Tomorrow's EU Framework for Sustainable Fuels: The Emerging Regulatory Framework for Hydrogen and Related Fuels

Kim Talus and Sirja-Leena Penttinen

A. Introduction: New Sustainable Fuel Targets

Similarly to many other countries, the EU has been experiencing a hydrogen boom. The EU published an ambitious Hydrogen Strategy in 2020, constituting the backbone of all EU hydrogen activities. With the Russian invasion of Ukraine and ensuing need to cut dependencies on fossil fuel sources, the EU revised its hydrogen-specific targets with the introduction of the REPowerEU plan[1], the specific focus of which is to promote the production of clean energy and diversify the energy supplies of the EU. The 'Hydrogen Accelerator' targets regarding hydrogen, published along with the REPowerEU plan, focus both on domestic production as well as hydrogen imports. According to the targets, the EU seeks to produce 10 million tonnes of domestic hydrogen and to import an equal amount by 2030.

Whilst the EU Hydrogen Strategy (i) outlined the overall vision of 'how the EU can turn clean hydrogen into a viable solution to decarbonise different sectors over time'; (ii) identified the challenges to overcome; and (iii) presented a roadmap of action for the years to come at the policy level, the legally binding sector-specific targets for hydrogen are set out in the Renewable Energy Directive.

At the time of the publication of the Hydrogen Strategy, the Renewable Energy Directive of 2018 ('RED II')[2] was in force, and did not include any hydrogen-specific provisions or targets. Instead, the recast Renewable

1 European Commission, Communication 'REPowerEU Plan' COM (2022) 230 final.

2 European Parliament and the Council Directive (EU) 2018/2001 of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) [2018] OJ L 328/82 (Renewable Energy Directive II).

https://doi.org/10.5771/9783748962801-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

Energy Directive of 2023 ('RED III')[3] sets out specific hydrogen-related sector-specific targets.[4]

The agreement is to raise the share of renewable energy in the EU's overall energy consumption to 42.5 % by 2030 with an additional 2.5 % indicative top-up that would, in line with the REPowerEU Plan[5], allow the EU to reach 45 %.[6] Hydrogen produced by relying on electrolysis powered by renewable energy sources falls under the scope of the Renewable Fuels of Non-Biological Origin (RFNBO) under the EU law, for which the newly agreed framework will create specific demand side targets for a range of end-use forms. The Directive 2023 sets out sector-specific targets for RFNBO.

In the industrial sector, according to Article 22a(1) the 2023 Directive, RFNBO should provide 42 % of the hydrogen utilised in industrial processes by 2030 and that by 2035, that percentage should rise to 60 %.[7] However, as a significant relaxation of these binding targets, Member States may rely on a derogation to reduce their RFNBO share in industry by 20 % provided they are: (1) on track with their use of renewable energy (national contribution to the binding overall EU target meets their expected contribution); and (2) are using no more than 23 % fossil-based hydrogen by 2030 and 20 % fossil-based hydrogen by 2035.[8] This requirement is conjunctive so that both conditions must be fulfilled for the derogation to apply.

In the transport sector, according to Article 25 of 2023 Directive, a binding combined sub-target for advanced biofuels and RFNBO is 1 % of

3 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 [2023] OJ L 2023/2413 (2023 Directive or RED III).

4 Council of the European Union formally adopted the directive on 9 October 2023. See Council of the European Union, 'Renewable energy: Council adopts new rules' <https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/renewable-energy-council-adopts-new-rules/> accessed 26 August 2024.

5 European Commission, 'REPower EU' (n 1).

6 See Council of the European Union, press release, 'Council and Parliament reach provisional deal on renewable energy directive' <https://www.consilium.europa.eu/en/press/press-releases/2023/03/30/council-and-parliament-reach-provisional-deal-on-renewable-energy-directive/> accessed 26 August 2024.

7 RED III (n 3) Article 22a.

8 RED III (n 3) Article 22b.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

fuels in transport by 2025, increased to 5.5 % by 2030. By 2030, the binding minimum target for RFNBO is set at 1 %.[9]

In the maritime sector, under the 2023 Directive, Member States with maritime ports should aim to ensure that by 2030, RFNBO shall occupy 1.2 % of the total amount of energy supplied to the maritime transport section.[10] The FuelEU Maritime Regulation[11] provides targets to reduce the GHG emissions that come specifically from maritime transport. In addition to specific targets for lowering GHG emissions, the legislation sets targets for RFNBO. According to the goal, if the percentage of RFNBO is still less than 1 % in 2031, a 2 % binding objective will be set for 2034.[12]

Lastly, in the aviation sector, fuel suppliers are required by the Regulation on ensuring a level playing field for sustainable air transport ('ReFuelEU Aviation Regulation')[13] to blend sustainable aviation fuels and, starting in 2030, synthetic fuels with the current jet fuel provided at EU airports. The obligation set for the aviation fuel suppliers to ensure that all fuel made available to aircraft operators at EU airports contains a minimum share of 2 % SAF from 2025 and, from 2030, a minimum share of 1.2%synthetic fuels**,** with both shares increasing progressively towards 2050 at which point the requirement is 70 % for SAF and 35 % for synthetic fuels.[14] 'Sustainable aviation fuels' and 'synthetic aviation fuels' include certified biofuels, RFNBOs and recycled carbon aviation fuels.

These targets, as set out now in the legislative tool, are important for the uptake of sustainable fuels and RFNBO. By creating regulatory demand for these fuels, the legislature creates a stable demand that producers can rely on when making investment decisions. Having said this, some caveats need to be considered.

9 RED III (n 3) Article 25.

10 ibid.

11 European Parliament and the Council Regulation (EU) 2023/1805 of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC [2023] OJ L234/48 (ReFuelEU Maritime Regulation).

12 ReFuelEU Maritime Regulation (n 11) Article 5.

13 The Council formally adopted the new Regulation on 23 October 2023. See Council of the European Union, 'RefuelEU aviation initiative: Council adopts new law to decarbonise the aviation sector' <https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/refueleu-aviation-initiative-council-adopts-new-law-to-decarbonise-the-aviation-sector/> accessed 26 August 2024.

14 ReFuelEU Aviation Regulation (n 13) Annex I.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

First, how stable is the regulatory regime put in place? Does it create legal certainty that these targets will be there in the long term? On the other side, are these targets realistic? Does the EU have all the necessary components to meet these targets? This last question relates, in particular, to RFNBO and the need for significant amounts of additional renewable electricity production.

Second, and in relation to the first, the EU has now sought to promote the use of hydrogen in particular in the decarbonisation of the hard-to-abate sectors, i.e. in those sectors where other mitigation measures, such as direct electrification, would be difficult to implement. These targets focus specifically on those sectors, industry and transport, where the potential for hydrogen to reduce greenhouse gas ('GHG') emissions is considered the greatest.

In light of the concerns as to whether there is sufficient demand to stimulate investment to hydrogen production, these legally binding targets, which have been adopted *inter alia* to do just that, have been warmly welcomed. However, the target for the transport sector, in particular, has been criticised as being too modest, in addition to which it should be noted that the specific ReFuelEU targets count towards the 'general' transport sector targets. At the same time, it now seems difficult to reach even these modest targets, as prices for RFNBO remain too high and investments are being delayed.

Finally, it should be noted that the 2023 Directive does not provide any additional details as to how EU Member States should reach the targets set; instead, the Member States are free to choose the measures required to reach their national contribution, whether it is via a variety of direct or indirect measures. Significant differences in Member States approaches are clear, some setting binding national targets and others refraining from doing so.

B. Classification of Various Fuels Under the EU Framework

1. Hydrogen

(a) RFNBO under EU law

Whilst the Directives have previously focused on biogenic fuels for transport, the winds are changing. Today the 'renewable liquid and gaseous fuels

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

of non-biological origin' or 'RFNBO' has emerged as the key concept for hydrogen and other fuels. The concept refers to a group of fuels defined under Article 2 (36) of the 2018 Directive, which provides that 'renewable liquid and gaseous transport 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.' In other words, these fuels are produced from renewable energy sources other than biomass. The more recent 2023 Directive amended the definition by eliminating the reference to "transport".

At the EU level, the key concept with regard to hydrogen is RFNBO. The relevant rules concerning the RFNBOs are provided for in several interlinked regulatory acts. While Renewable Energy Directive sets out the definition for the RFNBO, the more detailed rules, providing the methodology to determine that hydrogen is produced from renewable energy sources and achieves at least 70 % GHG emissions savings, are included in the Commission's delegated acts. The Commission's delegated acts, the Commission Delegated Regulation on methodology setting out detailed rules for the production of renewable fuels of non-biological origin ('RFNBO delegated act')[15] and Commission delegated regulation setting out the GHG calculation methodology for RFNBO and recycled carbon fuels ('GHG Methodology')[16], were adopted in the summer of 2023. The objective of these delegated acts is to ensure that hydrogen is produced from renewable energy sources and achieves at least 70 % GHG emissions savings.[17]

These delegated acts are key parts of the EU regulatory framework for hydrogen, which includes *inter alia* energy infrastructure investments and state aid rules, as well as legislative targets for renewable hydrogen for Member States, hydrogen market frameworks as well as rules around low-

15 Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council establishing a Union methodology setting out detailed rules for the production of renewable fuels of non-biological origin [2023] OJ L 157/11.

16 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 [2023] OJ L 157/20.

17 European Commission, 'Renewable hydrogen' <https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/hydrogen-delegated-acts_en> accessed 26 August 2024.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

carbon hydrogen. The RFNBO delegated act provides the rules in terms of which hydrogen, hydrogen-based fuels and other synthetic fuels can be considered RFNBO, and applies to both fuels produced within the EU and imported fuels. The GHG Methodology provides the methodology for calculating life cycle GHG emissions for RFNBO, in order to determine whether they comply with the EU's GHG emissions thresholds applicable to these fuels.

Furthermore, the RFNBO delegated act provides different rules relating to the source of electricity used for hydrogen production. This is notable as when electricity is fed into the grid, it is impossible to distinguish the origin of the electrons. Thus, if renewable electricity is fed into the grid, it is not necessarily the same electrons produced by renewable energy sources that consequently make it 'green', that will be consumed. As the EU seeks to create a *renewable* or *clean* hydrogen market, it is a priority for the EU to create rules to ensure that the electricity that powers the electrolysers is produced from (non-biological) renewable energy sources. As hydrogen in itself only produces water when consumed, the emissions associated with hydrogen production depend solely on the production method. Therefore, it is critical to be able to ensure that the electricity is renewables based.

Electricity required to power the electrolyser can be either acquired via a direct connection between the renewable energy facility and the electrolyser or from the grid. The EU Commission delegated act that provides for the criteria under which the hydrogen produced is considered 'renewable' under EU law, distinguishing between electricity obtained through a direct connection and via the grid. These rules will be examined in more detail in the following paragraphs.

(b) Qualification of Electricity from a Direct Connection With an Installation Generating Renewable Electricity as Fully Renewable

Article 3 of the RFNBO delegated act, 'Rules for counting electricity obtained from direct connection to an installation generating renewable electricity as fully renewable', provides the rules for situations where the electricity to a hydrogen or hydrogen-based fuel production facility is obtained from direct connection with an installation generating renewable electricity. In this case, electricity delivered via a direct line is recognised as fully renewable if the installation generating renewable electricity has not come into operation earlier than 36 months before the installation producing the renewable fuel thus fulfilling the 'additionality' requirement, which

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

is discussed in more detail below. In addition, the installation producing electricity should not be connected to the grid. If there is a connection to the grid, a smart metering system is required to measure electricity flows from the grid that proves no electricity was taken from the grid to produce the relevant RFNBO.

(c) Qualification of Electricity Taken from the Grid as Fully Renewable

Article 4 provides the general rules for counting electricity taken from the grid. Under this article, there are various scenarios where hydrogen or hydrogen-based fuel producers may count electricity taken from the grid as fully renewable. These are: (i) the bidding zone rule; (ii) the emission intensity rule; and (iii) the imbalance settlement rule. If none of these alternatives apply, the fuel producer may rely on the general rules of additionality and temporal and geographical correlation to prove that the electricity is renewable.

First, under the bidding zone rule, electricity is considered renewable if the installation producing hydrogen or hydrogen-based fuels is located in a bidding zone where the average proportion of renewable electricity exceeded 90 % in the previous calendar year, and the production of hydrogen or hydrogen-based fuels does not exceed a maximum number of hours set in relation to the proportion of renewable electricity in the bidding zone.

Second, under the emission intensity rule, electricity is considered renewable if the installation producing RFNBO is located in a bidding zone where the emission intensity of electricity is lower than 18 gCO2eq/MJ. However, in this scenario the fuel producer must have concluded directly, or via intermediaries, one or more renewable power purchase agreements with economic operators, producing renewable electricity in one or more installations generating renewable electricity for an amount that is at least equivalent to the amount of electricity that is claimed as fully renewable and the electricity claimed is effectively produced in this or these installations, provided that conditions of temporal and geographical correlation are met.

Third, the electricity used to produce hydrogen or hydrogen-based fuel is considered renewable if consumed during an imbalance settlement period which the fuel producer can demonstrate, based on evidence from the national transmission system operator.

Finally, if none of scenarios 1 – 3 are present, electricity taken from the grid can still be considered fully renewable where fuel producers: (i) pro-

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

duce an amount of renewable electricity in their own installations that is at least equivalent to the amount of electricity claimed as fully renewable; or (ii) have concluded directly, or via intermediaries, one or more renewables power purchase agreements, and the conditions on additionality, temporal correlation and geographic correlation are met. These criteria are discussed next.

(d) Additional Requirements of Additionality Temporal and Geographic Correlation

One of the key challenges with the concept of RFNBO is that it requires significant amounts of renewable electricity. From a practical perspective it appears that unless there are sufficient amounts of renewable electricity generation within the power system, the policy would target those applications where the efficiency is at its highest. This often means direct electrification. The conversion of electricity into hydrogen requires significant amounts of energy, and losses in this conversion are in the range of 30–35 %. Similarly, 13–25 % of energy is lost when hydrogen is converted into derivatives, such as ammonia, for transportation purposes and then cracked back into hydrogen.[18]

In terms of renewable electricity, the European Commission estimates that 500–550 TWh of renewable electricity is needed to produce 10 Mt of RFNBO by 2030.[19] In 2022, the EU produced 2641 TWh (terawatt-hours) of electricity.[20] Out of this, 15.9 % was wind power and 7.6 % was solar power.[21] This means that these renewable energies accounted for 23.5 % of all power produced in the EU. This translates into 620 TWh of renewable electricity from wind and solar. The EU hydrogen ambitions based on RFNBO would require almost doubling its electricity generation based on wind and solar, and much of this of new capacity would be consumed by RFNBO production.

18 See, for example, Irena, 'Green hydrogen – A guide to policy making' (2020) <https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Nov/IRENA_Green_hydrogen_policy_2020.pdf> accessed 26 August 2024.

19 European Commission, 'Questions and Answers on the EU Delegated Acts on Renewable Hydrogen' <https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_595> accessed 26 August 2024.

20 European Council, 'How is EU electricity produced and sold?' <https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/> accessed 26 August 2024.

21 ibid.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

Clearly, this is an enormous challenge. Significant new renewable energy production is required to meet the demand from hydrogen production. At the same time, the direct electrification of sectors like household heating and road vehicle fleets is progressing, creating additional demand for clean power. This requires tradeoffs between direct electrification and power-to-X conversion. As direct electrification does not entail the same energy losses as power-to-X, it is clear that until we can meet the entire demand for renewable electricity, preference should be given to the most efficient solutions. This means direct electrification. The EU simply cannot afford to waste renewable electricity on applications with lower efficiencies.

In order to avoid the cannibalisation effect on renewable electricity that is prone to happen should the renewable hydrogen production take off at the levels envisaged by the EU, the central criterion in determining whether the electricity used to produce RFNBO is renewable is the additionality requirement. The objective of the additionality requirement is that the renewable electricity used in RFNBO production is in addition to the renewable electricity used to meet the overall renewable energy targets and is not diverted from more efficient uses.

If RFNBO is produced by relying on grid-supplied electricity, and none of the scenarios outlined above, as enshrined in Article 4, can be applied, fuel producers may rely on the additionality requirement. The additionality requirement entails that hydrogen or hydrogen-based fuel producers conclude power purchase agreements ('PPAs') with new (i.e. which have come into operation not earlier than 36 months before the hydrogen or renewable fuel facility) and unsupported (no operating or investment aid) renewable electricity generation capacity.[22] To support the early scale-up of electrolysers, a grandfathering clause was included in Article 4 and hydrogen or hydrogen-based fuel production capacity that comes into operation before 2028 is exempted from these rules for 10 years, up until 1 January 2038.

In addition, the fuel produced must meet the requirement of temporal and geographic correlation. What this essentially means, is that the time and location of the RFNBO production must match those of the electricity production. Temporal correlation requires that the production of the hy-

22 These requirements, among others, are further elaborated in the Commission 'Q&A implementation of hydrogen delegated acts' document. See European Commission, 'Q&A implementation of hydrogen delegated acts' <https://energy.ec.europa.eu/document/download/21fb4725-7b32-4264-9f36-96cd54cff148_en?filename=2024%2003%2014%20Document%20on%20Certification.pdf> accessed 26 August 2024.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

drogen or hydrogen-based fuel uses electricity taken from the grid during either the same one-month period (until 31 December 2029) or the same one-hour period (starting from 1 January 2030) as the renewable electricity production under the relevant PPA. The temporal correlation condition is always considered to be met where the hydrogen or hydrogen-based fuel is produced during a one-hour period where the clearing price of electricity is lower or equal to 20 euros per MWh or lower than 36 % of the EU carbon price during the relevant period.

In turn, the geographic correlation rule requires that at least one of the following criteria is met:

1. the installation generating renewable electricity under the PPA is located, or was located at the time when it came into operation, in the same bidding zone as the electrolyser; and/or
2. the installation generating renewable electricity under the renewables PPA is located in an offshore bidding zone that is interconnected with the bidding zone where the electrolyser is located; and/or
3. the installation generating renewable electricity is located in an interconnected bidding zone, including in another Member State, and electricity prices in the relevant time period on the day-ahead are equal to or higher than in the production facility's bidding zone.

Member States may introduce additional criteria concerning the location of electrolysers and the installation producing renewable electricity in order to ensure compatibility of capacity additions with the national planning of the hydrogen and electricity grid. These additional criteria cannot, however, impact negatively on the functioning of the internal electricity market.

Under the definition provided by the Renewable Energy Directive and the RFNBO delegated act, hydrogen produced via electrolysis from renewable electricity fulfilling the requirements as set out in the delegated acts is considered RFNBO. However, hydrogen is not the only RFNBO, but instead, fuels such as ammonia, methanol or e-fuels are similarly considered RFNBOs when produced from renewable hydrogen. In this case, the fuel is produced from RFNBO and CO2. This means that the regulation of CO2 capture and utilisation is relevant for these other fuels.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

There are three fuels that rely on CCU technology under the Renewable Energy Directive: e-fuels, recycled carbon fuels and biofuels where CO2 can be used as feedstock in the production.[23] These will be examined next.

C. Other Sustainable Fuels Under the New EU Framework

1. Electrofuels

If the main target of the EU strategy is to create the preconditions for the production of renewable hydrogen, the second related leg of this strategy is focused on CO2. Electrofuels, better known by their acronym e-fuels, are produced by combining renewable hydrogen with captured CO2. The production of e-fuels therefore relies on carbon capture and utilisation (CCU).

CCU, however, requires significant amounts of additional electricity, just like hydrogen production. When done, these e-fuels then work like conventional fossil fuels with the key difference that they are climate-neutral – as such, they reduce the emissions associated with combustion car engines, and therefore provide a greener alternative while keeping the traditional combustion car industry alive as the same infrastructure can be relied on. E-fuels can be produced in either power-to-gas or power-to-liquid processes depending on the e-fuel required. While the first step of the production is hydrogen production by electrolysis from renewable electricity, the required e-fuel dictates the rest – CO2 is combined with hydrogen to produce e-crude and synthetic methane or methanol, whereas nitrogen is combined to produce synthetic ammonia. Similar to its fossil fuel-based counterpart, synthetic crude oil must be refined to produce synthetic kerosene or diesel.

The difference to many other CCU options is that the captured CO2 used in e-fuel production is intended to be released back into the atmosphere at the point of use of the fuel. The essential element in e-fuels is thus CO2, which can be either captured from the atmosphere or from the industrial facilities that use fossil fuels in their operations. Because of the variety of methods and sources to capture CO2, the e-fuel (production) costs as well as sustainability credentials depend on the source of CO2. This is critical as a key issue with e-fuels, recycled carbon fuels and advanced

23 See also, Kim Talus/Reza Maddahi, 'Carbon Capture and Utilization Under EU Law; Impermanent Storage of CO_2 in Products and Pre-combustion Carbon Capture' (2024) 00 Journal of World Energy Law and Business 1.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

biofuels is whether they can be counted towards EU, national or company level quotas or targets and EU or Member State levels.

When meeting the requirements of the GHG Methodology, e-fuels produced from renewable hydrogen and CO2 fall under the scope of RFNBO and can therefore be counted towards the fuel obligations under the Renewable Energy Directive or other sectoral rules (for aviation or maritime for example). As will be seen in more detail in the next section, in the context of recycled carbon fuels, meeting these quotas in the future will require the use of biogenic CO2.

2. Recycled Carbon Fuels

In addition to e-fuels, recycled carbon fuels are emerging as a more sustainable fuel alternative in the EU framework. Under Article 2 (35) of the Renewable Energy Directive, '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. This definition of 'recycled carbon fuels' connects to the EU waste hierarchy under the Waste Framework Directive[24] and ensures that the priority is for recycling over fuel application.

These recycled carbon fuels can replace petroleum-based fuels with more sustainable options, similarly to e-fuels, that can be used directly in the existing transport infrastructure for maritime shipping or aviation, for example.[25]

As already stated, under Article 25 of the Renewable Energy Directive, the combined share of advanced biofuels and biogas produced from a range of biogenic waste[26] and of RFNBO in the energy supplied to the transport sector must be at least 1 % in 2025 and 5.5 % in 2030, of which at least

24 Directive 2008/98/EC of the European parliament and of the Council of 19 November 2008 on waste and repealing certain Directives [2008] OJ L 312/3.

25 For an early discussion, see Christopher Graves/Sune D. Ebbesen/Mogens Mogensen/Klaus S. Lackner, 'Sustainable hydrocarbon fuels by recycling CO2 and H2O with renewable or nuclear energy' 15/1 (2011) Renewable and Sustainable Energy Reviews 1.

26 This refers to the biogenic feedstock listed in Part A of Annex IX of RED II (n 2).

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

1 % is RFNBO in 2030. Member States can count recycled carbon fuels towards their transport targets[27] as long as the recycled carbon fuels meet the minimum requirements, especially that of GHG emissions savings of at least 70 %.

Therefore, the central criteria in determining whether recycled carbon fuels fall under the scope of sustainable fuels is the GHG emissions savings. GHG Methodology sets a minimum GHG emissions saving threshold of 70 % for all types of recycled carbon fuels.[28] As such, it is necessary for any renewable fuel that has carbon content to comply with this 70 % emission savings requirement. Given that the combustion of these fuels produces the same GHG emissions as fossil fuels, they rely on avoided emissions to meet the 70 % threshold. This can be done through captured and reused CO2. Captured CO2 can be deducted from the carbon footprint of the recycled carbon fuel (as well as RFNBO).

Emissions from existing use or fate include all emissions in the existing use or fate of the input that are avoided when the input is used for fuel production. These emissions include the CO2 equivalent of the carbon incorporated in the chemical composition of the fuel that would have otherwise been emitted as CO2 into the atmosphere. This means that the GHG Methodology treats sustainable CO2 as carbon neutral as the release of CO2 during combustion is still taken into account (and reduction only takes place at the level of fuel production). This includes CO2 that was captured and incorporated into the fuel provided that at least one of the following conditions is fulfilled:

(a) Industrial CO2: The CO2 has been captured from an industrial activity, accounted for upstream in an effective carbon pricing system and incorporated in the chemical composition of the fuel before 2036 (or 2041 in other cases than CO2 stemming from the combustion of fuels for electricity generation).
(b) Direct air capture of CO2.
(c) Biogenic CO2: The captured CO2 stems from the production or the combustion of biofuels, bioliquids or biomass fuels complying with the sustainability and GHG saving criteria and the CO2 capture did not receive credits for emission savings from CO2 capture and replacement under the 2018 Directive. Biomass may not be combusted strictly as a carbon source.

27 RFNBO delegated act and Article 25 of RED III (n 3).
28 Article 2 of the GHG Methodology. Also incorporated in Article 29a of RED III (n 3).

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

(d) CO2 from RFNBO or recycled carbon fuels: The captured CO2 stems from the combustion of RFNBO or recycled carbon fuels complying with the GHG saving criteria.
(e) Geological CO2: The captured CO2 stems from a geological source of CO2 and the CO2 was previously released naturally.[29]

As illustrated, the GHG Methodology prohibits the use of CO2 stemming from industrial sources for the production of RFNBO from 2041 onwards. Options remaining are largely restricted to direct air capture or biogenic CO2. Given the costs associated with direct air capture, without significant cost reduction, the clear focus after 2041 is on biogenic CO2. Biogenic CO2 comprises CO2 that stems from the production or the combustion of sustainable biomass. CO2 from the treatment of biogenic waste is also eligible. In order to be eligible to count as emissions from existing use or fate ex-use[30], biogenic CO2 must comply with the sustainability and GHG saving criteria and must not have received credits for emissions savings from CO2 capture and replacement.[31]

3. Biofuels Under the Renewable Energy Directive of 2023

Whilst the previous sections have discussed the regulatory framework concerning emerging new fuels such as hydrogen and e-fuels, biofuels continue to play a role in the EU decarbonisation efforts. As these emerging new fuels are not yet available at scale, there is still a need for liquid fuels for heavy transport, maritime transport and aviation, for instance. Biofuels are therefore considered a tool for increasing the share of renewable energy and reducing GHG intensity in the transport sector.

Biofuels were a major source of renewable energy within the EU in 2021. Within this area, primary solid biofuels held the largest share at 70.3 %. Liquid biofuels accounted for 12.9 %, the share of biogas/biomethane was 10.1 %, and the renewable share of municipal waste held a 6.6 % share.[32] This share is set to increase and, for example, the current EU production

29 Commission Delegated Regulation, 'GHG Methodology' (n 20).
30 "Emissions from inputs' existing use or fate".
31 European Commission (n 22).
32 European Commission, 'Union Bioenergy Sustainability Report' COM (2023) 650 final.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

target for 2030 is to increase biomethane production by 50 % (up to 35 bcm of biomethane).[33]

Biofuels are considered in the specific transport targets under Article 25 of the Renewable Energy Directive, with the limitation that at least 1 % of the supplier fuel obligation needs to consist of RFNBO. The current focus is on advanced biofuels from feedstock listed in Part A of Annex IX of the Directive. These are non-food resources, like biowaste[34], biomass fractions of waste and residues from forestry and forest-based industries, or certain biomass fractions of mixed municipal waste. Under Article 25 of the Directive, Member States are also encouraged to set differentiated targets for advanced biofuels and biogas and RFNBO.

Importantly for national incentivisation schemes, and the demand of biofuels, Article 27 of the Renewable Energy Directive, which provides for the calculation rules for the minimum share of sustainable fuels in the transport sector, provides that the share of biofuels and biogas are considered to be twice its energy content.

For biomass, the Directive introduces stricter criteria on the use of biomass to ensure that the EU does not subsidise unsustainable practices. It provides that:

In line with the cascading principle, woody biomass should be used according to its highest economic and environmental added value in the following order of priorities: 1) wood-based products; 2) extending their service life; 3) re-use; 4) recycling; 5) bio-energy; and 6) disposal.[35] Member States' support schemes for bioenergy should therefore be directed towards such feedstocks for which little market competition exists with the

33 European Commission, 'REPowerEU' (n 1) 8. RED III (n 3) refers, in recital 9, to the achievement of the Union's target of an annual production of sustainable biomethane of 35 billion cubic meters by 2030, as set out in the Commission staff working document of 18 May 2022 accompanying the REPowerEU Plan, entitled 'Implementing the Repower EU Action Plan: Investment needs, hydrogen accelerator and achieving the bio-methane targets'.

34 Under point (4) of Article 3 of Directive 2008/98/EC, biowaste means 'biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants'. Such biowaste from private households can be used as feedstock for advanced biofuels where they are subject to separate collection prior to the transport to a waste treatment facility.

35 RED III (n 3), preamble 4 and Article 3(3).

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

material sectors, and whose sourcing is considered positive for both climate and biodiversity.[36]

Member States are allowed to derogate from the cascading principle in duly justified circumstances, for example where required for security of energy supply purposes, such as in the case of particularly severe cold conditions. Member States are also allowed to derogate from the cascading principle where there are no industries or processing facilities that could make a higher added value use of certain feedstocks within a geographical perimeter.[37] These feedstocks are:

(a) necessary forest management activities, aiming at ensuring precommercial thinning operations or in compliance with national legislation on wildfire prevention in high-risk areas;
(b) salvage logging following documented natural disturbances; or
(c) harvest of certain woods whose characteristics are not suitable for local processing facilities.[38]

For processes that result in biomass being processed with fossil fuels in a common process, Article 28(5) of the Renewable Energy Directive empowers the Commission to adopt delegated acts specifying the methodology to determine the share of biofuel, and biogas for transport in this connection.

D. Discussion – Future Uncertainties

The general trend with the 2023 Directive is increasingly ambitious targets covering more and more sectors, but the possibility of giving the Member States the option to reduce their RFNBO share in the industry by 20 % is of importance as this allows for incorporating other types of low-carbon hydrogen such as blue, pink as well as orange. With this change, it is possible that Member States taking the advantage of the target reduction for RFNBO, would provide support for other types of low-carbon hydrogen. The clear advantage of this would be that it would better consider national circumstances. It would also alleviate the issue with the amounts of renew-

36 RED III (n 3), preamble 4.
37 RED III (n 3), preamble 4.
38 RED III (n 3), Article 3(3).

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

able electricity discussed above. For these low-carbon hydrogen options, the 70 % GHG emissions saving applies.[39]

In addition, an adjustment mechanism for the methodology identifying when electricity used for producing RFNBO can be considered fully renewable has been introduced. In this respect, the 2023 Directive incorporates the RFNBO delegated act rules on additionality, temporal correlation, and geographic correlation for RFNBO production, but further includes a possibility to revisit the methodology for defining RFNBO. By 1 July 2028, the Commission should assess the impact of the methodology defining when electricity used for producing RFNBO can be considered fully renewable. This report would need to assess in particular their impact on the availability and affordability of RFNBO for industry and transport and on the ability of the EU to achieve its RFNBO targets taking into account the EU strategy for imported and domestic hydrogen while minimising the increase in GHG emissions in the electricity sector and the overall energy system. If these objectives are not met and the EU targets for RFNBO for 2030 are not going to be met, then the Commission should review the EU methodology and, where appropriate, adopt a delegated act to modify such methodology to provide the necessary adjustments to the criteria in order to facilitate the ramp-up of the hydrogen industry.[40] These changes, and potential future changes, can create scope for policy adjustments that could work to reduce the challenges in meeting renewable electricity demands in the future.

The Strategy was adopted in 2020 – not too many years ago – and legislative action has since been taken to further the objectives as set out in the Strategy. This policy framework is already being adapted.[41] While the scope of the Strategy was very wide, covering many sectors such as household heating and road transport, the current legislative tools signal more targeted action, focusing on the hard-to-abate sectors such as transport – aviation and maritime – as well as industry. Some sectors, that were perhaps initially envisaged to be powered or fueled by hydrogen under the

39 For a discussion on other types of hydrogen within the EU framework, see Kim Talus/Francisca Gallegos/Jaqueline Pinto, 'Realism at the end of the rainbow? An argument towards diversifying hydrogen in EU regulation' (2024)17/4 Journal of World Energy Law and Business 217.

40 RED III (n 3), preamble 34a and Article 27(6).

41 For example, Germany revised its national hydrogen strategy in 2023, French revised strategy is expected in 2023 and RED III creates the potential for further amendments over the next years.

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

Strategy, are moving away from hydrogen as direct electrification is (still) considered the priority mechanism for decarbonization for various reasons, the most important of which are cost and efficiency. Similarly, while the initial focus seemed to be only on RFNBO, the current developments at the legislative level indicate a more flexible approach towards low-carbon hydrogen, as its role as a transition fuel – at least – has been acknowledged.

This lack of coherence between the overarching policy level and legislative level, due to many uncertainties and open questions, is natural and to be expected, but at the same time unfortunate as it reduces certainty about the desired end result. As the objective is the rapid creation of a hydrogen market, rapid deployment of capital for investments is a key consideration. While there is still uncertainty at the policy level, legislative action has also commenced. Both Member States and the EU are already regulating the future hydrogen market. Because of the uncertainties at the level of policy, it is likely that this detailed regulatory framework will be amended in the future. While understandable from the viewpoint of the regulation of new technologies and markets, this uncertainty nevertheless will have implications for the speed of investments within the EU.

The 2023 Directive extends the RFNBO rules to new sectors and sets new demand-side targets. At the same time, an important change which it brings about, contrary to the 2018 Directive, is that while the RFNBO sub-targets contribute towards the overall renewable energy targets, the renewable electricity used to produce RFNBO will not be counted.

When calculating the share of renewable energy in a Member State, RFNBO should be counted in the sector where they are consumed (electricity, heating and cooling, or transport). To avoid double-counting, the renewable electricity used to produce those fuels should not be counted. This will have the benefit of allowing the real energy consumed to be counted, taking account of energy losses in the process to produce those fuels. It also allows RFNBO imported into and consumed in the EU to be counted.[42] At the same time, this change will have trade implications between Member States, as those states that plan to import hydrogen will have the energy in imported hydrogen counted (Germany for instance), whereas those states that plan to export hydrogen cannot count the renewable electricity used to produce hydrogen towards their national targets (Finland for instance).

42 RED III (n 3), preamble 12, Article 7. For RFNBO imports, see Talus/Gallegos/Pinto (n 39).

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -

This aggravates the renewable electricity problem for hydrogen-exporting Member States.

Bibliography

Council of the European Union, 'Renewable energy: Council adopts new rules' <https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/renewable-energy-council-adopts-new-rules/> accessed 26 August 2024

Council of the European Union, press release, 'Council and Parliament reach provisional deal on renewable energy directive' <https://www.consilium.europa.eu/en/press/press-releases/2023/03/30/council-and-parliament-reach-provisional-deal-on-renewable-energy-directive/> accessed 26 August 2024

Council of the European Union, 'RefuelEU aviation initiative: Council adopts new law to decarbonise the aviation sector' <https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/refueleu-aviation-initiative-council-adopts-new-law-to-decarbonise-the-aviation-sector/> accessed 26 August 2024

European Commission, Communication 'REPowerEU Plan' COM (2022) 230 final

European Commission, 'Q&A implementation of hydrogen delegated acts' <https://energy.ec.europa.eu/document/download/21fb4725-7b32-4264-9f36-96cd54cff148_en?filename=2024%2003%2014%20Document%20on%20Certification.pdf> accessed 26 August 2024

European Commission, 'Questions and Answers on the EU Delegated Acts on Renewable Hydrogen' <https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_595> accessed 26 August 2024

European Commission, 'Union Bioenergy Sustainability Report' COM (2023) 650 final

European Council, 'How is EU electricity produced and sold?' <https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/> accessed 26 August 2024

European Commission, 'Renewable hydrogen' <https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/hydrogen-delegated-acts_en> accessed 26 August 2024

Graves C/Ebbesen S D/Mogensen M/Lackner K S, 'Sustainable hydrocarbon fuels by recycling CO2 and H2O with renewable or nuclear energy' 15/1 (2011) Renewable and Sustainable Energy Reviews 1

Irena, 'Green hydrogen – A guide to policy making' (2020) <https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Nov/IRENA_Green_hydrogen_policy_2020.pdf> accessed 26 August 2024

Talus K/Maddahi R, 'Carbon Capture and Utilization Under EU Law; Impermanent Storage of CO2 in Products and Pre-combustion Carbon Capture' (2024) 00 Journal of World Energy Law and Business 1

Talus K/Gallegos F/Pinto J, 'Realism at the end of the rainbow? An argument towards diversifying hydrogen in EU regulation' (2024)17/4 Journal of World Energy Law and Business 217

https://doi.org/10.5771/9783748962601-71 - am 21.12.2025, 23:15:45. https://www.inlibra.com/de/agb - Open Access -