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EU REQUIREMENTS FOR RENEWABLE HYDROGEN AND ITS DERIVATIVES

Analysis of the two delegated acts adopted by the European Commission in February 2023 specifying the conditions under which electricity used to produce renewable fuels of non-biological origin (RFNBO) may be counted as fully renewable & the methodology to assess the greenhouse gas emissions savings from RFNBO

IMPRINT

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Berlin, 17th April 2023 (updated 29th September 2023)

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ABBREVIATIONS

CBAM	EU Carbon Boarder Adjustment Mechanism
CDR	Commission Delegated Regulation
DA	Delegated act(s)
EP	European Parliament
ETS	EU Emission Trading Scheme
GHG	Greenhouse Gases
ITRE	Committee on Industry, Research and Energy of the European Parliament
MEP	Member of the European Parliament
MJ	Megajoule
PPA	Power purchase agreement
PtX	Power-to-X
RCF	Recycled carbon fuels
RED (I – II – III)	EU Renewable Energy Directive (1st version of 2009, 2nd of 2018, and 3rd likely to be adopted in 2023)
RES	Renewable energy sources
RES-e	Electricity generated from renewable energy sources
RFNBO	Renewable (liquid and gaseous transport) fuels of non-biological origin (with different definitions in RED II and RED III, as explained in the text)

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1 INTRODUCTION

This briefing analyses the contents of the two Commission Delegate Regulations (CDR, also known as delegated acts) adopted by the European Commission on 10 February 2023 and entered in force in June 2023: CDR 2023/1184 contains detailed rules on the conditions under which electricity used to produce hydrogen may be counted as fully renewable according to European Union (EU) law; CDR 2023/1185specifies a methodology to assess the greenhouse gas (GHG) emissions savings from renewable fuels based on hydrogen (so called renewable fuels of non-biological origin, RFNBOs) and for recycled carbon fuels (RCFs).

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Relevance of these delegated acts for Power-to-X markets outside the EU

Besides their direct applicability on activities inside the EU, the two CDR are likely to have a wider impact on the emerging global markets for PtX products. This is for three main reasons:

- First, their requirements will be applicable for producers inside and outside the EU, if products used in the EU market should benefit from being counted towards achieving the recently increased EU renewable energy targets. This benefit includes access to renewable support schemes or public procurement rules, and greater chances of being considered under voluntary renewable energy and decarbonization commitment schemes by companies (e.g., steel makers, airlines).
- Second, the EU has often been a trendsetter in environmental and climate standards and regulations. As the EU is the first actor to adopt comprehensive and detailed regulations in this field, it is conceivable that the rules described in this briefing might influence standards in other parts of the world.
- Third, the long-awaited adoption of these two CDR will prompt certification schemes (so called voluntary schemes) to be recognized for the EU criteria and therefore kickstart official certification of hydrogen/RFNBOs under these criteria, which might benefit markets players and regulators also outside the EU.

Structure of this briefing

This briefing consists of three chapters:

- A concise, yet updated and precise introduction to the legal and policy background of the two CDR, looking both at their immediate legal basis (RED II of 2018,) and at very recent developments of EU legislation (adoption of RED III) that will or are likely to impact the frame for the application, and possibly the further development, of these two delegated acts.
- An analysis of the delegated act CDR 2023/1184, pursuant to Article 27(3) of RED II, which specifies the conditions under which electricity used to produce RFNBO may be counted as fully renewable.
- An analysis of the delegated act CDR 2023/1185, pursuant to Articles 25 (2) and 28(5) of RED II, which, among other provisions, sets the methodology to assess the GHG emissions savings from RFNBOs.

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Key legal sources

This briefing largely consists of an analysis of the following documents:

Short Name:	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
URL:	At this page, you can find a complete version of RED II in HTML as well as in PDF format, in each of the 24 official languages of the European Union: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG
Short Name:	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.
URL:	https://eur-lex.europa.eu/eli/reg_del/2023/1184/oj At this URL, the document is available in all 24 official languages of the European Union.
Short Name:	CDR 2023/1184, 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.
URL:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1185. At this URL, the document is available in all 24 official languages of the European Union.

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2 LEGAL AND POLICY BACKGROUND

The two Commission Delegated Regulations (CDRs) analyzed in this briefing have been adopted in February 2023, as delegated acts pursuant to the version of the EU Renewable Energy Directive that was adopted in 2018 and is currently in force (RED II). The two CDRs entered in force in June 2023, just few months before the EU legislators will finally adopt a comprehensive overhaul of this Directive (RED III). On its turn, RED III will trigger a future revision of at least some of the provisions of these CDR. This chapter provides background information on this intricate situation.

We first look at the structure of the basic legal acts underlying the two CDRs; then we look at their provisions concerning targets, with a special attention to the specific targets most relevant for the deployment of renewable hydrogen and PtX products, e.g., the RFNBO targets; then we shortly explain the concepts of RFNBO and of delegated acts in the EU; finally, we discuss the context for possible future revisions of the two delegated acts.

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The EU Renewable Energy Directive: RED I, RED II and RED III

The EU Renewable Energy Directive (RED) is the legal framework for promoting the deployment of renewable energy sources (RES) across all sectors of the EU economy. The first RED (RED I) was adopted by the EU in 2009. Among many other provisions, it set a target of 20% renewables share on the total final EU energy consumption by 2020, which the EU overachieved.

RED I was replaced by a **second version** (**RED II**), which was adopted in 2018 and is currently in force. In the legislative process, Directives are proposed by the European Commission (EC), then amended and finally adopted by the two legislators, the European Parliament (EP) and the European Council, where the Member States are represented.
After a long negotiation among the two legislators, on **12 September 2023** the EP adopted a text of the **third version** (**RED III**), which had been previously informally agreed upon by the Council. It can be assumed that this text will be adopted by the end of 2023 and enter in force shortly afterwards[1].

EU Directives are not directly applicable: they **must** first **be transposed into national legislation**. For RED III, the Member States will have to do so within 18 months after the date of entry to in force of RED III

This means that, while RED III is likely to enter into force in December 2023 or January 2024, its provisions will become fully applicable in the individual Member States only after they will have transposed RED III into national law, which will probably be in June/July 2025. Until then, all detailed provisions of RED II will still be fully applicable, including the two CDR analysed in this briefing.

Overall and sectorial renewable energy targets

With the RED III, the EU has strongly **increased its renewable energy target for 2030,** from 32% (as agreed in 2018 in the RED II) to 42.5% of the EU's overall energy consumption, with an additional 2.5% indicative top up that would increase the target to 45%. Except for the addition of osmotic energy, the general definition of what is considered as energy from renewable sources has not changed[2].

Besides this overall target, RED III also strongly increases and modifies the rules concerning **sector targets**, which include specific targets for (hydrogen based) **renewable fuels of non-biological origin (RFNBO)**.

Subtargets for the transport sector

With the RED III, the 2030 binding subtarget for the transport sector **increases from at least 14%** (as foreseen in RED II) **to at least 29%** of renewables within the final consumption of energy in the transport sector by 2030. Alternatively, Member States may choose to set a binding target of 14.5% reduction of the transport sector's GHG intensity by using renewables.
Additionally to these two general options for the transport sector target, RED III sets a **minimum requirement of 1% of RFNBO** in the share of

[1] The analysis in this briefing is based on the final text approved by the European Parliament on 12 September 2023, which is available here: https://www.europarl.europa.eu/doceo/document/TA-9-2023-0303_EN.html#title2 Previously, the identical legal text had been formally endorsed (see: https://www.consilium.europa.eu/media/65109/st10794-en23.pdf) by COREPER, which is the Council's main preparatory body and consists of the member states' permanent representatives to the EU. It is extremely seldom, but formally not precluded, that the Council changes its mind after COREPER has adopted a text. If such a change of mind does not happen, the text approved by the EP in September 2023 will enter in force, pending the correction of potential technical or legal mistakes.

[2] According to Art 2 RED III: "…*'energy from renewable sources' or 'renewable energy' means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, osmotic energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas*". Osmotic energy is defined as "energy created from the difference in salt concentration between two fluids, such as fresh water and salt water". The proposal by some EU Member States to include nuclear energy in this list encountered strong opposition from other EU Member States and was finally rejected. On the other hand, nuclear energy might contribute to achieve one of the conditions necessary for electricity used to produce RFNBO to be counted as fully renewable, though this is into likely to play a major role in practice. More on this in Chapter 3 of this paper.

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renewable energies supplied to the transport sector in 2030, as well as a minimum requirement of 5.5% for the sum of biofuels and RFNBOs. The latter means that, in case of a low availability and/or competitiveness of biofuels complying with the relevant EU sustainability criteria, the share of RFNBO in the transport sector might need to be higher than 1%.

The clause that allows Member States to fulfil the transport sector target with recycled carbon fuels as well remains unchanged in RED III.[3]

Subtargets for the industry sector

Moreover, article 22a of RED III introduces for the first time a specific renewable energy target for the industry sector, expressed as an indicative increase of at least 1,6 % as an annual average calculated for the periods 2021 to 2025 and 2026 to 2030. In addition, RED III sets a binding target, according to which at least **42% of the hydrogen used in industry should come from RFNBO by 2030**, and 60% by 2035. A derogation (20% less) is foreseen for Member States that fulfil two conditions: First, they must meet their expected contribution to the overall EU renewables target; second, the share of hydrogen from fossil fuels consumed (in all sectors) may not be more than 23% in 2030 and 20% in 2035.

What are RFNBO and why this concept was introduced

In short, RFNBO means **renewable fuels of non-biological origin**. In other words, RFNBO can be seen as a subpart of **Power-to-X (PtX)** products, with two additional requirements: first, the electricity must fulfil the criteria for renewable energy according to EU law; second, the RFNBO must meet a certain GHG emissions reduction threshold. Also, RFNBO must be by definition fuels, whereas the PtX concept also includes power-based feedstock. These requirements are discussed in detail in the following chapters of this briefing.

The RFNBO concept was first introduced in the RED II, according to which the EU Member States can reach the transport sector subtarget either with biofuels and biogas or with RFNBO. The rationale for setting a specific subtarget for the transport sector was that, while renewables deployment was rapidly progressing in the electricity and, to a lesser extent, in the heating sector, at that time there had been very little progress in the transport sector. In 2009, the costs of green hydrogen were still prohibitively high. However, when RED II was adopted in 2018, the massive cost reductions of wind and solar power made a wide use of green hydrogen seem potentially viable in the foreseeable future. Thus, the **rationale for introducing the RFNBO concept** was that the EU needed a legal concept for (at that time only transport) fuels of non-biological origin that fulfil the EU renewable energy targets.
However, as seen above, RED III introduces specific renewable energy targets also for the industrial sector, which can be fulfilled using RFNBO. Therefore, in RED III RFNBO count regardless of the sector in which they are consumed. Accordingly, Article 2 of RED III establishes a new definition of the RFNBO concept, without the word transport: " '*renewable fuels of non-biological origin' means liquid and gaseous fuels the energy content of which is derived from renewable sources other than biomass*".

What are "Delegated Acts" and how are they applied?

What are "delegated acts" and Commission Delegated Regulations (CDR)?

Although both legal acts analysed in this briefing are commonly called "delegated acts", their formal denomination is "***Commission Delegated Regulation***". According to EU law[4], Regulations are binding in their entirety and - unlike Directives - are **directly applicable in all EU countries**. While ordinary Regulations are jointly adopted by the EU's main legislators (European Parliament and European Council), Delegated Regulations are adopted by the European Commission, if it has been given the mandate to do so by the two main legislators in a legislative act.

[3] Recycled carbon fuels (RCF) are defined by RED II as *"liquid and gaseous fuels that are produced from liquid or solid waste streams of non-renewable origin which are not suitable for material recovery (…), or from waste processing gas ad exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of the production process in industrial installations".* In other words, RCF can be for instance synthetic fuels produced with CO_2 captured from fossil-based industrial processes.

[4] For an official overview of all existing EU legal instruments, see: https://eur-lex.europa.eu/EN/legal-content/glossary/eu-legal-instruments.html.

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The RED II mandate to the European Commission to adopt these delegated acts

In RED II, this was the case among others for the two delegated acts discussed in this briefing. Specifically, article 27 (3) of RED II shortly defines general rules on the conditions under which electricity used to produce RFNBO may be counted as fully renewable. It contains a mandate to the European Commission to adopt a delegated act establishing a methodology setting out more detailed rules on this topic. Additionally, articles 25(2) and 28(5) of RED II set further general rules for renewable energy in the transport sector. They include a mandate to the European Commission to adopt a delegated act specifying the methodology for assessing GHG savings from RFNBOs and from recycled carbon fuels.

Will the provisions of these CDR be changed?

According to RED III, the European Commission must submit a report to the Parliament and the Council by 1 July 2028, assessing the impact of the methodology defining when electricity used for producing RFNBO can be considered to be fully renewable, e.g., the contents of CDR 2023/1184, which is described in detail in the next chapter of this paper. For the case that the report concludes that there is a need for revision RED III gives the Commission the mandate to adopt a new delegated act amending CDR 2023/1184.

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3 CONDITIONS FOR COUNTING ELECTRICITY FOR RFNBO PRODUCTION AS FULLY RENEWABLE

The delegated act CDR 2023/1184, pursuant to Art. 27(3) RED II, defines two general options under which electricity supplied to the installation producing RFNBOs (RFNBO plant) may be counted as fully renewable. The first one is a direct connection between the installation generating renewable electricity (RES-e plant) and the RFNBO plant. In the second option, the RFNBO plant uses electricity from the grid.

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General

- The provisions in CDR 2023/1184 explicitly **apply both to domestic and imported RFNBO**.
- The underlying assumption is that electrolysis will be the main technology used to produce hydrogen. The rules concerning electricity supply set by the CDR 2023/1184, however, also hold for other less common technologies that have electricity as a major input.

The CDR 2023/1184 defines **two general options** under which electricity supplied to the installation producing RFNBOs (RFNBO plant) may be counted as fully renewable. The first one is a **direct connection** between the installation generating renewable electricity (RES-e plant) and the RFNBO plant. In the second option, the RFNBO plant uses **electricity from the grid**.
For both Option I and Option II, CDR 2023/1184 sets very detailed rules. Their main rationales are the intention to minimize GHG emissions associated with the additional electricity demand caused by the RFNBO production and to limit additional stress to the electricity grid. CDR 2023/1184 is based on three underlying principles:

1. The **principle of additionality** should incentivize the deployment of additional and new renewable electricity generation capacity, thus avoiding the risk that renewable electricity used to produce RFNBO is no longer available for other uses.
2. The **principle of temporal correlation** should incentivize RFNBO production to take place at times when it supports the integration of RES-E production into the electricity system, thus reducing the risk that RFNBO production triggers additional fossil-based electricity generation.
3. The **principle of geographical correlation** should incentivize RFNBO production to take place in grid areas with high RES-E shares and/or low carbon emissions, thus limiting the risk that RFNBO production causes additional stress to the electricity grid.

The following diagram shows the overall structure of CDR 2023/1184 and the options it defines. The options and requirements are described in detail in the following sections.

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Under which conditions may electricity used to produce RFNBO counted as fully renewable?

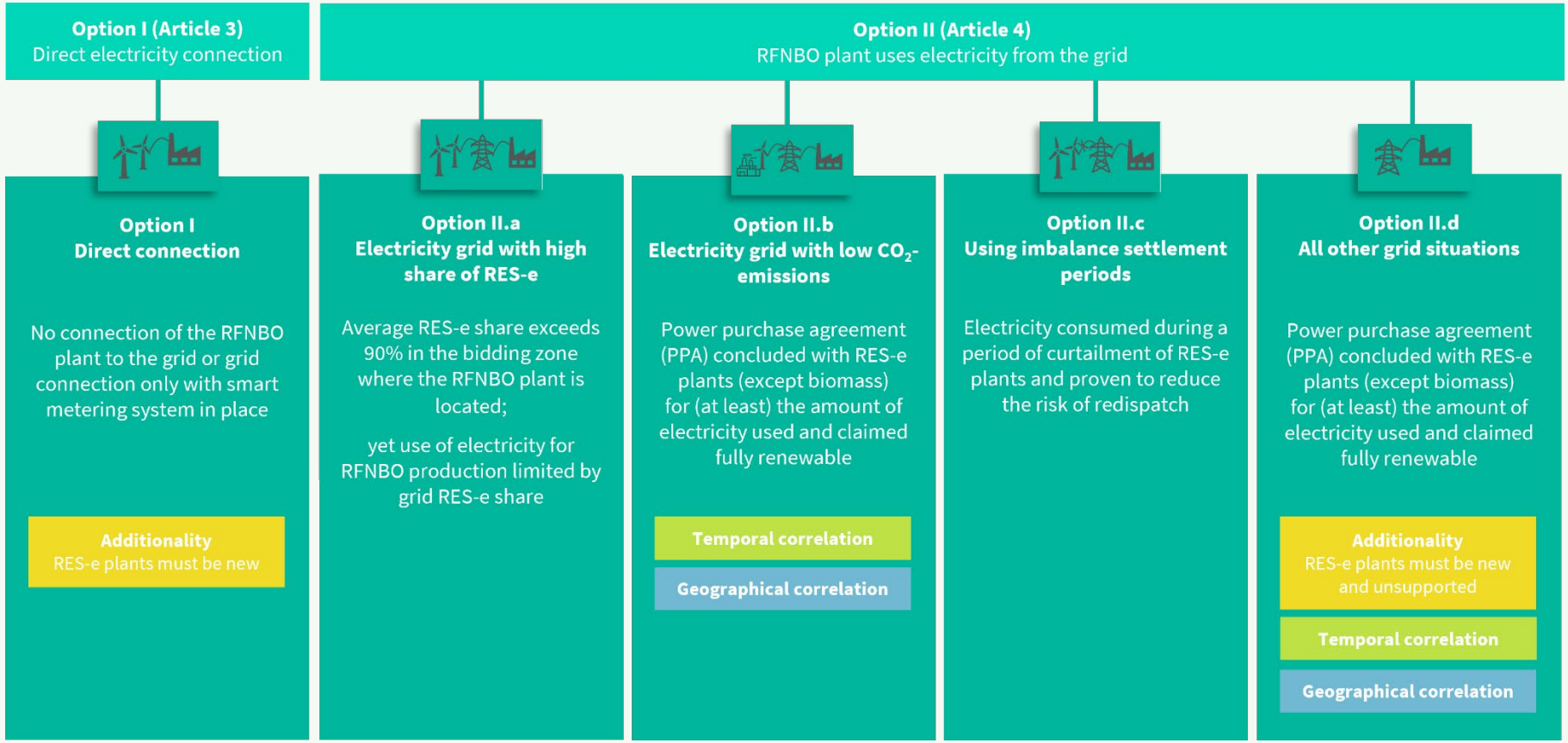

Figure 1. Source: Own illustration

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Option I: Direct connection

A direct connection between the RES-e plant and the RFNBO plant is considered a reliable option to provide evidence that renewable electricity is being used. For this option to be valid, each of the following **three requirements** must be complied with:

1. There has to be a direct connection between the RES-e plant and the RFNBO plant. This can be a direct electricity line or, alternatively, generation of electricity and RFNBO production takes place within the same installation (for example if an electrolyser is located directly at a wind farm).
2. The RES-e plants need to be new, meaning that they came into operation at the earliest 36 months before the RFNBO plant came into operation.
3. Either the RES-e plant is not connected to the grid, or if it is connected, a smart metering system has to prove that no electricity has been taken from the grid to produce RFNBOs.

Option II: Grid connection

As shown in the chart above, there are **four general options for counting electricity taken from the electricity grid as fully renewable.**

II.a The RFNBO plant uses electricity from a grid with a high share of RES-e. This is considered to be the case if the RFNBO production takes place in a bidding zone[5] with an average RES-e share above 90%.

II.b The RFNBO plant uses electricity from a grid with low CO_2 emissions. This is considered to be the case if the RFNBO production takes place in a bidding zone with average emissions intensity of electricity below 18gCO_{2eq}/MJ.

II.c The RFNBO plant uses electricity from a grid during an imbalance settlement period[6]. This option is only applicable if specific conditions are met during this period (curtailment of RES-e plants). The aim is to use electricity from RES-e that would have been lost otherwise.

II.d If the three options above do not apply, further requirements are set to count electricity taken from a grid (with no specific qualities) as fully renewable.

In the following, further details about each of these four options are explained.

Option IIa: Electricity grid with high share of RES-e

In this option, RFNBO production takes place in a bidding zone with an average RES-e share above 90%. To count the electricity used to produce RFNBOs as fully renewable, both of the following requirements must be fulfilled:

1. The average RES-e share must exceed 90%. This share has to be documented for the previous calendar year in the bidding zone where the RFNBO production takes place. Once the share exceeds 90% in one calendar year, it is assumed that it also exceeds 90% for the next five calendar years. Detailed rules on how to calculate the RES-e share can be found in Article 4(1) of CDR 2023/1184.
2. The maximum number of hours of RFNBO production is limited in proportion to the RES-e share within the bidding zone. The number of hours eligible for RFNBO production is calculated by multiplying the total number of hours per calendar year during which the RES-e share exceeds 90% by 8760 (= number of hours per calendar year). This should incentivize a reduction of RFNBO production during times of low RES-e shares.

Option IIb: Electricity grid with low CO_2-emissions

In this option, RFNBO production takes place in a bidding zone with average emissions intensity of electricity below 18gCO_{2eq}/MJ. To count the electricity used to produce RFNBOs as fully renewable, all of the following four requirements must be fulfilled:

[5] 'Bidding zone' according to the EC means the largest geographical area within which power market participants are able to exchange energy without capacity allocation (equivalent concepts can be applied for countries outside the EU). In the EU, some countries have one bidding zone, while others have several.

[6] 'Imbalance settlement period' is defined as the time unit for which an imbalance of the balance responsible parties is calculated. This is the case for example if electricity supply and demand cannot be balanced via the electricity grid. For third countries, an equivalent concept may be applied.

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1. The production of RFNBOs is located in a bidding zone where emission intensity of electricity is lower than 18gCO_{2eq}/MJ.[7] This is to ensure that RFNBO-production is associated with relatively low GHG emissions. Once the emission intensity of electricity is proven to be lower than this threshold in one calendar year, it is assumed that it is below this value for the next five calendar years as well. Detail rules on how to calculate the RES-e share can be found in article 4(2)(b) of CDR 2023/1184.
2. Fuel producers must conclude power purchase agreements (PPAs) with RES-e plants. The amount covered by those PPAs has to be at least equivalent to the amount used for RFNBO production that is claimed to be fully renewable. In this case, the RES-e plants do not need to be new or unsupported (in contrast to "additional renewable electricity generation" in Option IId below).
3. Temporal correlation has to be proven, please see below section "*Temporal correlation*"
4. Geographical correlation has to be proven, please see below section "*Geographical correlation*"

Option IIc: Using imbalance settlement periods

In this option, electricity sourced to produce RFNBO is consumed during an imbalance settlement period (curtailment of installations generating renewable electricity) [8]. To count the electricity used to produce RFNBOs as fully renewable, the producer of RFNBOs has to show evidence from the transmission system operator that both following requirements are fulfilled:

1. The electricity consumed to produce RFNBOs is consumed during a time period in which RES-e plants had to deviate from their planned production schedule and deliberately reduce electricity output due to grid bottlenecks (curtailment).
2. The electricity consumed to produce RFNBOs reduces the need for redispatch by the corresponding amount.

Option IId: All other grip options

If the three options above (IIa to IIc) do not apply, electricity from the grid may be counted as fully renewables, if requirements on additionality, temporal and geographical correlation are met. Electricity consumption from the grid may be counted as fully renewable, if all of the three following conditions on additionality, temporal correlation and geographic correlation are met.

[7] This clause has been criticised or welcomed, depending on the point of view, for paving the way for nuclear-based electrolysis to fulfil the criteria for renewable based hydrogen. However, it should be noted that the other three conditions above must be met, including concluding a PPA with RES-e plants. Moreover, in the RED III, the definition of RES will not include nuclear (see footnote 4 above). In the EU in 2020, this value was met only by Sweden (4.1 CO_{2eq}/MJ), which has a very high combined share of renewables and nuclear. The only other EU country close to this benchmark was France (19.6 CO_{2eq}/MJ). These values are provided in Table A in the Annex to the CDR 2023/1185 discussed in the next chapter of this briefing.

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Addtionality

To comply with the additionality condition, each of the **three following requirements** must be fulfilled:

1. RFNBO producers must conclude power purchase agreements (PPAs) with RES-e plant operators. The amount of electricity covered by those PPAs has to be at least equivalent to the amount used for RFNBO production that is claimed to be fully renewable.
2. The RES-e plants have to be 'new'. This means they came into operation no earlier than 36 months before the RFNBO plant. RES-e plants are also considered to be 'new' if they have ended a PPA with a RFNBO producer before entering into a new PPA. In case additional capacity is added to the RES-e plant up to 36 months after its initial deployment, they are assigned the same date of initial deployment. This means that the added capacity is considered to have come into operation at the same time as the initial installation.
3. The RES-e plant has not received operating or investment support. Excluded from this rule is support received before a repowering, support for grid connection, support that is fully repaid or support received in the context of research, testing and demonstration of RFNBOs production.

Transition phase: In case the RFNBO plant comes into operation before 1 January 2028, the requirements 2 and 3 described in this section do not apply until 1 January 2038.

Temporal correlation

To comply with the temporal correlation condition, it is sufficient to meet **one of the following requirements**.

1. The production of RFNBOs takes place during the same time period as renewable electricity is produced in the RES-e plants contracted by the PPAs. Another option is the use of electricity from new electricity storage assets that are connected to the same electricity-grid connection point as the RFNBO plant or RES-e plant. However, the storage must be charged during the same time period in which the electricity contracted by the PPA is produced.
   The definition of the 'time period' gets stricter over time:
   - Until 31 December 2029 the 'time period' is defined as the 'same calendar month'.
   - From 1 January 2030 the 'time period' is defined as the 'same hour'.
2. The production of RFNBOs takes place during a one-hour period when the day-ahead price of the bidding zone where RFNBO production takes place is
   a. below 20€/MWh,
   b. or lower than 0.36 times the price of an EU ETS emission allowance, corresponding to the right of emitting one ton of $CO_{2\,eq}$.

Geographical correlation

To comply with the geographical correlation condition, **one of the following requirements** must be met:

1. The RFNBO plant and the RES-e plants contracted by the PPA are located in the same bidding zone.
2. The RFNBO plant and the RES-e plants contracted by the PPA are located in interconnected bidding zones. Interconnected means that there is an electricity-grid connection between the bidding zones. However, this option can only be applied in time periods (monthly or hourly, see above 'temporal correlation') when the following condition applies: The electricity price on the day-ahead market in the RES-e plant's bidding zone is equal or higher than the electricity price on the day-ahead market in the RFNBO plant's bidding zone.
3. RES-e plants contracted by the PPA are located in an offshore bidding zone that is interconnected to the bidding zone where the RFNBO production takes place.

EU Member States may introduce additional criteria on geographical correlation valid on their territory.

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Open issues for hydrogen and RFNBO production in non-EU countries

Article 1 of the CDR 2023/1184 states that the rules shall apply, regardless of whether the RFNBO is produced inside or outside the EU.

However, some of the rules are based on the EU regulatory framework and very specific to the EU context. The compliance with them might be difficult to demonstrate when producing RFNBO outside the EU. The **following paragraphs** show the **main issues that might become a hurdle for third countries**. The EU has not yet established an official procedure on how to deal with them, which will be object of future discussions. Evolving certification systems for RFNBO production might play a major role for proof of compliance and need to further define those open issues.

Reference to the EU Emissions Trading System

One of the options to comply with the temporal correlation requirement (see section "*Temporal correlation*") refers to the EU Emissions Trading System (ETS). In non-EU countries with no or fundamentally different emission trading schemes, this rule might not be directly appliable.

Reference to day-ahead electricity price

Some of the options refer to an electricity price on the day-ahead market. However, if the electricity system or the market structure in third countries does not include some form of day-ahead price, this option might not be applicable.

Definition of 'bidding zone'

A number of options and requirements within the CDR 2023/1184 refer to bidding zones. A bidding zone is defined as the largest geographical area within which market participants are able to exchange energy without capacity allocation. The third recital (the legally non-binding statements in the preamble of the legal document) of the CDR 2023/1184states:

"*Where reference is made to bidding zone and imbalance settlement period, concepts that exist in the Union but not in all other countries, it is appropriate to allow fuel producers in third countries to rely on equivalent concepts provided the objective of this Regulation is maintained and the provision is implemented based on the most similar concept existing in the third country concerned. In case of bidding zones such concept could be similar market regulations, the physical characteristics of the electricity grid, notably the level of interconnection or as a last resort the country.*"

Besides this, there currently is no further definition of what can be declared by whom as such an 'equivalent concept'.

Definition of 'imbalance settlement period'

Similarly, to the definition of the bidding zone, an equivalent concept for third countries might be applied. Again, it is not defined what can be declared as such an 'equivalent concept'. Also, it is yet to be defined which institution can attest this 'equivalent concept'.

Data availability

Sufficient and validated data needed to comply with the regulations might not be given in third countries. For example, data needs to be available to prove a grid share of above 90% or that RES-E plants have not received financial support. Again, certification systems might fill the gap and define which data needs to be documented.

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4 RULES FOR GHG ACCOUNTING OF RFNBO

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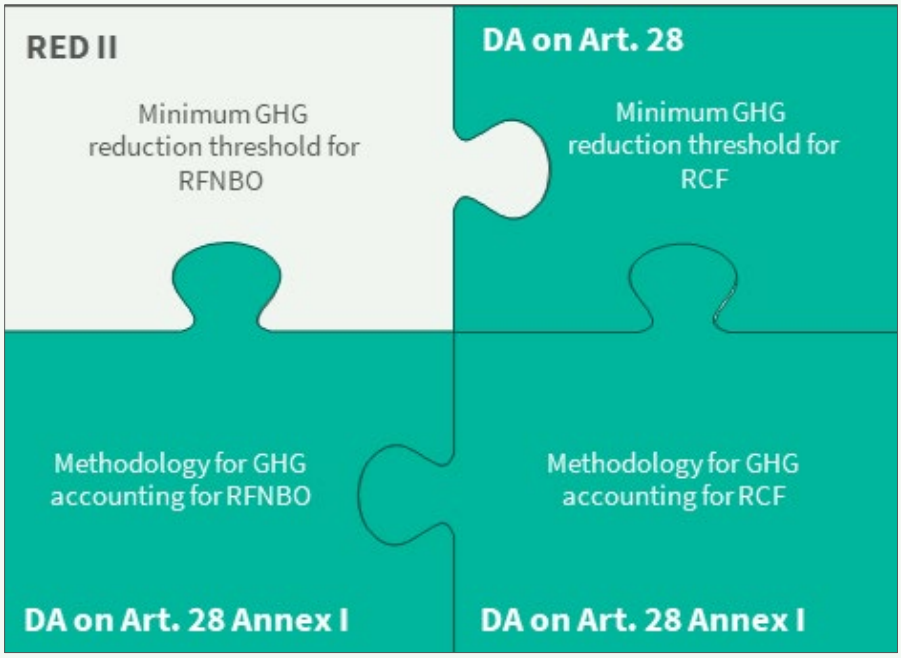
Both RED II and RED III define **a minimum GHG savings threshold of 70% for RFNBOs in relation to the fossil comparator of 94 gCO_{2eq}/MJ:**

- **This translates into a maximum GHG intensity threshold of 28.2 $gCO_{2\,eq}$/MJ or, based on the table "Energy content of fuels" (see Annex III RED II), into 3.38 $tCO_{2\,eq}$/ ton of hydrogen from renewable sources.**
- RFNBOs exceeding this threshold are not forbidden in the EU, but they will not count for the purpose of achieving the RES targets according to RED II and RED III.

Overall context of the delegated act CDR 2023/1185



- **RED II and RED III set for RFNBOs a minimum GHG savings threshold of 70%** in relation to the fossil comparator. This means that synthetic fuels that do not meet this threshold cannot be considered as of "renewables origin" according to EU law. However, RED II does not determine the methodology for GHG accounting for RFNBO.
- **The CDR 2023/1185 sets the rules for GHG accounting** for RFNBOs.
- The CDR 2023/1185 also sets a minimum GHG savings threshold of 70% for all types of RCFs and sets the rules for GHG accounting for RCFs; however, RCFs do not lie in the focus of this briefing and will only be mentioned where necessary for explaining the contents of the DA relevant for RFNBO.

Figure 2. Source: Own illustration

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The CDR 2023/1185 provides more detailed rules:

- **The methodology and rules for GHG accounting** for RFNBO:
  - Considers full life cycle emissions;
  - Considers three greenhouse gases: CO_2, N_2O and CH_4, the latter two are accounted as CO_2 equivalents according to RED II (§4 Annex V Part C);
  - Defines the methodology to avoid double-counting of emissions savings.
- The conditions under which the emissions of **captured CO_2 incorporated in a RFNBO** may be subtracted.
- **The rules for co-processing and co-production** with conventional fuels and biomass.
- **The default GHG emissions intensities** for common inputs (e.g., national grid electricity emissions intensity).

The Annex to the CDR 2023/1185 includes nearly all rules and definitions.

Overall methodology for GHG accounting

The emission savings of the RFNBO compared to the fossil fuel comparator (E_F) are calculated in the following manner:

$$Emission\ savings = \frac{E_F - E}{E_F} \geq 70\%$$

$E_F = 94\ gCO_{2\text{-}eq}/MJ$

To calculate the total emissions when producing RFNBO, the emissions of the whole value chain need to be accounted for using the following formula. Not accounted for are emissions from manufacturing of machinery and equipment.

$$E = e_i + e_p + e_{td} + e_u - e_{ccs}\ ,$$

Where:

- ei are emissions from inputs (rigid, elastic and emissions from inputs' existing use or fate),
- ep are emissions from processing,
- etd are emissions from transport and distribution,
- eu are emissions from utilization (combustion), and
- eccs are emissions savings from carbon capture and storage.

In the following, we discuss each element of this formula.

Emissions from inputs

Emissions from inputs are split into three parts:

$$e_i = e_{i,\,rigid} + e_{i,\,elastic} - e_{i,\,ex\ use}$$

Emissions from rigid inputs

Rigid inputs are inputs where "supply cannot be expanded to meet extra demand". If inputs are outputs from incorporated processes[9], they need to be produced in fixed ratios and make up less than 10 % of the economic value of the incorporated processes' outputs.

An example for a rigid input can be **flue gas**; per definition, **all carbon sources qualifying to produce RCF** are rigid (on the latter point, see below).

[9] Incorporated processes are defined as taking place in the same industrial complex, or supplying the input via a dedicated supply infrastructure, or supplying more than half of the energy of all inputs to the production of RFNBO.

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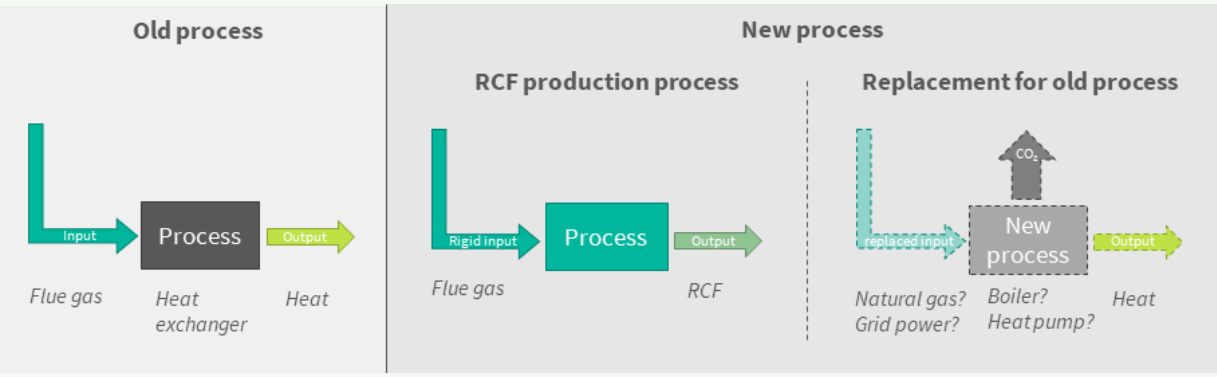
The calculation of the emissions intensity of rigid inputs must include:

- All emissions resulting from **diversion of feedstock from previous use**
- Emissions from **additional treatment and transport**
- Emissions from **lost production:** When a feedstock of a previous process (for example using heat from a flue gas stream) is diverted to be a rigid input for RFNBO or RCF

production, the emissions resulting from the replacement of the provided heat must be accounted as well. This can be calculated with standard emissions factors that are provided in the annex of the DA. However, the DA does not prescribe the method for determining the replacement process. Accounting for lost production is illustrated in the following figure:

Rigid inputs: lost production



On the left-hand side, the figure shows flue gas being led through a heat exchanger, providing heat to an end use application such as space heating; in the middle, it shows the flue gas being diverted to create fuel; on the right-hand side, the replacement process for the lost heat is depicted which needs to be taken into account for the GHG balancing of the fuel.

Figure 3. Source: Own illustration

Emissions from elastic inputs

Elastic inputs are inputs where "supply can be increased to meet extra demand", as well as inputs from incorporated processes that make up more than 10 % of the economic value of the incorporated processes' outputs, or where the ratio of the processes' outputs can be changed.

Examples for elastic inputs include hydrogen, electricity and petroleum products.

When calculating emissions, the data needs to be based on the actual production process and must include:

- Emissions from the **extraction of primary energy** required to make the input.
- Emissions from the **processing** and the **transportation** of the inputs.
- Not including emissions from the **combustion** of inputs (those are counted under e_p or e_u).

Emissions from non-incorporated processes can be assessed on the basis of Annex Part B of the CDR 2023/1185, on the basis of LCA databases or from peer-reviewed literature.

For the emissions associated with **electricity** used as input to produce RFNBO or RFC, the CDR 2023/1185 stipulates the following:

- Electricity **qualifying as renewable** according to article 27(3) RED II shall be accounted with **zero emissions.** The detailed rules to determine whether electricity qualifies as renewables are established by the CDR 2023/1184, analysed above.
- In all other cases, during each calendar year, one of the three following alternatives can be used.
    - **Grid emissions** at country level or, if data are publicly available, at the level of the bidding zone.
      The formula to calculate the grid emissions includes both emissions incurring in the power plants and upstream emissions. Part B of the CDR 2023/1185 contains a list of standard values for the GHG emission intensities of elastic inputs (including fossil fuels used for electricity generation), which indicates both combustion emissions and upstream emissions. Part C explains the methodology to be used to calculate grid emissions at the country or bidding zone level.
    - Alternatively, where „the **number of full load hours** of the installation producing RFNBO is equal or lower than the number of hours in which the **marginal price of electricity** was **set by** installations producing **renewable electricity or nuclear power plants** in the preceding calendar year" (own bolding of the text by the authors of this briefing), emissions can be counted as zero; if the installation producing RFNBO exceeds this number of full load hours, grid electricity used during these hours is attributed a standard value of 183 $gCO_{2\,eq.}$/MJ.
    - Alternatively, the GHG emissions value of the **marginal unit** generating electricity at the time of RFNBO production **in the relative bidding** zone, if this value is publicly available.

Emissions from inputs' existing use or fate

Emissions from inputs' existing use or fate are **emissions** "that are **avoided when carbon is used as input for fuel production"** (own bolding). They can be counted as avoided and **subtracted** from the emissions of the RFNBO only if the CO_2 was captured and incorporated into the fuel from one of the following carbon sources:

- CO_2 from **direct air capture**
- CO_2 from **biofuels/-liquids/-mass** if it complies with the sustainability and GHG saving criteria of RED II**.**
- **RFNBO** or **RCF** according to RED II.
- **Geological sources** where CO_2 was previously released naturally.
- **CO_2 from activities subject to** the **EU ETS** (Emission Trading Scheme), provided that:
    - It was subject to an **"effective carbon pricing scheme"**. This is by definition the case within the EU. Under which conditions carbon pricing schemes outside the EU can be considered as "effective" will likely be determined in the upcoming EU Carbon Boarder Adjustment Mechanism.
    - The CO_2 has been incorporated in the chemical composition of the fuel by the end of 2035 if it comes from **electricity generation,** or by the end of 2040 if it comes from **other processes**.

Emissions which are not considered avoided **may not be subtracted**. These include:

- All cases not explicitly mentioned above. The EU does not forbit specific carbon sources, however the rules above need to be followed.
- CO_2 from fuel deliberately combusted with the purpose of producing CO_2.
- CO_2 which "has received emissions credit under other provisions of the law".

The EU does not forbid the use of any particular CO_2 sources. However, in order to be able to count the product as RFNBO, the rules of this DA must be followed. For this purpose, it is necessary to meet the 70% minimum GHG reduction threshold and using CO_2 sources that may be counted as “avoided emission” makes an important contribution to meeting this threshold.

These rules are expected to be applied to future imports of synthetic fuels into the EU as well.

Emissions from processing

Processing describes the parts of the value chain where the fuel is produced, for example an electrolyser or a synthesis process. Emissions from processing include atmospheric emissions stemming directly from processing, emissions from waste treatment, from leakage and from storage operation associated with CCS (including transport of CO_2).

Emissions from transport and distribution

After processing, the finished fuel usually needs to be stored, transported and distributed. The associated emissions must be included in the accounting.

Emissions from utilisation

In the above formula, the term e_U means emissions from utilization, which in this case refers to the combustion of the RFNBO.

Emission reduction from carbon capture and storage

The CDR 2023/1185includes the possibility to subtract negative emissions. This only counts for carbon emissions that are permanently stored in accordance with Directive 2009/31/EC.

Time intervals

The calculation interval for GHG averaging is **one calendar month or less.** Where **electricity** qualifying as fully renewable according to RED II (as specified in detail in the CDR 2023/1184, see chapter above) is used as input, the time interval shall be in line with the requirements applying for temporal correlation between the electricity production and fuel production**.** If these individual time intervals are shorter than the calculation interval for GHG averaging, they can be used to calculate the average, but each one of these individual time intervals must meet the GHG savings threshold of 70%.

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Rules for co-processing

If an output is a **mix of RFNBO and RCF** or other fuels, all types of fuels are considered to have the **same emissions intensity**, calculated according to the following formula:

$$Emission\ intensity\ of\ output\ [\frac{kg\ CO_{2\ eq}}{MJ}] = \frac{total\ amount\ of\ emissions\ [kg\ CO_{2\ eq}]}{total\ amount\ of\ produced\ fuel\ [MJ]}$$

When **RFNBO and RCF are co-processed with conventional fuels or biomass-based products**, meaning the inputs don't fully qualify as of renewable origin, the share of RNFBO/RCF is determined by relevant shares of input energy according to:

$$Share\ of\ RFNBO\ or\ RCF\ [\%] = \frac{relevant\ inputs\ energy\ to\ produce\ RFNBO\ or\ RCF[MJ]}{Total\ inputs\ energy\ [MJ]}$$

Additionally, **emissions can be allocated to by-products** such as chemicals, heat, mechanical energy and electricity. If the output ratio of these products is fixed and the outputs are all fuels, electricity or heat, emissions of each output are calculated based on the emissions of relevant inputs as well as on the energy-related fraction of the other emissions components:

$$Emissions_{output}\left[\frac{kgCO_{2\ eq}}{MJ}\right] = e_{i,relevant} + fraction * (e_P + e_{td} - e_{ccs}),$$

where *fraction* is the share of relevant input energy. The text of the CDR 2023/1185 is not unambiguous with regard to the role of e_u in the above equation. In contrast to all other emissions, it does not mention it explicitly; however, the view of the authors of this briefing is that these probably also have to be taken into account in case the output is fuel.

If the process used allows for varying the output ratios, then the process emissions have to be allocated based on the effect on the process emissions of incrementing just one of the outputs (while the shares of others remain constant). For co-products without energy content, the allocation is based on the economic value.

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