

Non-fossil Fuel Categories in EU Legislation and their Significance for Hydrogen

A Comprehensive Reference Guide



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by the German Bundestag

IMPRINT

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by:

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices:

Bonn and Eschborn, Germany

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The International PtX Hub is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Affairs and Climate Action (BMWK). Financed by the International Climate Initiative (Internationale Klimaschutzinitiative, IKI), the International PtX Hub is a contribution to the German National Hydrogen Strategy of 2020 and represents one of the four pillars of the BMUV's PtX action programme initiated in 2019.

The opinions and recommendations expressed do not necessarily reflect the positions of the commissioning institutions or the implementing agency.

Berlin, 30th Jan 2025

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1 Introduction

Fuels play a fundamental role in our daily lives and are deeply embedded in the global economy, powering industries, moving transport and heating homes. Oil, coal and natural gas have been the most commonly used fuels for energy consumption worldwide ¹. However, the combustion of fossil fuels has brought immediate consequences, such as air pollution and climate change. While some processes can be directly electrified, industrial processes, aviation, shipping and possibly heavy transport require fuel in the form of molecules. To defossilise the fuel sector and related industries, several increasing efforts to transition towards sustainable and more environmentally friendly alternatives are being set, such as targets in the aviation sector. The European Union (EU) promotes the use of non-fossil fuels in the Renewable Energy Directive (RED) II and III and other legislations. The EU legislative framework acknowledges different renewable/low-carbon/biogenic fuel types which contribute to a different extent to the reduction of greenhouse gas emissions (GHG). Hydrogen is a versatile energy vector with high potential to defossilise industries where electrification is difficult. The following paper outlines different categorisations of non-fossil fuels, links them to the relevant EU legislative texts, gives insights on fuel targets set in the EU market and uses concrete examples for fuel production pathways in determining which type of non-fossil fuel is produced. Creating this reference document became necessary due to the variety of existing categories, legal texts and technical production pathways for non-fossil fuels. Hydrogen and its derivatives are at the core of this paper with multiple cross references made. Especially against the recent context of the EU Hydrogen and Gas Directive and its upcoming Delegated Act (on Article 9) concerning the methodology for accounting GHG emissions of low-carbon fuels, the role of hydrogen and its derivatives in transforming the fuel sector is crucial.

1 Oil, coal, and natural gas were the three main fuels in primary energy consumption worldwide from 2018 to 2023. [Global primary energy consumption by fuel 2023 | Statista](#)

Categories of hydrogen and EU targets

Hydrogen can be produced via different production pathways, such as electrolysis, gasification or steam methane reforming. In principle, the energy source for hydrogen production can be renewable, biogenic or fossil. This leads to different categories of hydrogen (see figure 1).

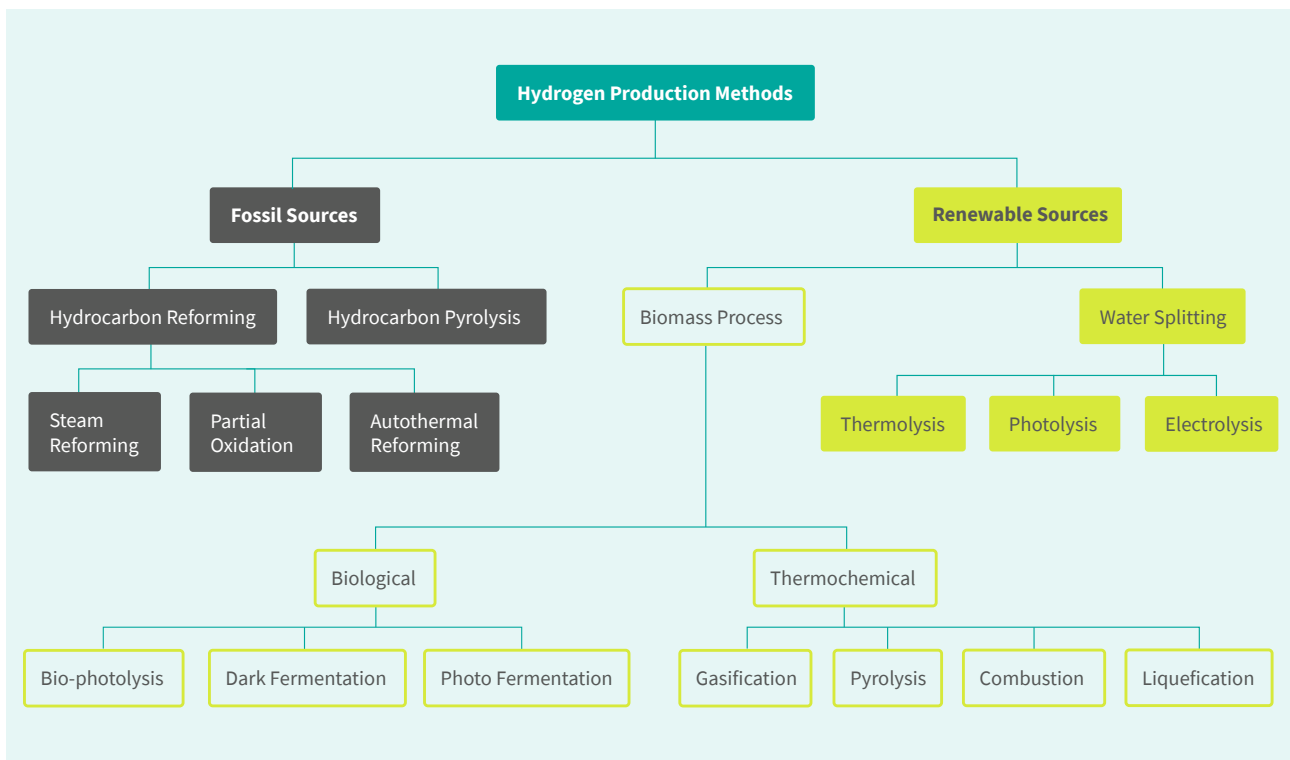


Figure 1: Hydrogen production pathways.

Source: Kumar, S. S., & Himabindu, V. (2019). Hydrogen production by PEM water electrolysis– A review

The EU has set targets regarding certain types of fuels for its Member States (e.g., RED III, ReFuelEU Aviation, FuelEU Maritime; see figure 2). Hydrogen (and its derivatives) can be counted towards some of these targets. The type of feedstocks or energy sources could affect the eligibility of the fuel towards these targets. This eligibility is important, since the targets set by the EU steer the demand and therefore also affect prices. For example, if one of the production pathways of hydrogen (e.g., electrolysis – RFNBO) leads to a product that complies with EU targets, this product can reach better prices and be more competitive ². There will be a higher willingness from the industry to pay a “green premium”, as they can count to reach the target. The eligibility of hydrogen for different EU targets is shown below in figure 2 by Hydrogen Europe.

Note that the figure below refers to categories of hydrogen. Some of these categories are not explicitly mentioned in the EU legislative text. This is why this paper explains in chapter 3 under which conditions hydrogen can be an RFNBO, hydrogen can be biohydrogen or hydrogen can be an RCF and therefore be eligible towards specific EU targets.

	RED transport targets				RED industry targets	RefuelEU Aviation targets		FuelEU Maritime targets	
	1% RFNBO target	5.5% sub-target with advanced biofuels	Overall RES target (29%)	GHG reduction target	42% RFNBO target	Synthetic aviation fuels (1.2% by 2030)	SAF (6% by 2030)	RFNBO (1% by 2030)	GHG reduction target
RFNBO	x2 multiplier x1.5 multiplier for aviation and maritime			YES	YES	YES	YES	YES	X2 multiplier until 2033
Bio-hydrogen (advanced)	NO	YES	YES	YES	NO	NO	YES	NO	YES
Bio-hydrogen (1 st gen)	NO	NO	YES (limited)	YES	NO	NO	NO	NO	NO
Low-carbon	NO	NO	NO	NO	NO	NO	NO	NO	YES
Low-carbon non-fossil	NO	NO	NO	NO	NO (but can reduce the target)	YES	YES	NO	YES
RCF	NO	NO	YES (if the MS chooses to do so)	YES (if the MS chooses to do so)	NO	NO	YES	NO	YES
By-product	NO	NO	NO	YES (if low-carbon)	NO (but reduces the target)	NO	YES (if low-carbon)	NO	YES (if low-carbon)

Figure 2: Categories of hydrogen and their eligibility towards EU targets

Source: Hydrogen Europe (2024), Clean Hydrogen Production Pathways Report

² For a more detailed explanation, see figure 1 in this paper: [Identification of suitable carbon as feedstock for PtX products to be exported to Europe - PtX Hub](#)

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Exemplary scenarios (contextualisation)

A complete overview of different fuel types in the EU legislative texts is provided in Annex I including definitions, relevant legal texts, examples and the criteria for determining when a fuel qualifies as a specific fuel type. In some cases, fuel types overlap and also include subcategories. This is visually depicted in figure 3.

From a hydrogen perspective, figure 3 and Annex I also identify under which legally defined fuel type in the EU, a hydrogen production pathway may fall. In practice, this means, for example, that hydrogen produced from biogenic energy sources can be called biohydrogen (see figure 2). In the EU legislative texts however, biohydrogen is not defined. With the help of the figure below and Annex I, it is possible to identify in which legally defined fuel category, biohydrogen could fall (renewable gas / biogas / biomass fuel). The exact categorisation would then depend on the production pathways and which criteria the biohydrogen meets or does not meet.

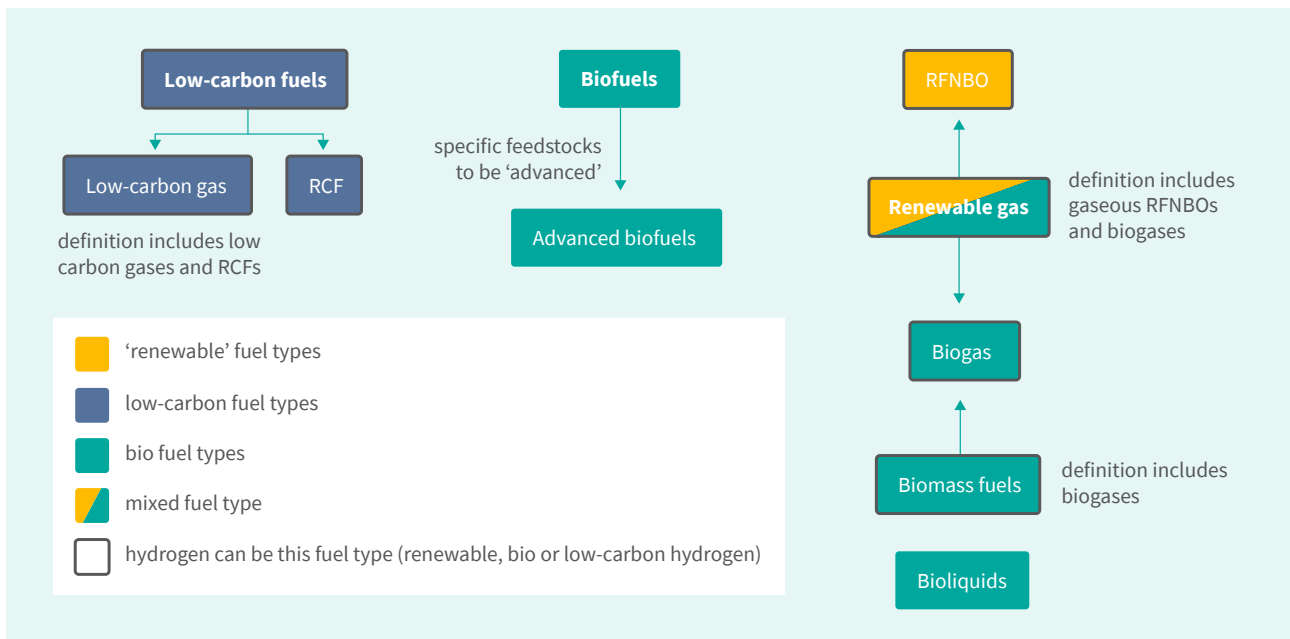


Figure 3: Types of fuels in the EU legislation, their relationships among each other and their relationship to hydrogen

Source: Own illustration.

The exact categorisation of any hydrogen/PtX fuel is key to assess from which EU targets the final product could benefit. Therefore, examples are given below in figure 4 and 5. Please note that the examples below summarise only some of many possible scenarios and can only be seen as a rough assessment. With each set-up, an in-depth analysis needs to be done on whether the specific criteria of each fuel type are met in order to be able to be counted towards the targets illustrated above. This analysis includes but is not limited to:

- Feedstock analysis: Does your feedstock have the characteristics set out in the legislative texts?
- GHG emission calculation: Does your final product meet the respective GHG emission threshold?
- Co-processing and mixed production set-ups: From which feedstock(s) does the energy content of your final product come from? This mainly determines the type of fuel you are producing.

The figures below (figure 4 and 5) depict simplified examples on which production pathways lead to specific fuel types of hydrogen and methanol. Examples on methanol are added because carbon sources play a crucial role in determining the fuel type and calculation of the GHG emissions of a fuel.

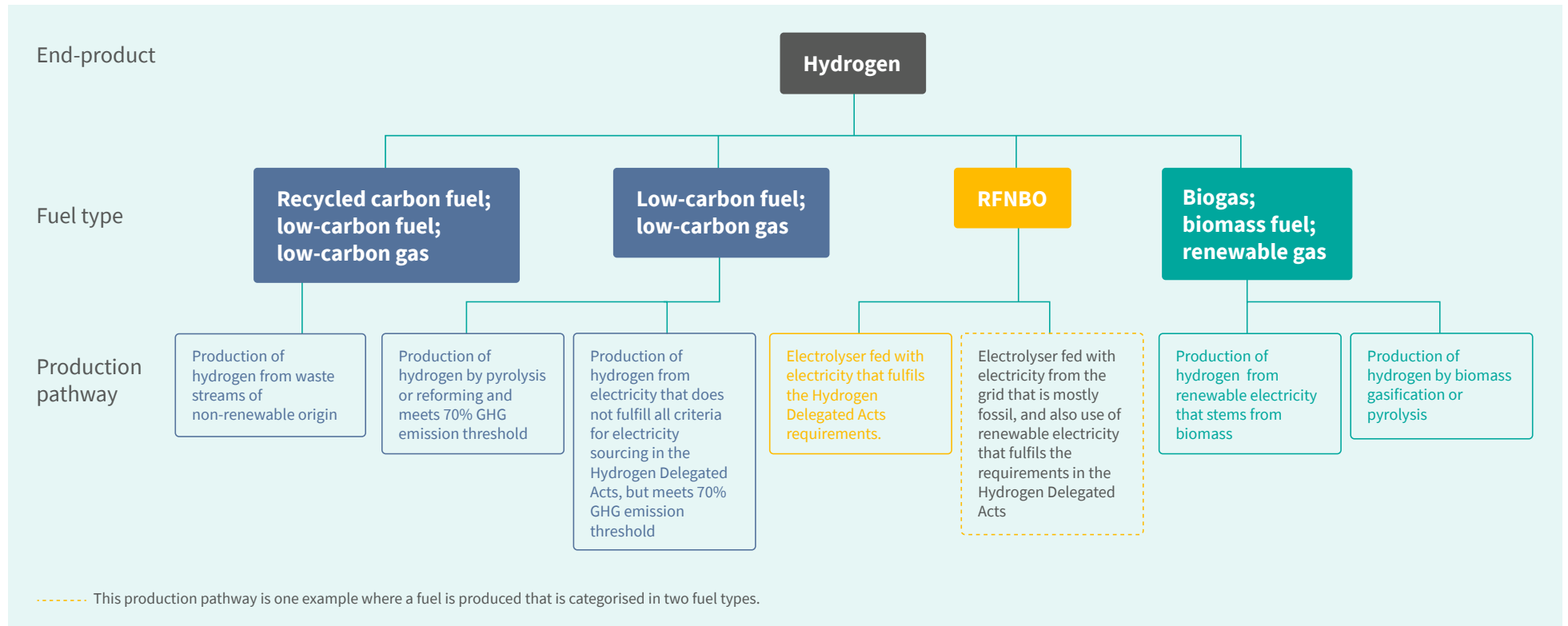


Figure 4: Production pathways of hydrogen and their EU fuel categorisations

Source: Own illustration

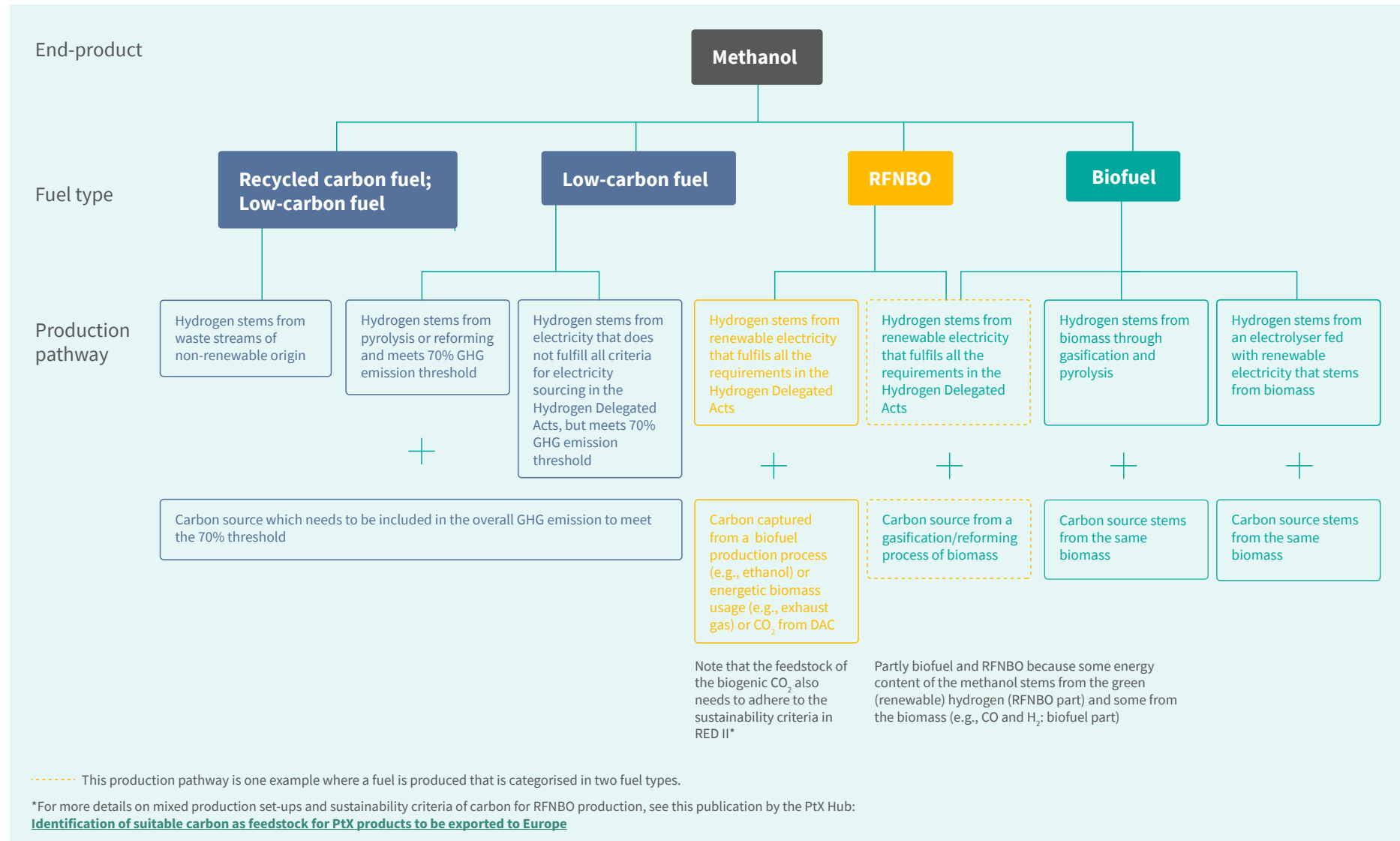


Figure 5: Production pathways of methanol and their EU fuel categorisations

Source: Own illustration.

4

Future considerations

The explained categorisations are important to have clear rules on which fuel types are produced and therefore under which policy targets they can be accounted for. These targets represent one policy measure to create market demand for certain fuel types. In the context of green ³ hydrogen/PtX, this is especially important as policy measures are needed to support an effective market ramp-up.

The key ingredients of these categorisations are the energy content of the fuel and the GHG emissions – two very important aspects when it comes to assessing the sustainability of a certain fuel type. However, with green hydrogen/PtX, the fuel landscape changes significantly, as these integrated approaches can replace fossil feedstocks or enhance the use of existing biogenic or recycled fossil feedstocks. Therefore, it remains to be seen whether the targets using the different fuel types and categorising them based on the energy content of the feedstock, will “reward” innovative and integrated set-ups accordingly. Eventually, all production set-ups that switch from ‘grey’ to ‘green’ processes, that maximise feedstock use, capture CO₂, and that ensure fair production practices for renewable hydrogen/PtX will play a crucial role in defossilising economies globally.

The categorisation of fuels, especially when they require a carbon source, as bio, non-bio, low-carbon, etc., could become complex and therefore, hinder or delay investments. This complexity is difficult to understand and sometimes very theoretical, for example, when the same fuel must be categorised as two fuel types.

3 Note that the EU terminology is “renewable”.

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Annex I:

In-depth overview of fuel categories in the EU legislative texts

Name of fuel	Definition	Examples	Main criteria/ production requirement	Legal background texts	Can hydrogen be considered as this fuel type?	Relation to other categories
Renewable fuel of non-biological origin (RFNBO)	“renewable liquid and gaseous transport ⁴ fuels of non-biological origin means liquid or gaseous fuels which are used in the transport sector other than biofuels or biogas, the energy content of which is derived from renewable sources other than biomass” (RED II)	Hydrogen produced from renewable electricity which is not derived from biomass. This hydrogen could also be called renewable ⁵ hydrogen Any derivative from this hydrogen such as e-SAF, e-methanol or ammonia ⁶	Renewable electricity sourcing GHG footprint of final product reaching 70% threshold (= below 28,2g CO ₂ eq/MJ)	Defined in RED II , also relevant RED III ⁷ Relevant for production requirements and GHG emission methodology: Hydrogen Delegated Acts of RED II: Commission Delegated Regulation (EU) 2023/1184 ; Commission Delegated Regulation (EU) 2023/1185	Yes, if the criteria are met, hydrogen can be an RFNBO (renewable hydrogen)	Overlap by definition with renewable gas

⁴ Note that the reference to ‘transport’ in the definition is now deleted in RED III and therefore not restricted to the use in transport.

⁵ Note that no colour scheme is used (e.g., green hydrogen) to describe different types of hydrogen in the EU context.

⁶ Note that for additional inputs, like carbon, some requirements are also defined in the mentioned texts. For more details on the role of carbon sources, see this publication by the PtX Hub: [Identification of suitable carbon as feedstock for PtX products to be exported to Europe – PtX Hub \(ptx-hub.org\)](#)

⁷ It is always advised to consult RED II and RED III for details. This is because the implementation of RED III by EU Member States is currently ongoing.

Name of fuel	Definition	Examples	Main criteria/ production requirement	Legal background texts	Can hydrogen be considered as this fuel type?	Relation to other categories
Recycled carbon fuel (RCF)	“recycled carbon fuels means liquid and gaseous fuels that are produced from liquid or solid waste streams of non-renewable origin which are not suitable for material recovery in accordance with Article 4 of Directive 2008/98/EC, or from waste processing gas and exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of the production process in industrial installations” (RED II)	<p>Hydrogen produced from waste gases, for example via water gas shift reaction</p> <p>Diesel fuel made from waste plastic (e.g., from HDPE ⁸ via pyrolysis)</p> <p>Any fuels made from non-renewable waste which includes fossil waste such as plastics, rubber or gases</p>	GHG footprint of final product reaching 70% threshold (= below 28,2g CO ₂ eq/MJ)	<p>Defined in RED II, also relevant RED III</p> <p>Relevant for production requirements and GHG emission: Hydrogen Delegated Acts of RED II: Commission Delegated Regulation (EU) 2023/1184; Commission Delegated Regulation (EU) 2023/1185</p>	Yes, if the criteria are met, hydrogen can be an RCF	Can be seen as subcategory of low-carbon fuel and low-carbon hydrogen
Low-carbon fuel	“low-carbon fuels means recycled carbon fuels as defined in Article 2, point (35), of Directive (EU) 2018/2001, low-carbon hydrogen and synthetic gaseous and liquid fuels the energy content of which is derived from low-carbon hydrogen, that meet the greenhouse gas emission reduction threshold of 70 % compared to the fossil fuel comparator for renewable fuels of non-biological origin set out in the methodology adopted pursuant to Article 29a(3) of Directive (EU) 2018/2001” (EU Hydrogen and Gas Decarbonisation Directive)	<p>Hydrogen from fossil energy sources</p> <p>Any derivative from this hydrogen such as SAF, methanol or ammonia</p> <p>See RCFs</p>	GHG footprint of final product reaching 70% threshold (= below 28,2g CO ₂ eq/MJ)	<p>Defined in EU Hydrogen and Gas Decarbonisation Directive</p> <p>Delegated Act on the methodology for assessing greenhouse gas emissions savings from low-carbon fuels still to be published</p>	Yes, if criteria are met, hydrogen can be a low-carbon fuel (low-carbon hydrogen)	Includes RCFs, low-carbon hydrogen and low-carbon gas

Name of fuel	Definition	Examples	Main criteria/ production requirement	Legal background texts	Can hydrogen be considered as this fuel type?	Relation to other categories
Low-carbon hydrogen	“low-carbon hydrogen means hydrogen the energy content of which is derived from non-renewable sources, which meets the greenhouse gas emission reduction threshold of 70 % compared to the fossil fuel comparator for renewable fuels of non-biological origin set out in the methodology for assessing greenhouse gas emissions savings from renewable fuels of non-biological origin and from recycled carbon fuels, adopted pursuant to Article 29a(3) of Directive (EU) 2018/2001” (EU Hydrogen and Gas Decarbonisation Directive)	See low-carbon fuel Possible production pathways ⁹ : <ul style="list-style-type: none"> • Electrolysis (low and high temperature) • Reforming with carbon capture (SMR¹⁰, ATR ¹¹ with CCS) • By-product hydrogen not classified as RCF; • Methane splitting (pyrolysis of methane) 	GHG footprint of final product reaching 70% threshold (= below 28,2g CO ₂ eq/MJ)	Defined in EU Hydrogen and Gas Decarbonisation Directive Delegated Act on the methodology for assessing greenhouse gas emissions savings from low-carbon fuels still to be published	Yes, if criteria are met, hydrogen can be a low-carbon hydrogen	Can be seen as subcategory of low-carbon fuel

⁹ Derived from Hydrogen Europe: [240527-Low-carbon-DA-Hydrogen-Europe-final-paper-clean.pdf \(hydrogeneurope.eu\)](#)

¹⁰ Steam methane reforming

¹¹ Autothermal reforming of natural gas

Name of fuel	Definition	Examples	Main criteria/ production requirement	Legal background texts	Can hydrogen be considered as this fuel type?	Relation to other categories
Low-carbon gas	“low-carbon gas means the part of gaseous fuels in recycled carbon fuels as defined in Article 2, point (35), of Directive (EU) 2018/2001, low-carbon hydrogen and synthetic gaseous fuels the energy content of which is derived from low-carbon hydrogen, that meet the greenhouse gas emission reduction threshold of 70 % compared to the fossil fuel comparator for renewable fuels of non-biological origin set out in the methodology adopted pursuant to Article 29a(3) of Directive (EU) 2018/2001” (EU Hydrogen and Gas decarbonisation Directive)	See low-carbon fuel and low-carbon hydrogen	GHG footprint of final product reaching 70% threshold (= below 28,2g CO ₂ eq/MJ)	Defined in EU Hydrogen and Gas Decarbonisation Directive Delegated Act on the methodology for assessing greenhouse gas emissions savings from low-carbon fuels still to be published	Yes, if criteria are met, hydrogen can be a low-carbon gas	Includes low-carbon hydrogen, is a subcategory of low-carbon fuels and excludes biogas
Renewable gas	“renewable gas means biogas as defined in Article 2, point (28), of Directive (EU) 2018/2001 including biogas that has been upgraded to biomethane, and renewable fuels of non-biological origin as defined in Article 2, point (36), of that Directive” (EU Hydrogen and Gas Decarbonisation Directive)	See RFNBO and biogas Biomethane and hydrogen made from biomass Hydrogen and synthetic methane made from renewable electricity (RFNBO)	See RFNBO and biogas	See biogas and RFNBO	Yes, criteria are met, hydrogen can be a renewable gas (either as renewable hydrogen or bio-hydrogen)	Includes biogas and RFNBO

Name of fuel	Definition	Examples	Main criteria/ production requirement	Legal background texts	Can hydrogen be considered as this fuel type?	Relation to other categories
Biofuels	“biofuels means liquid fuel for transport produced from biomass” (RED II)	Bioethanol Biodiesel HVO/HEFA	GHG footprint of final product reaching a certain threshold depending on end-use sector and time of production (see Article 29 (10) RED III for details) Sustainability requirements: RED III, for example, Article 29	Defined in RED II , also relevant RED III	No, hydrogen cannot be a biofuel as by this definition but bio-hydrogen derivatives could be biofuels. See also biogas.	/
Advanced biofuels	“advanced biofuels means biofuels that are produced from the feedstock listed in Part A of Annex IX” (RED II) Feedstocks listed in Annex IX include, for example: algae, straw, animal manure and sewage sludge, bagasse, nut shells or husks	Bioethanol from these specific feedstocks Biodiesel from these specific feedstocks HVO/HEFA from these feedstocks	GHG footprint of final product reaching a certain threshold depending on end-use sector and time of production (see Article 29 (10) RED III for details) Sustainability requirements: RED III, for example, Article 29 Derived from listed feedstocks	Defined in RED II , also relevant RED III	No, hydrogen cannot be an advanced biofuel as by this definition but hydrogen derivatives could be advanced biofuels. See also biogas.	Subcategory of biofuels

Name of fuel	Definition	Examples	Main criteria/ production requirement	Legal background texts	Can hydrogen be considered as this fuel type?	Relation to other categories
Bioliquids	“bioliquids means liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass” (RED II)	See biofuels (main distinction is the end-use)	GHG footprint of final product reaching a certain threshold depending on end-use sector and time of production (see Article 29 (10) RED III for details) Sustainability requirements: RED III, for example, Article 29	Defined in RED II , also relevant RED III	No, hydrogen cannot be a bioliquid as by this definition	/
Biomass fuels	“biomass fuels means gaseous and solid fuels produced from biomass” (RED II)	Briquettes or pellets See biogas	GHG footprint of final product reaching a certain threshold depending on end-use sector and time of production (see Article 29 (10) RED III for details) Sustainability requirements: RED III, for example, Article 29	Defined in RED II , also relevant RED III	Yes, if the criteria are met, hydrogen can be a biomass fuel (bio-hydrogen)	Includes biogas
Biogas	“biogas means gaseous fuels produced from biomass” (RED II)	Gas derived from biogenic raw materials like manure, agricultural wastes, or sewage. Via upgrading biomethane can be produced	GHG footprint of final product reaching a certain threshold depending on end-use sector and time of production (see Article 29 (10) RED III for details) Sustainability requirements: RED III, for example, Article 29	Defined in RED II , also relevant RED III	Yes, if the criteria are met, hydrogen can be a biogas (bio-hydrogen)	Subcategory of renewable gas and biomass fuels



Annex II:

Resources

- **PtX Hub: EU Requirements for Renewable Hydrogen and its Derivatives:**
Link: <https://ptx-hub.org/publication/policy-brief-on-eu-requirements-for-renewable-hydrogen-and-its-derivatives/>
- **PtX Hub: Industry targets in European legislation for hydrogen and PtX products:**
Link: [Industry targets in European legislation for hydrogen and PtX products – PtX Hub \(ptx-hub.org\)](#)
- **PtX Hub: Identification of suitable carbon as feedstock for PtX products to be exported to Europe**
Link: [Identification of suitable carbon as feedstock for PtX products to be exported to Europe – PtX Hub \(ptx-hub.org\)](#)
- **Hydrogen Europe: Clean Hydrogen Production Pathways report**
Link: [2024 H2E CleanH2ProductionPathwaysReport.pdf \(hydrogeneurope.eu\)](#)
- **RED II**
Official Name: Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources
Link: [Richtlinie – 2018/2001 – EN – EUR-Lex \(europa.eu\)](#)
- **RED III**
Official Name: Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652
Link: [Directive – EU – 2023/2413 – EN – Renewable Energy Directive – EUR-Lex \(europa.eu\)](#)
- **CDR 2023/1184, also known as delegated act (DA) pursuant to Art 27(3) RED II**
Official Name: Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin.
Link: https://eur-lex.europa.eu/eli/reg_del/2023/1184/oj



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- **CDR 2023/1185, also known as delegated act (DA) pursuant to Art 25(2) and 28(5) RED II**
Official Name: Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels.
Link: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1185>
- **EU Hydrogen and Gas Decarbonisation Directive**
Official Name: Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast)
Link: [Directive – EU – 2024/1788 – EN – EUR-Lex \(europa.eu\)](#)
- **Q&A implementation of hydrogen delegated acts – Version of 14/03/2024**
Link: [Q&A implementation of hydrogen delegated acts \(europa.eu\)](#)



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