
- Electricity in rail also contributes to the RED target, but because it is not included in the annual renewable energy obligation in the Netherlands and because it is not included in the scope of the FQD this category is not included in our estimations. Note that the contribution of electricity in rail in the Netherlands count towards the target, but is not part of the obligation imposed on fuel suppliers.

Minimum GHG emission reduction requirements

Currently, the minimum GHG emission reduction (over the entire life cycle) for biofuels to count towards the target (as laid down in sustainability criteria of the RED and FQD) shall be at least 35% (only direct emissions, not taken into account ILUC emissions). From 1 January 2017 onwards this saving should be at least 55%. From 1 January 2018 the GHG emission savings should be at least 60% for biofuels and bio liquids produced in installations in operation since 1 January 2017 or later (European Commission, 2009). Due to the current overcapacity in the market, it could, however, be questioned if any new production facilities will come in operation before 2020. In Table 4 the GHG reductions assumed in this paper for the different type of biofuels are listed. These are required to estimate the contribution of biofuels to the FQD target.

Table 4 **Average GHG emissions reduction per biofuel type as assumed in this study**

	GHG reduction assumed
Single-counting biofuels	55% (minimum requirement from 2017 is 50%)
Double-counting biofuels	80%
Advanced biofuels	90%

5 Results for 2020

5.1 Overall share of biofuels to be expected to meet the 10% target

Figure 4 shows the results for the two scenarios, as introduced in Section 4, illustrating the differences in the renewable energy mix and administrative realisation of the targets for both caps compared to the current situation (2013). The share of single-counting biofuels is assumed to equal the cap (due to lower cost and higher supply) and as can be seen can still grow significantly in the coming years. Note that advanced biofuels should be seen as a subcategory of double-counting biofuels: these biofuels count double and contribute to the sub-target at the same time.

Figure 4 **Renewable energy mix and administrative realisation of the 10% target**

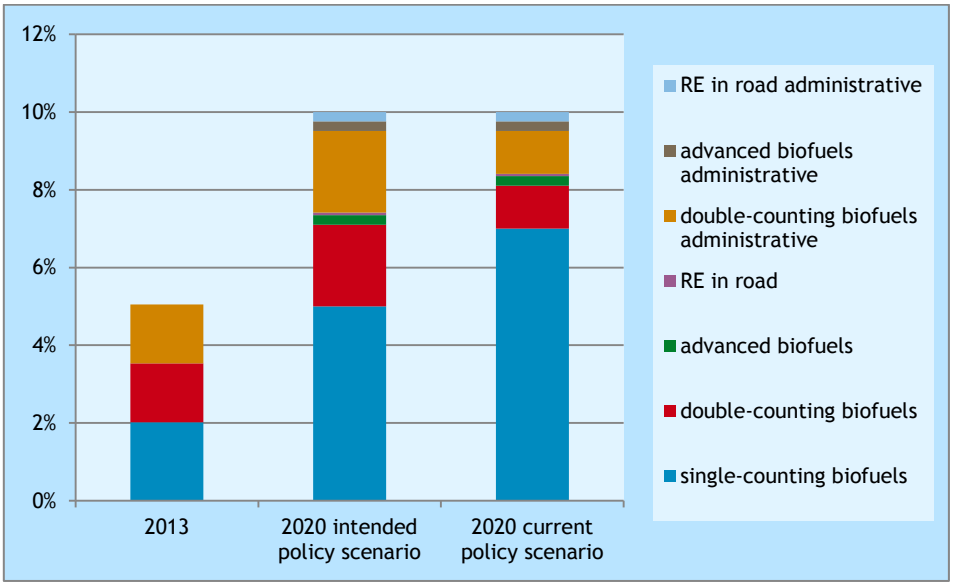


Table 5 **Renewable energy mix and administrative realisation of the 10% target**

		2013	2020 intended policy scenario	2020 current policy scenario
Actual physical contribution	Single-counting biofuels	2%	5%	7%
	Double-counting biofuels	2%	2.1%	1.1%
	Advanced biofuels		0.25%	0.25%
	RE in road		0.06%	0.06%
Administrative contribution	Double-counting biofuels administrative	2%	2.1%	1.1%
	Advanced biofuels administrative		0.25%	0.25%
	RE in road administrative		0.24%	0.24%
Total (including administrative contribution)			**10%**	**10%**
Total (without administrative contribution			**7.4%**	**8.4%**

If we leave the administrative contribution towards the target out and only take into account the physical shares of biofuels (which are input parameters for the NEV), biofuel shares between 7.4 and 8.4% will be realised (see Table 6). Note that these scenarios only look at compliance with the RED, the FQD is not taken into account yet (see Section 5.2 for further discussion on meeting the FQD).

Table 6 **Share of physical biofuels in transport energy**

	2020 5% cap	2020 7% cap
Single	5%	7%
Double	2.1%	1.1%
Advanced	0.25%	0.25%
Total	**7.4%**	**8.4%**

5.2 Overall share of biofuels to be expected to meet the FQD target

Based on the GHG emission reduction per biofuel type as assumed in Table 3, a rough estimation of the FQD contribution of biofuels is made for the minimum assumed GHG reduction of 50%, as well as two slightly higher reduction percentages. The results are depicted in Table 7. Based on these outcomes it can be concluded that the FQD will not be met with the biofuel shares being sufficient to fulfil the RED obligations.

Table 7 **FQD contribution of biofuels[2] in % reduction of the average GHG intensity compared to 2010**

	2020 5% cap	2020 7% cap
50%	4.4%	4.6%
55%	**4.7%**	**5.0%**
60%	4.9%	5.3%

This implies additional efforts are required and confirms the statements of the Dutch Sustainable Biomass Commission that the FQD will become leading in the consumption of biofuels in the transport sector rather than the RED target.

Fuel suppliers have different compliance strategies to close the gap between the 6% target and the contributions depicted in Table 7, namely:

- On the fossil fuel side they could:
  - Reduce upstream emissions in the fossil fuel chain (e.g. reducing emissions from flaring and venting).
  - Bring less GHG intensive fossil fuels on the market.
- On the biofuel side they could:
  - Bring a higher volume of (double-counting) biofuels on the market. This requires double-counting biofuels, because we assume the cap have been fully utilised already.
  - Bring the same quantity of biofuels on the market, but biofuels with a lower GHG intensity.

[2] Electricity in road is not taken into account here, but will only have a relatively small contribution to the target.

The two fossil fuel options to meet the FQD target will probably not impact the actual share of biofuels on the market. The option to bring higher volumes of biofuels on the market will enlarge the biofuel shares and thus the shares in the NEV forecast. The second option, where biofuels with a lower GHG intensity are preferred over biofuels with higher GHG intensities, could result in less biofuels in case the biofuels with lower GHG intensity are (partly) double-counting biofuels. In case these are single-counting, biofuel shares will remain stable.

We conclude that the compliance options for the FQD might result in an increase as well as in a decrease of biofuel consumption compared to the shares that are needed for meeting the Dutch implementation of the RED. The estimates for the overall biofuel shares as presented in Section 5.1 can be regarded as most likely estimates, for both RED and FQD. An argument for this is that an increase in biofuels might result in exceedance of the current blending limits of the FQD.

5.3 Expected share per transport mode in 2020

Biofuels in road transport

The share of biofuels in road transport will be mainly determined by:

- the use of low petrol and diesel blends within the current blending limits;
- the use of higher blends in dedicated HDV fleets of transport operators;
- the use of biogas in gas powered vehicles;
- the use of biofuels in non-road transport modes.

As mentioned earlier, the current blending limits for ethanol in petrol and FAME in diesel are E5/E10 and B7 (volume%), but E10 has not been introduced in the Netherlands yet. In terms of energy content this equals: 3.4% bioethanol in E5, 6.8% of bioethanol in E10, and 6.4% biodiesel in B7. Because both predicted shares are above these blending limits, other marketing strategies are required to bring the quantities required to meet the target on the market.

For **ethanol** we assume E10 to be introduced on the market in the coming years. Although not all vehicles will be able to run on this higher blend, we assume a large share of these vehicles to be able to drive on E10 in order to close the gap between the blending limit and the required biofuel quantities. Fuel suppliers might use financial incentives to boost market uptake. Examples from other countries have shown that these financial incentives can be very effective in combination with a good communication strategy on vehicle compatibility. These financial incentives can be provided by the government, but could also be part of the strategy of fuel suppliers to reach their targets.

For **diesel** problems with the blending limit can be avoided by blending fungible biofuels, like HVO, or by applying high blends in dedicated fleets, like B100 in bus fleets or heavy duty vehicles of a specific transport company. The use of more double-counting biofuels would also be an option, but might hinder meeting of the FQD target.

Share in diesel and petrol

It could be questioned how the shares between diesel and petrol will evolve in the future now that the sub-target for petrol is no longer in place. There are several incentives to prefer biodiesel over bioethanol:

- As result of financial incentives in the last decades diesel vehicles are dominating the European fleet.
- From a refinery perspective there is a shortage of diesel on the European market and a surplus of petrol. Therefore, from this perspective, biodiesel is the preferred option over bio petrol.
- Double-counting biofuels, currently available on a commercial scale, are mainly biofuels from UCO and animal fat and thus consist of diesel replacers rather than petrol replacers. More advanced conversion technologies might also result in more double-counting bioethanol, but it can be expected that biodiesel will keep dominating the share of double-counting biofuels in the next years.

In Table 8 it is shown that the share of renewables in biodiesel was slightly higher than in petrol in the period 2011-2013. We take this preference for diesel into account in our assumptions, but also acknowledge the fact that E10 might be a cheaper compliance option compared to HVO for biofuel shares beyond the E5 and B7 blending limits.

Table 8 **Shares in energy content of RE in petrol and diesel in the period 2011-2013 (based on annual NEa reports)**

	2011	2012	2013
Total renewable energy in transport	4.31 %	4.54 %	5.05 %
Total RE in petrol	3.78 %	3.99 %	4.07 %
Total RE in diesel	4.62 %	4.86 %	5.62 %

The use of biogas in gas powered vehicles

Based on the intended actions of the gas sector in various initiatives, as described in the separate gas report of the National Fuel Strategy (Brandstofvisie) (Ministerie van Infrastructuur en Milieu, 2014) it can be expected that:

- ll CNG vehicles will run on 100% bio-CNG by 2020 (administrative). In 2011 the sector laid down this ambition in a covenant (Groengasmobiel, 2011).
- LPG vehicles will run on 10% bio-LPG from 2017 onwards (Ministerie van Infrastructuur en Milieu, 2014).

Note that the administrative share of biogas in CNG is relevant for the meeting of the RED target, **but cannot be applied when calculating the TTW CO_2 emission factor of CNG**. For that emission factor, the average share of biogas in all CNG used in all sectors in the Netherlands should be applied (so including built environment).

The use of biofuels in non-road transport modes

Because of a lack of policy incentives to apply biofuels in maritime shipping, aviation and diesel trains, the biofuel shares in these sectors are mainly the result of voluntary pilots and testing and are therefore limited to small amounts. Therefore we do not assume any significant contributions from biofuels in maritime shipping, aviation and diesel trains. Also in inland navigation the share of biofuel use in 2020 is expected to be negligible.

In mobile machinery we expect that part of the diesel used (estimated at 50%) will come from regular filling stations and therefore automatically contains the same percentage of biofuel as for road vehicles (this share will also count towards the target); in the other diesel used by mobile machinery it is expected that no biofuel is blended.

Assumptions for shares per transport mode

- Passenger cars and vans will run on the same (low) blends. For mobile machineries we assume the same biofuel shares as for road vehicles with same fuel type.
- Plug-in vehicles partly running on electricity and diesel or petrol will also contain biofuels; these will run on the same low blends.
- The shares in HDV will be slightly higher compared to passenger cars and vans due to the contribution of high blends in captive fleets. Therefore we have introduced a factor for captive fleets of 1.05 (intended policy scenario) and 1.1 (current policy scenario)

All assumptions are depicted in the Table 9, Table 10 and Table 11.

Table 9 Assumptions for the shares of petrol

	Intended policy scenario		Current policy scenario	
	Of total petrol consumption	Share (energy %)	Of total petrol consumption	Share (energy %)
E5	20%	3.4%	10%	3.4%
E10	80%	6.8%	90%	6.8%
Total	100%	6.1%	100%	6.5%

Table 10 Assumptions for the shares of diesel

	Intended policy scenario		Current policy scenario	
	Of total diesel consumption	Share (energy %)	Of total diesel consumption	Share (energy %)
B7	100%	6.4%	100%	6.4%
HVO	100%	0.6%	100%	2.1%
Total blended		7.0%		8.5%
Factor for captive fleets (HDV)	1.05		1.1	
Total for HDV		7.4%		9.4%

Table 11 Bio-content assumed for gas powered vehicles (equal for both scenarios)

	Intended policy scenario	Current policy scenario
LPG	10%	0%
CNG*	100%	100%

* Note that this percentage cannot be applied for calculating the TTW CO_2 emission factor of CNG; for that the average share of biogas in all CNG used in all sectors in the Netherlands should be applied (so including built environment).

These assumptions are optimized in a way the overall share of 7.4% (intended policy scenario) and 8.4% (current policy scenario) are realized. Overall this results in the following shares per transport mode:

Table 12 Share of biofuels per transport mode (based on energy content)

			Intended policy scenario	Current policy scenario
Road	Passenger cars	Petrol	6.1%	6.5%
		Diesel	7.0%	8.5%
		LPG	10%	-
		Electric	-	-
		PHEV petrol	5.3%	5.6%
		PHEV diesel	6%	8%
		CNG*	100%	100%
	Vans	Petrol	6.1%	6.5%
		Diesel	7.0%	8.5%
		LPG	10%	-
		Electric	-	-
		PHEV diesel	6%	8%
		CNG*	100%	100%
	Trucks	Diesel	7.4%	9.4%
	Busses	Diesel	7.0%	8.5%
	Special vehicles	Petrol + LPG	6.1%	6.5%
		Diesel	7.0%	8.5%
	Two-wheelers	Petrol	6.1%	6.5%
Non-road	Inland shipping	Diesel	-	-
	Recreational shipping	Petrol	-	-
		Diesel	-	-
	Mobile machinery	Petrol	3.1%	3.2%
		Diesel	3.5%	4.3%
		LPG	10%	-

* Note that this percentage cannot be applied for calculating the TTW CO_2 emission factor of CNG; for that the average share of biogas in all CNG used in all sectors in the Netherlands should be applied (so including built environment).

6 European policy framework up to 2030

6.1 Climate and Energy Package 2030

The RED and FQD are both policies aimed at realising the overall targets of the Energy and Climate package for 2020. This package is often referred to as the 20-20-20 framework because it requires:

- a 20% reduction in EU GHG emissions compared to 1990 levels;
- a share of 20% renewable energy in EU energy consumption; and
- a 20% improvement in EU energy efficiency.

In January 2014 the European Commission published a proposal for the new policy framework for energy and climate in 2030 (European Commission, 2014) and on 23 October 2014 the EU leaders agreed on the so-called Energy and Climate package (European Council, 2014).

The new package proposes:

- At least a 40% reduction of domestic GHG emissions compared to 1990 by 2030. To achieve this, the sectors covered by the EU emissions trading system (EU ETS) would have to reduce their emissions by 43% compared to 2005; emissions from sectors outside the EU ETS (including transport) would need to be cut by 30% below the 2005 level.
- At least a 27% share of renewable energy by 2030.
- Increasing energy efficiency by at least 27% by 2030 compared to the business-as-usual scenario.
- Reform of the EU emissions trading system.

Continuation of the 10% transport target

At time of writing, it is still unsure whether there will be a specific (or indicative) renewable energy source in transport target for 2030. The Council decision suggests, however, that there will be no national binding renewable energy targets, only EU-wide targets.

Future of the FQD GHG reduction target

At the same time it is also unsure to what extent the FQD will continue after 2020. Finnish MEP Nils Torvalds (ALDE), also responsible for the ILUC file, has underlined the need to continue this Directive (Vieuws, 2015). There are, however, no other signs that the FQD will be extended making the future of the FQD as unsure as the future of the RED.

Blending limits

With respect to the fuel specifications laid down in the FQD we expect these to remain in place after 2020. In order to enlarge the marketing options of biofuels the blending limits will probably be adapted to permit mid and higher blends like E20, E25 or B10.

6.2 Guidelines on state aid

On June 28 2014 the European Commission has published the Communication 'Guidelines on State aid for environmental protection and energy 2014-2020'. These guidelines are applicable from 1 July 2014 until 2020 and contain several provisions related to state aid for biofuels, such as:

- The European Commission recognizes the current overcapacity in the food-based biofuel market and therefore does no longer see investment aid from government institutions in new and existing capacity to be justified. Investment aid should therefore only be allowed in case of conversion into advanced biofuel plants.
- Operation aid to food-based biofuels can no longer be granted after 2020. Operation aid until 2020 should only be granted to plants in operation before 31 December 2013.
- Biofuels that fall under a blending obligation and receive state aid as well will not result in an increased level of environmental protection and therefore should not receive any state aid. Member States are only allowed to grant state aid in case they can demonstrate the aid is meant for sustainable biofuels that are too expensive to come on the market without financial support.
- New and existing aid schemes for food-based biofuel should be limited to 2020.

Despite these limitations for financial support for biofuels, Member States will still be allowed to provide non-financial incentives for food-based biofuel consumption after 2020. For example, by the continuation of the current blending obligations.

6.3 Translation into Directives

In the recent Energy Union Package (COM(2015)80 final) a number of relevant actions were announced, namely that the Commission will propose a new Renewable Energy Package in 2016-2017, which will include a new policy for sustainable biomass and biofuels as well as legislation to ensure that the 2030 EU target is met cost-effectively (European Commission, 2015). The design of the Directives let alone the way these new Directives will be implemented in national policies is still very uncertain.

6.4 ILUC and sustainability requirements

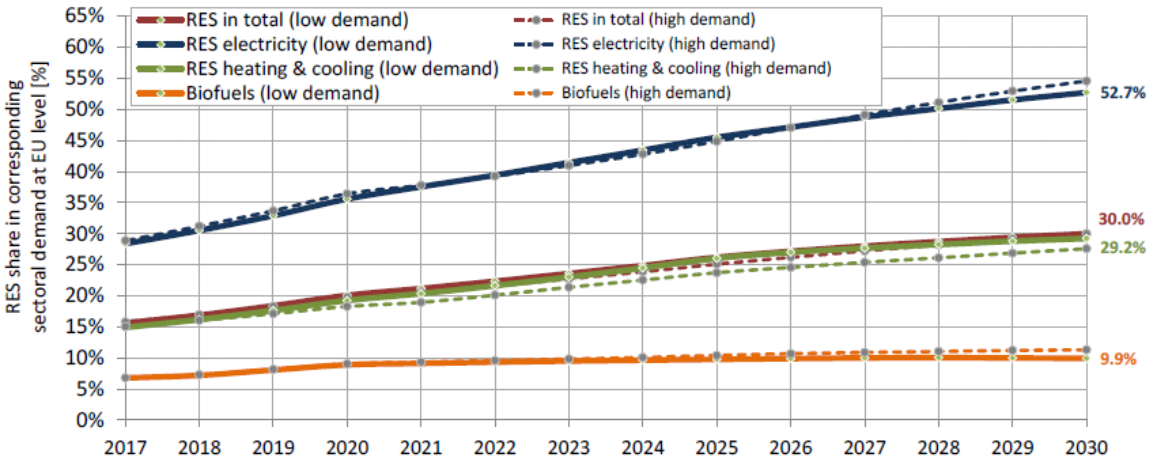
The role of the ILUC decision after 2020 depends on the implementation by Member States in the coming years and the continuation of these policies after 2020. In the long term, the ILUC decision can be a strong driver for advanced biofuels, but this strongly depends on the level of the cap on land-based biofuels after 2020. In general, a continuation of the current sustainability requirements (sustainability criteria in the RED and FQD + provisions of the to be published ILUC Directive) or further gradual strengthening of these requirements can be expected.

7 EU-wide expectations for 2030

7.1 Biofuel demand

Despite the fact that the new policy framework is not clear yet, several studies have published predictions for the shares of renewable energy in transport (RES-T) and biofuels for 2030. The outcomes of these studies are summarized below. (Resch, et al., 2014) have assessed the impact of various 2030 RES targets, including a target of 30%, which is closest to the 27% target mentioned in the EU package. In this case there is not a specific target for the transport sector. The study does not mention any double-counting or any role of the FQD. From their report it can be concluded that the authors have assumed a cap on land-based biofuels. According to their modelling outcomes, a stagnation of biofuel consumption can be expected for the period 2020-2030 including a shift from first to second generation biofuels. As can be seen in Figure 5 a biofuel demand of 9.9% is expected for the transport sector for 2030. This can turn out slightly higher in practice in case the implementation of measures in other sectors, like the heating and cooling sector, turns out to be ineffective. Increased biofuel consumption can compensate for these failures (Resch, et al., 2014).

Figure 5 **Future renewable energy sources (RES) pathways up to 2030 at EU level, pursuing a 30% target, in total and per energy sector depending on the future gross final energy demand**



Source: (Resch, et al., 2014).

E4Tech has developed an Autofuel Roadmap (E4Tech, 2013) for the year 2030. According to this roadmap the share of biofuels in road transport will be between 10.6 and 11.8% (see Table 13). These shares are based on the assumption that the blending limit for FAME (B7) will not be increased, a roll-out of E10 across the entire EU by 2020 and the introduction of E20 in 2025. The study does not zoom in on the policy incentives that are required to reach this in practice.

Table 13 **Energy share of biofuels in transport in 2020 and 2030 (Autofuel roadmap)**

	2020	2030
Road transport	5.8-6.3%	10.6-11.8%
All transport (incl. non-road transport)	6.7-7%	12-15%
Biofuels from waste and residues		diesel: 9-21% gasoline: 16-21%

Source: E4Tech, 2013.

According to the Prospects for EU agricultural markets and income 2014-2024 (EC 2014f) the total share of biofuels in (all) transportation fuels will amount to approximately 7% (energy content) in 2018 and will next remain constant up to 2024. The policy assumptions behind this conclusion are, however, not completely clear. This has been based on slow increases of biofuel demand in recent years and absence of strong policy incentives.

In general, above mentioned studies give a relatively consistent picture of the biofuel blending in 2030. The forecasts of above mentioned studies all take into account the time needed for the shift to advanced biofuels and the limitations due to the blending limits and vehicle compatibility. On the one hand the outlooks all predict consolidation of the first generation biofuels production at best. On the other hand, the outlooks recognize that any incentives for advanced biofuel demand will take time to result in significant increases in supply. Based on literature, we may assume the overall biofuels shares are likely to remain in the range of 10-12% (based on energy content) in 2030. Note that these studies all assume a policy framework to be in place after 2020 (mainly in line with the recent policy developments (Energy and Climate package announcement and the ILUC debate).

7.2 Biofuel production and shifts in type of feedstocks (EC, 2014f)

With respect to advanced biofuels, the current policies, especially the double-counting provision of the RED (Article 21(2)), have proven to be an effective incentive for the use of biofuels from waste and residues that can be produced with well-developed, mature production processes. This has resulted in a strong increase of consumption of biofuels (FAME and HVO) from used cooking oil and animal fats. Other advanced biofuels, however, are still in R&D phase or are only just starting commercial scale production. As new production technologies are necessary to unlock the potential of ligno-cellulosic waste, residues and other types of low-ILUC biomass for sustainable transport fuel production, technology developments are crucial to the future growth of sustainable biofuels. Commercial scale production of advanced bioethanol production has started only recently, advanced biodiesel production from ligno-cellulosic biomass has not (yet) progressed this far.

Most outlooks predict a shift from first generation biofuels (from food crops) to advanced biofuels (from waste and residues, ligno-cellulosic biomass, etc.)

- Production of biodiesel will grow slightly, but growth is only related to increased utilisation of waste oils. Utilization of primary vegetable oils will remain at current levels.
- First generation bio-ethanol production in the EU will increase slightly with 10-20% and will be based increasingly on cereals while utilization of sugar beets (and molasses) will decline.
- There will hardly be any 2nd generation diesel (i.e. biodiesel from ligno-cellulosic and woody feedstock) and only limited volumes of 2nd generation bio-ethanol on the market in 2024.

8 National implementation up to 2030

Because of a lack of knowledge on the details of a post-2020 EU policy framework, Member States cannot work on their national implementation plans yet. There is, however, a continuous need for an increasing share of renewable energy in transport because of the long term decarbonisation targets the sector has to meet. These long term policy goals might help to predict biofuel demand in 2030. In the Netherlands the Energy Agreement for Sustainable Growth, formulated under the auspices of the Social Economic Council (SER) and signed in 2013, provides the basis for a widely supported energy and climate policy. This agreement commits the signatories to ambitious long term targets for transport in the Netherlands: 25 Mton CO_2 by 2030 and 12.2 Mton CO_2 by 2050.

It is, however, unsure to what extent these long term targets will result in biofuel consumption if no specific biofuel policy will be in place: without strong biofuel incentives or obligations, biofuel use in transport might drop to almost zero.

On the other hand, the Netherlands play an important role in biofuel trade, especially in biofuel export. Due to the existence of a biofuel industry in the Netherlands it might be that higher shares of biofuels will be maintained after 2020 compared to countries with no biofuel production facilities.

9 Scenario descriptions

Because of the high uncertainties related to the policy framework for biofuel consumption after 2020, and renewable energy transport in general, biofuel projections for 2030 are chosen to be presented by means of three scenarios:
- Scenario A: A currently adopted policy scenario;
- Scenario B: 10% share of biofuels without administrative contributions;
- Scenario C: An ambitious growth path based on technical potential.

Scenario A – Currently adopted policy scenario
This currently adopted policy scenario represents a scenario in which only at the time of writing adopted policies are taken into account.

Policies in place
The RED and FQD no longer have a legal status after 2020. This implies the 10% renewable energy share and the average GHG intensity of fuels are not required to be maintained. Due to the expiration of these Directives the double-counting provision and sustainability criteria as laid down in these Directives will no longer have a legal status as well. The Dutch government might choose to continue with the annual renewable energy obligation, but in this scenario we assume this will not be the case.

Although the general outline of the Energy and Climate package is known yet, this package has not been translated into specific directives and regulations and therefore also does not have a legal status yet. This also counts for the outcome of the ILUC debate: an ILUC Directive hasn't been published and entered into force either.

This implies that without additional policy by the Dutch government no incentive for biofuel consumption can be assumed for the post-2020 scenario.

Overall biofuel consumption
Biofuel consumption will drop significantly as a result of a lack of incentives for these more expensive fuels. Remaining biofuel consumption will completely be the result of voluntary initiatives by for example, local governments and/or market actors. Due to this more bottom-up demand for biofuels, biofuels are more likely to be used in dedicated fleets. There is no need to bring the more expensive HVO on the market, because the blending limits are not fully utilised.

Blending limits
The current blending limits, as laid down in the FQD, will be maintained, although these limits will not be fully utilized.[3] For ethanol, the sales of E10, introduced on the market to meet the 2020 target, will drop significantly after 2020 and E5 will become the base blend again. No new mid or higher blends will be introduced.

Developments in biofuel production
The lack of incentives will result in overcapacity in the market. As result of this overcapacity some facilities will probably close. Other facilities might keep producing biofuels for other markets outside the Netherlands and outside the EU. By 2030 more producers might have moved their production facilities

[3] Note that we assume that the fuel specifications of the FQD will be maintained after 2020. The blending limits of Article 3 and 4 are part of these fuel specifications.

to other countries, like the US, depending on the investment security in other countries and on the depreciation of production facilities in the Netherlands. As result of this, the port of Rotterdam will lose its function of bio-hub. Innovation in terms of advanced biofuel production technologies will only take place if other countries provide an incentive for investments. Modifications are an option for Dutch and EU installation, but if new installations are required these installations will probably be built in other countries.

Transport modes included
Due to the lack of a blending obligation standard low blends will no longer be applied on a wide scale. The use of biofuels will probably be limited to dedicated fleets. When alternative powertrains (electricity, hydrogen, etc.) become more competitive the use of biofuels might drop further.

Scenario B - 10% physical share of biofuels without administrative contributions
This scenario is based on the outcomes of various studies predicting the share of biofuels in transport in 2030 and assuming a modest growth in the use of biofuels for transport between 2020 and 2030 (see: Section 7).

Policies in place
The aforementioned studies are mainly based on the implementation of the Energy and Climate package assuming no specific renewable target for transport. This would result in a slight increase in the use of biofuels for transport. A modest growth in biofuels could also be the result of the continuation of the FQD demanding a further reduction of the average GHG intensity of fuels. We also assume the implementation of the ILUC outcome without additional requirements or strengthening of current requirements.

Although there will be no specific transport target in place, we assume that the Dutch government will continue the blending obligation after 2020. The annual growth rates are, however, assumed to be much lower compared to 2010-2020 annual growth rates.

Overall biofuel consumption
Although a 10% share seems to equal the 2020 target, it must be noticed that this share assumes a 10% share of biofuels in physical terms (energy based), while the 10% share in 2020 is partly met in an administrative way. Based on Part 1, this scenario therefore represents a growth of the share of biofuels for transport between 1.6 and 2.6% (percentage point). As a result of this growth HVO and other drop-in biodiesel will also slightly grow.

Blending limits
B7 will be maintained as the blending limit for diesel. Higher shares of biodiesel are realised through additional HVO consumption. For ethanol, E20 will be introduced on the market after the (successful) implementation of E10 by 2020. Raising the blending limit for ethanol is more likely, because the technical challenges related to raising the blending limit for FAME are higher than for ethanol due to for example fuel stability issues. Besides this, advanced bioethanol (like ligno-cellulosic ethanol) is more likely to play a role in the 2020-2030 period than advanced biodiesels other than increased utilisation of waste oils.

Developments in biofuel production
As a result of the modest growth in biofuel consumption in combination with the implementation of the ILUC Directive we also expect a modest growth in advanced biofuel production capacity within this specific scenario. Conventional biofuel production facilities will remain constant at a level enabling the full utilization of land-based biofuels allowed under the cap on land-based biofuels.

Transport modes included
In order to further decarbonise inland shipping and to enable a further growth of biofuel consumption in general, the scope of the annual renewable energy obligation will be extended by including inland shipping as well.[4]

Scenario C – Ambitious growth path based on technical potential
This scenario is based on the assumptions made in 'A vision on sustainable fuels for transport' (de Brandstofvisie). (Ministry of Infrastructure and the Environment, 2014) Because these assumptions mainly focus on the technological potential of the various options, this scenario is chosen as the most ambitious scenario in this study.

Policies in place
In contrast to Scenario B this scenario assumes a strong binding transport target to be in place after 2020, including the introduction of strong policy incentives and target setting in non-road transport. Overall, decarbonisation of the transport sector is high on the agenda of the Dutch government (and/or the European Commission) and the Dutch government shows a strong commitment to meet the long term policy goals, including the intermediate targets for 2030.

In this scenario other sectors might fail to realise renewable energy shares required to meet 2030 targets resulting in the demand for a higher contribution from transport to compensate for these failing sectors.

Overall biofuel consumption
The ambitious growth path in this scenario will result in an overall biofuel share of about 13.6%. As stated in Part 1 biofuel shares will amount to between 7.4 and 8.4% by 2020 (without double-counting). A share of 13.6% in 2030 would therefore imply a doubling of biofuel consumption in the 2020-2030 period. Because stricter sustainability requirements will be in place in the 2020-2030 period compared to the 2009-2020 period, this growth path can indeed be called very ambitious. Besides higher blending limits, HVO and other fungible biofuels will also play a significant role in this scenario in order to overcome barriers linked to vehicle compatibility.

Blending limits
By 2030 B10 will be introduced. 'A vision on sustainable fuels for transport' assumes B7, but because other sources also assume the introduction of B10 before 2030, B10 is included in this ambitious scenario. This scenario also assumes a smooth and early introduction of E20, including strong incentives from fuel suppliers to persuade consumers to use E20.

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[4] Note that we have not investigated the exact implementation of increased biofuel volumes in inland shipping in terms of the division between national and international share of fuel consumption and exact biofuel flows. For reasons of simplification we have assumed biofuel shares to equal the biodiesel blends in passenger cars, because a contribution from non-road transport is required to meet the overall share of biofuels foreseen in each specific scenario.

Developments in biofuel production

In line with the implementation of the ILUC decision most of the growth after 2020 should come from non-land-based biofuels. Because biofuel consumption will more or less double in 2030 compared to 2020, the growth in this scenario is therefore only possible if technological breakthroughs are realised in advanced biofuel production (especially for advanced ethanol) and sufficient advanced biofuel production facilities are realised before 2030 to meet the demand required. Without these developments in biofuel production availability of biomass meeting the sustainability requirements will hinder the growth foreseen in this scenario. This makes that this scenario depends on technological breakthroughs.

Transport modes included

Compared to Scenario A and B this scenario expects a high contribution from other non-road transport modes (inland shipping, maritime shipping, aviation and NRMM). Due to the transnational character of these modes, this also requires action from organisations like the IMO and ICAO. Because no action has been taken yet in these organisations, the shares of biofuels in maritime shipping and aviation are not included in the scenario calculations here. Estimations of biomass availability have been part of the assessment of these scenarios: all scenarios are assessed to be realistic, although problems might arise in case only the lower ranges of biomass availability are reached in practice.

10 Summary of assumptions

Based on above scenario descriptions the assumptions are quantified below. Assumptions are provided for both 2025 and 2030. In Table 14 the blending limits are depicted. In Table 15 the shares per blend are depicted. In scenario B E20 will be introduced in 2025 (in line with the study of E4Tech) and the market penetration of E20 is predicted to take more time than in Scenario C. There E20 will already be introduced somewhat earlier (2023/2024) and will completely replace E10 by 2030.

Table 14 Blending limits petrol and diesel

	Scenario A		Scenario B		Scenario C	
	2025	2030	2025	2030	2025	2030
Diesel	B7	B7	B7	B7	B10	B10
Petrol	E5	E5	E10	E20	E20	E20

* In Scenario A the blending limits remain the same, but in practice these blends might not contain any biofuels at all.

Because the penetration of higher blends depends on the renewal rate of the fleet we have assumed a transition period from the ‘old’ blend towards the new ‘blend’. For example in case of Scenario B, E20 will be introduced in 2030, but we will assume that still 50% of the fleet will run on E10 in 2030 due to vehicle compatibility issues.

Table 15 Assumptions for the biofuel shares in petrol in the overall fleet

	Scenario A			Scenario B			Scenario C		
	Share of blend in total petrol consumption		Biofuel share for this blend (energy %)	Share of blend in total petrol consumption		Biofuel share for this blend (energy %)	Share of blend in total petrol consumption		Biofuel share for this blend (energy %)
	2025	2030		2025	2030		2025	2030	
E5	-	-	-	-	-	-	-	-	-
E10	-	-	-	95%	50%	6.8%	90%	-	6.8%
E20	-	-	-	5%	50%	13.6%	10%	100%	13.6%
Total	-	-	-	100%	100%	10.2%	100%	100%	13.6%

For diesel the assumptions are depicted in Table 16. B10 will only be introduced in Scenario C. The table also shows the expected shares of HVO and the assumptions of captive fleets.

Table 16 Assumptions for the shares of diesel in the overall fleet

	Scenario A				Scenario B				Scenario C			
	Share of blend in total diesel consumption		Biofuel share for this blend (energy %)		Share of blend in total diesel consumption		Biofuel share for this blend (energy %)		Share of blend in total diesel consumption		Biofuel share for this blend (energy %)	
	2025	2030	2025	2030	2025	2030	2025	2030	2025	2030	2025	2030
B7	-	-	-	-	100%	100%	6.4%	6.4%	100%	50%	6.4%	6.4%
B10	-	-	-	-	0%	0%	-	-	-	50%	-	9.2%
HVO or other drop-in biodiesel	-	-	-	-	100%	100%	2%	2.5%	100%	100%	3.8%	5.5%
Total blended	-	-	-	-			8.4%	8.9%			10.2%	13.3%
Factor for captive fleets (HDV)	1% B30 (also for buses)		1% B30 (also for buses)		1.1				1.1			
Total for HDV	-	-	-	-			9.2%	9.8%			11.2%	14.0%

The assumptions for gas-powered vehicles are depicted in Table 17.
These assumptions are based on the assumptions made for 2020. However, the assumptions for Scenario A have been revised, because assuming a high share of biogas would not be in line with a total drop of biofuel consumption.

Table 17 Bio-content assumed for gas powered vehicles (equal for all scenarios)

		Scenario A	Scenario B	Scenario C
LPG	2025	0%	20%	30%
	2030	0%	20%	30%
CNG*	2025	0%	100%	100%
	2030	0%	100%	100%

* Note that this percentage cannot be applied for calculating the TTW CO_2 emission factor of CNG; for that the average share of biogas in all CNG used in all sectors in the Netherlands should be applied (so including built environment).

The use of biofuels in non-road transport modes

Because of a lack of policy incentives to apply biofuels in maritime shipping, aviation and diesel trains, the biofuel shares in these sectors are mainly the result of voluntary pilots and testing and are therefore limited to small amounts. Therefore we do not assume any significant contributions from biofuels in maritime shipping, aviation and diesel trains. Also in inland navigation the share of biofuel use in 2020 is expected to be negligible.

In mobile machinery we expect that part of the diesel used (estimated at 50%) will come from regular filling stations and therefore automatically contains the same percentage of biofuel as for road vehicles; in the other diesel used by mobile machinery it is expected that no biofuel is blended.

Table 18 **Assumptions non-road transport modes Scenario B and C (2025 and 2030)**

Mode	Assumption
Inland navigation	Same blend as diesel road
Recreational shipping	Same blend as diesel road
NRM	50% from regular filling stations

11 Results for 2030

Assumptions for shares per transport mode

- Passenger cars and vans will run on the same (low) blends (within the blending limits). For inland shipping and mobile machineries we assume the same biofuel shares as for road vehicles with same fuel type.
- Plug-in vehicles partly running on electricity and diesel or petrol will also contain biofuels; these will run on the same low blends.
- The shares in HDV will be slightly higher compared to passenger cars and vans due to the contribution of high blends in captive fleets. Therefore we have introduced a factor for captive fleets of 1.1. In Scenario A we have assumed 1% of trucks and buses to run on B30. In fact the contribution of these captive fleets will be the only biofuel consumption as result of green public procurement incentives, contracts with public transport operators or just voluntary initiatives by private actors.

Table 19 Share of biofuels per transport mode (based on energy content) 2025

			Scenario A Currently adopted policy scenario		Scenario B 10% physical share of biofuels in 2020		Scenario C Ambitious growth path based on technical potential	
			2025	2030	2025	2030	2025	2030
Road	Passenger cars	Petrol	0.0%	0.0%	7.1%	10.2%	7.5%	13.6%
		Diesel	0.0%	0.0%	8.4%	8.9%	10.2%	13.3%
		LPG	5.0%	5.0%	0.0%	10.0%	10.0%	10.0%
		Electric						
		PHEV petrol*	0.0%	0.0%	5.8%	7.8%	6.1%	10.4%
		PHEV diesel*	0.0%	0.0%	6.8%	6.8%	8.3%	10.2%
		CNG**	50.0%	50.0%	100.0%	100.0%	100.0%	100.0%
	Vans	Petrol	0.0%	0.0%	7.1%	10.2%	7.5%	13.6%
		Diesel	0.0%	0.0%	8.4%	8.9%	10.2%	13.3%
		LPG	5.0%	5.0%	0.0%	10.0%	10.0%	10.0%
		Electric						
		PHEV diesel	0.0%	0.0%	6.8%	6.8%	8.3%	10.2%
		CNG*	50.0%	50.0%	100.0%	100.0%	100.0%	100.0%
	Trucks	Diesel	0.3%	0.3%	9.2%	9.3%	11.2	14.6%
	Busses	Diesel	0.3%	0.3%	8.4%	8.9%	10.2%	13.3%
	Special vehicles	Petrol + LPG	0.0%	0.0%	7.1%	10.2%	7.5%	13.6%
		Diesel	0.0%	0.0%	8.4%	8.9%	10.2%	13.3%
	Two-wheelers	Petrol	0.0%	0.0%	7.1%	10.2%	7.5%	13.6%
Non-road	Inland shipping	Diesel	-	-	8.4%	8.9%	10.2%	13.3%
	Recreational shipping	Petrol	-	-	8.4%	8.9%	10.2%	13.3%
		Diesel	-	-	8.9%	10.2%	13.3%	0.0%
	Mobile machinery	Petrol	-	-	3.6%	5.1%	3.7%	6.8%
		Diesel	-	-	4.2%	4.5%	5.1%	6.7%
		LPG	-	-	0.0%	10.0%	10.0%	10.0%

* Note that we assume 22% of the energy consumption of PHEVs to be electric.

** Note that this percentage cannot be applied for calculating the TTW CO_2 emission factor of CNG; for that the average share of biogas in all CNG used in all sectors in the Netherlands should be applied (so including built environment).

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