



# REGATRACE

Renewable Gas Trade Centre in Europe

## D4.1 Guidelines for the Verification of Cross-Sectoral Concepts

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## Executive Summary

This Deliverable presents *verification guidelines* for *cross-sectoral renewable gas concepts* regarding *Guarantee of Origin (GO)* issuance according to Article 19 RED II and *Proof of Sustainability (PoS)* issuance according to Article 25-31 RED II.

The cross-sectoral renewable gas concepts covered by this report are:

- Power-to-hydrogen/synthetic methane
- Biomethane to Bio-LNG
- Biomethane to Biomethanol

The results section presents *open issues* regarding cross-sectoral gas concept verification (chapter 6.1.) and *verification methods* for cross-sectoral renewable gas technologies to meet RED II requirements as well as the *GO/PoS end product* (chapter 6.2.1.) after conversion.

This document handles the needs and proposes processes related to the verification of (see chapter 6.2. for more details):

- *Plausibility* of energy input and output *quantities* of the renewable gas installation
- Origin of input energy source/*Renewability*
- *Geographical correlation* [Hydrogen]
- *Temporal correlation* [Hydrogen]
- *Additionality* [Hydrogen]
- *Water consumption* [Hydrogen]
- *Carbon source* (fossil-based, biogenic) [synthetic methane-specific]
- GHG reduction crediting regarding CCU [synthetic methane-specific]
- Information on cancelled GO/PoS

The following Member States as well as ISCC and CertifHy already have verification standards for the respective cross-sectoral gas technologies in place (see Annex for more details):

*Table 1: Overview of countries which have cross-sectoral verification guidelines in place for the respective technology*

| Cross-sectoral technology  | Geographical relevance                                 |                   |
|----------------------------|--|-------------------|
|                            | GO   | PoS               |
| Hydrogen/Synthetic Methane | Belgium, Germany, Italy, the Netherlands, UK, CertifHy | ISCC              |
| Bio-LNG                    | Belgium, UK  | Germany, UK, ISCC |
| Biomethanol                |  | Germany, UK, ISCC |

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## Abbreviations

|        |   |
|--------|---|
| CAC    | Carbon Air Capture  |
| CIC    | Certificati Immissione in Consumo   |
| CCU    | Carbon Capture and Utilisation  |
| CPPA   | Corporate Power Purchase Agreement  |
| DSO    | Distribution System Operator  |
| EEA    | European Economic Area  |
| EEG    | German Renewable Energy Act   |
| EFET   | European Federation of Energy Traders                                       |
| ETS    | European Trading Scheme   |
| GHG    | Greenhouse gas  |
| GO     | Guarantee of Origin   |
| ISCC   | International Sustainability and Carbon Certification                       |
| LNG    | Liquefied natural gas   |
| MS     | Member State  |
| OVAM   | Public Waste Agency of Flanders (Openbare Vlaamse Afvalstoffenmaatschappij) |
| PoS    | Proof(s) of Sustainability  |
| PPA    | Power Purchase Agreement  |
| PtG    | Power-to-Gas  |
| PtX    | Power-to-X  |
| PV     | Photovoltaic  |
| RE     | Renewable Energy  |
| RED    | Renewable Energy Directive 2009/28/EC                                       |
| RED II | Renewable Energy Directive 2018/2001/EC                                     |
| RES-E  | Renewable energy sources for electricity                                    |
| RFNBO  | Renewable fuels of non-biological origin                                    |
| RTO    | Regenerative Thermal Oxidation  |
| SNG    | Syngas  |
| TSO    | Transition System Operator  |

## REGATRACE in a Nutshell

REGATRACE (REnewable GAs TRAdE Centre in Europe) aims to create an efficient trade system based on issuing and trading biomethane/renewable gases certificates/Guarantees of Origin (GO) with exclusion of double sale.

This objective will be achieved through the following founding pillars:

- European biomethane/renewable gases GO system
- Set-up of national GO issuing bodies
- Integration of GO from different renewable gas technologies with electric and hydrogen GO systems
- Integrated assessment and sustainable feedstock mobilisation strategies and technology synergies
- Support for biomethane market uptake
- Transferability of results beyond the project's countries

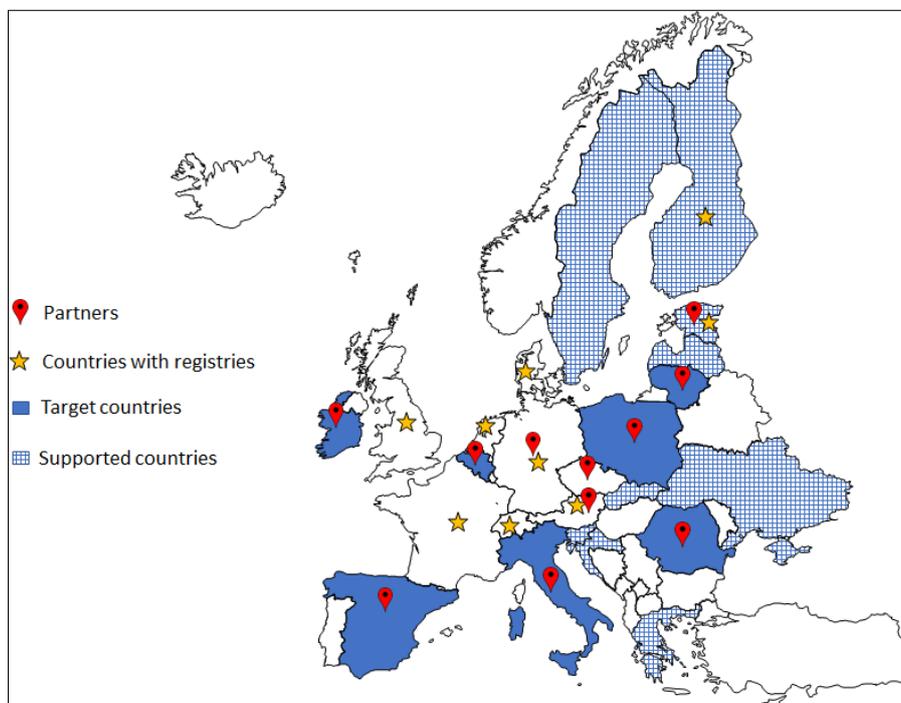


Figure 1: REGATRACE countries and partners

The network of issuing bodies will be established by including existing national biomethane registries (Austria, Denmark, Estonia, Finland, France, Germany, The Netherlands, Switzerland and UK) and by creating issuing bodies in the Target countries of the project (Belgium, Ireland, Italy, Lithuania, Poland, Romania and Spain).

Moreover, REGATRACE will prepare the ground for setting-up national biomethane registries in other 7 Supported countries (Croatia, Czech Republic, Greece, Latvia, Slovenia, Sweden, and Ukraine).

Using a participatory process involving several stakeholders, REGATRACE will develop strategic visions and national roadmaps to boost the biomethane market.

## 1. Introduction

Sector coupling is key in order to reach the EU target of a carbon-neutral society by 2050. However, in order to make the success of this pathway traceable, transparent and accountable, verification guidelines need to be in place for evaluating the performance across energy conversion against various parameters like, among others, declaration of renewable origin, efficiency, carbon savings. Such verification guidelines for cross-sectoral technologies are still in their infancy. Guarantees of Origin (GOs) and Proofs of Sustainability (PoS) are instruments that were introduced by Directive 2009/28/EC (RED) and further developed by Directive 2018/2001 (RED II). GOs were implemented for disclosure purposes (i.e., disclosing the origin of supplied energy towards a consumer) and PoS to demonstrate compliance with sustainability criteria and to showcase target compliance to national and EU-wide renewable energy targets (Art. 3 RED II). PoS are not mentioned as an instrument as such in RED II (see Chapter 3.2.).

This Deliverable uses the experience of the biomethane registries within the EU as a starting point for assessing challenges and lessons learned of the GO and PoS issuing authorities regarding cross-sectoral gas technologies and derives practical guidelines from the assessment.

It further analyses the cross-sectoral concepts Power-to-hydrogen/synthetic methane and biomethane to bio-LNG and biomethane to biomethanol, identifies open issues, and describes appropriate verification guidelines for the transfer and handling of GOs and PoS along cross-sectoral supply chains.

Open issues regarding the verification guidelines involve the uncertainty what evidence to provide for mass balancing, what electricity sources are eligible for hydrogen production, and how to account for different carbon sources (fossil-based or biogenic) within the greenhouse gas balancing. For this reason, national issuing bodies of guarantees of origin for renewable electricity and operators of biomethane registries were approached by means of a survey to identify what kind of proofs can be exchanged between different biomethane registries or mass balance systems. Guidelines for the verification of cross-sectoral renewable gas concepts shall help national registries to implement GO/PoS verification procedures and standards in the future. The established national biomethane registries (operating in AT, CH, DE, DK, EE, FI, FR, NL and UK) and the consortium partners from BE, ES, IE, and IT, as well as representatives of CertifHy and ISCC shared their experiences, which are summarized and presented in the Annex. The analysis describes identified open issues (chapter 6.1) and develops guidelines for innovative renewable gas concepts (chapter 6.2) where no or only little approaches exist.

**This Deliverable aims to address the following questions:**

1. What hurdles need to be overcome regarding verification guidelines of cross-sectoral gas technologies?
2. What GO/PoS product (→ **Glossary**) results from conversion (Power-to-hydrogen/synthetic methane, biomethane to bio-LNG, and biomethane to biomethanol)?
3. What product can be used to prove the origin of the input into the conversion?
4. What additional information needs to be verified if one energy carrier is converted into another?
5. What verification could be appropriate for cross-sectoral renewable gas technologies to meet RED II requirements?

## 2. Renewable Cross-Sectoral Gas Technologies

This chapter introduces the cross-sectoral gas technologies power-to-hydrogen/synthetic methane, biomethane to bio-LNG and biomethane to biomethanol, for which this Deliverable aims to establish verification guidelines. The technologies are subdivided according to their relevance for GOs and PoS, as well as their direct or indirect connection to the production plant of the input energy carrier.

### 2.1. Power-to-Hydrogen/Synthetic Methane

**Renewable hydrogen** can be produced through several processes such as electrolysis, steam methane reforming, pyrolysis, etc. This report focuses on the production of renewable hydrogen from renewable electricity and water. Renewable hydrogen makes variable renewable energy sources (e.g., solar and wind) more versatile by increasing their storage capability and reducing the voltage and frequency variability in the power grid. Hydrogen can be produced through water electrolysis with electricity from the public power grid and/or from electricity of the electricity production device with a direct connection to the electrolyser. As shown in Figure 2, in a second step it is possible to convert the hydrogen into **synthetic methane** via an external carbon source (Götz et al., 2016). If the produced synthetic methane is aimed at being categorized or labelled as renewable, then some requirements must be fulfilled, e.g., regarding the input power and carbon source. However, how these criteria are defined in detail still needs to be specified by the delegated act following Art 27(3) of the Renewable Energy Directive 2018/2001. Potential carbon sources for synthetic methane technologies are Carbon Air Capture (CAC) and Carbon Capture and Utilisation (CCU). The future global CO<sub>2</sub> demand of power fuels will be approximately 6,000 Mt CO<sub>2</sub> by 2050 (Global Alliance Powerfuels, 2020a). The utilisation of **fossil-based carbon** from industrial flue gas makes it controversial to term the end-product as “renewable”. As depicted in Figure 2, carbon can also be bio-based. The fermentation of biomass to biogas creates **biogenic carbon** as a by-product. **Carbon Air Capture** is another way of harvesting carbon. However, this technology is energy and cost-intensive (Schiebahn et al., 2015). The Global Alliance Power fuels assessed different carbon sources (industrial, biogenic, CO<sub>2</sub> from ambient air) based on their costs, scalability/expected long-term availability, regional availability in power fuels producing regions, sustainability and verifiability/credibility (Global Alliance Powerfuels, 2020a). A third scenario would be to produce gas from a **carbon mix**, e.g., through the incineration of heterogeneous household waste. D4.1. focuses on how the different carbon sources could be documented and verified.

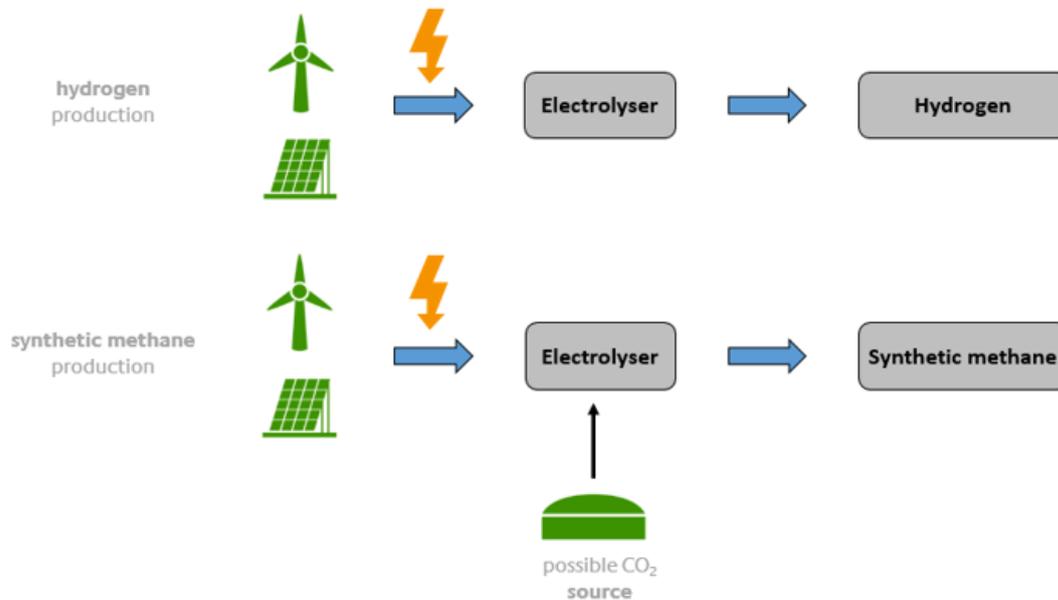


Figure 2: Schematic presentation of hydrogen and synthetic methane production

## 2.2. Biomethane to Bio-LNG

Bio-LNG is produced by liquefying biomethane. Its high energy density makes it a suitable fuel for e.g. heavy duty transport and shipping (dena, 2019). It is also used for transporting biomethane to places without a connection to the gas grid (e.g., Norway). The biomethane liquefaction process can take place in two ways: (1) directly, at the biomethane production plant or (2) indirectly, through the gas grid which is connected to a liquefaction plant (Müller et al., 2020). The liquefaction is done at low temperature (-162°C).

## 2.3. Biomethane to Biomethanol

Methanol is consumed in high quantities in China, which has a blending share of 15 % methanol (M15) in the total gasoline volume. Whereas in the EU there is a low blending wall (→ **Glossary**) (max 3%; EN 228) in place. High blending ratios require dedicated engines and therefore high efforts of changing the vehicle fleet (Methanol Institute, 2019). As illustrated in Figure 3, several production pathways exist for biomethanol production; for example, pyrolysis, gasification, bio-synthesis, electrolysis and photo-electrochemical processes (IRENA, 2013). Methanol can be produced on the basis of natural gas, biomethane (produced from SNG or biogas), or directly from syngas (SNG). There are even projects planned which aim at producing methanol from hydrogen, e.g., Westküste 100. The production on the basis of natural gas is the most prevalent process. In the first stage, synthesis gas is produced by steam reforming with natural gas. The purified and conditioned synthesis gas is then converted into methanol (Majer & Gröngroft, 2010). Syngas is a gas mixture consisting of carbon monoxide, hydrogen, carbon dioxide, water and other hydrocarbons (IRENA, 2013). The pathway of producing biomethane from SNG and converting it to biomethanol has been applied in the production plant in Güssing, Austria. Pyrolysis is an attractive option for large-scale applications, such as in diesel engines and gas turbines. Gasification on the other hand is more cost effective than pyrolysis (Shamsul et al., 2014). In this Deliverable we solely investigate the last option: Biomethanol produced from biogas. The gasification pathway consists of three production steps: (1) anaerobic digestion of biomass

and gasification of solid biomass, (2) gas purification to natural gas quality (biomethane) in an upgrading plant, and (3) the biomethane is fed directly or indirectly via the gas grid to the conversion plant (methanol synthesis) (Majer & Gröngröft, 2010).

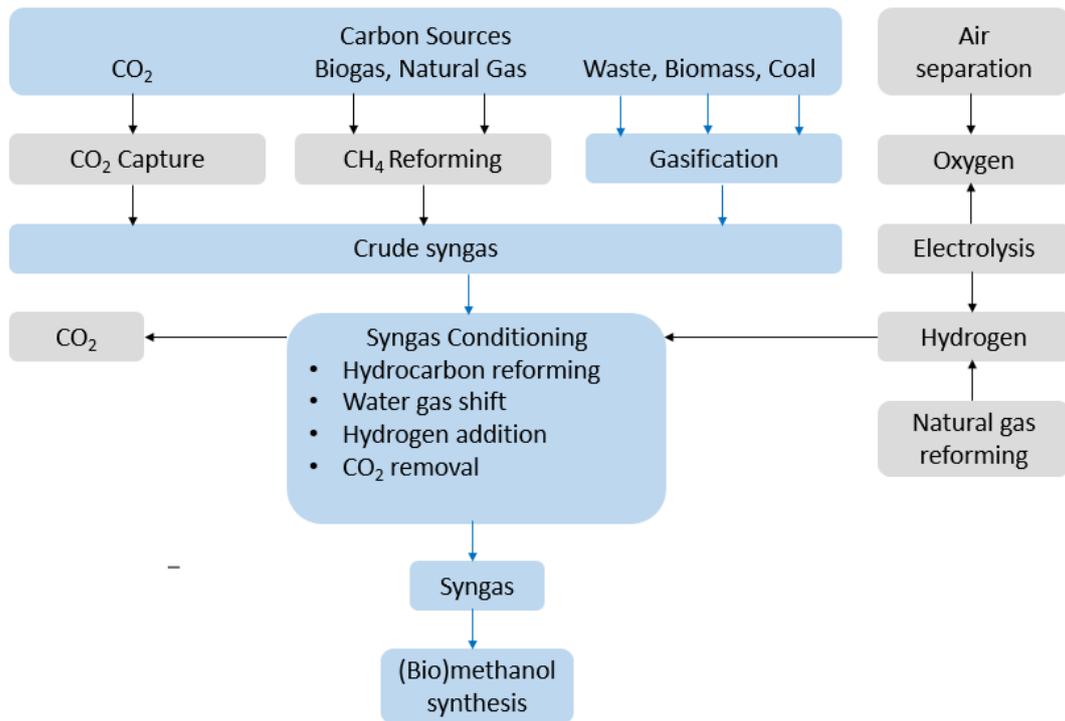


Figure 3: Biomethanol production pathways covered by REGATRACE D4.1. (in blue) (IRENA, 2013)

### 3. Recast of the Renewable Energy Directive (RED II)

RED II provides two types of proofs for gaseous energy sources from biogenic and non-biogenic origin: (1) **Guarantee of Origin (GO)** according to Art. 19 and (2) **Proof of Sustainability (PoS)** according to Art. 25 to 31. Both were introduced with RED 2009/28/EC. GOs had been established solely for the electricity sector, but with the publication of RED II, the concept has been extended to cover other energy carriers such as gas. GOs serve for demonstrating to a final customer the share or quantity of energy from renewable energy sources in the energy supplied to them. PoS are an instrument for demonstrating compliance with the sustainability requirements for energy carriers used as a transport fuel. Expanding the GO and PoS concepts to cover more energy carriers and sectors, requires certification and verification guidelines for electricity-based gases and new bioenergy carriers (e.g., bio-LNG), which have yet to be developed. Some registries implement certificates that simultaneously cover the characteristics of GOs and PoS (represented by the grey interface in Figure 5).

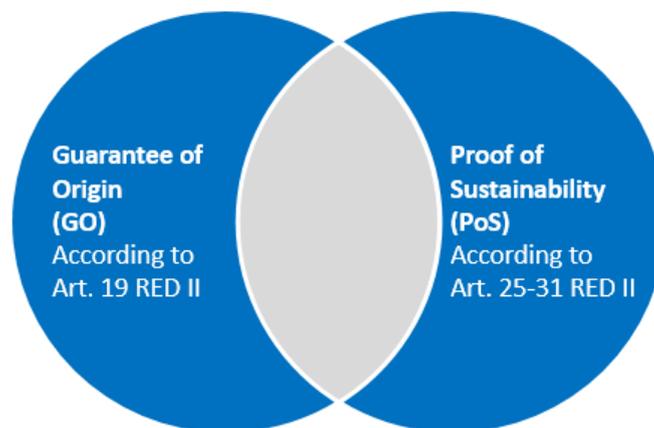


Figure 4: Certificate types introduced by RED

Table 2: GOs vs PoS

|                                | Guarantee of Origin (GO)  | Proof of Sustainability (PoS)  |
|--------------------------------|---|--|
| <b>Relevant RED II Article</b> | Art. 19   | Art. 25-31   |
| <b>Geographical Scope</b>      | EU  | Global   |
| <b>Beneficiary</b>             | Energy consumer   | Economic operators obtaining production support or having to meet target obligations   |
| <b>Purpose</b>                 | Simple mean of identifying and disclosing the energy source to end consumers.<br>Independent of RED II sustainability requirements. | Counting produced volumes towards the renewable energy targets (Art.3).<br>Proof of compliance with the sustainability criteria of RED II. GHG reduction potentials are to be indicated. |
| <b>Area of application</b>     | All renewable energies according to RES definition in Art. 2, incl. biomass   | Biofuels, bioliquids and biomass fuels   |
| <b>Lifetime</b>                | 12 months (eligible for transfer) and 18 months (eligible for cancellation).  | Unlimited  |
| <b>Trade principle</b>         | Book & Claim  | Mass balancing   |

### 3.1. Guarantee of Origin (GO)

As stated in Art. 19 RED II, a GO is an electronic document used for demonstrating the origin of the energy carrier on the European market. It also contains information about how and where the gaseous energy carrier was produced, including its original energy source (e.g., renewable or fossil). GOs were introduced with the RED (Art. 15), which initially only covered GOs for electricity, heating and cooling. The requirements of RED II remained largely the same as those from RED. GOs cannot be used by MS to count towards the renewable energy target (Art. 3). A GO is traded exclusively through book & claim, which means that the physical path travelled by an energy carrier can be different than that of the GO issued specifically for the production of this energy carrier. Additionally, there is no mandatory correlation between the chain of custody of the physical energy and the corresponding GO. Any sustainability documentation, such as GHG emissions, is not provided according to Art. 19 RED II. GOs serve primarily as a mean to identify and disclose the energy source to the end user. Thus, the beneficiary of the GO is the energy consumer. National GO issuing bodies are responsible for reliable, accurate and verifiable operation of the GO system within their national borders. In addition, requirements for cross-border trade of certificates should be fulfilled to enable a common European renewable gas market. MS have to designate a national competent body responsible for issuing, transferring and cancelling GOs. An issuing body could operate an officially recognized system when given the respective governmental mandate. Competent issuing bodies may also issue GOs for energy from non-renewable sources produced on their domain, to facilitate documentation of all production

volumes. This facilitates consumer choice on broader aspects than only the renewable origin. Examples are that national natural gas production may be favoured over imported gas and that low-carbon hydrogen will have a market value different than fossil-based hydrogen. The **lifetime** of a GO, as mandated in RED II, should be 12 months (eligible for transfer) and 18 months (eligible for cancellation). For more information on the establishment of GO registries in the EU MS, please see REGATRACE D3.2 *Report on the set-up of biomethane registries*.

### 3.2. Proof of Sustainability (PoS)

In this report, PoS are defined as certificates that demonstrate compliance with the requirements of the sustainability regulations stated in Art. 25-31 RED II, including ILUC prevention, renewable fuels of non-biological origin (RFNBO) sustainability criteria, emission savings and mass balancing. However, the term “Proof of Sustainability” is not used as such by RED II. PoS require sustainability certification. Voluntary certification schemes (e.g., ISCC) dedicated to the sustainability of energy sources should certify whether they meet the sustainability criteria defined by RED II. The European Commission (EC) has officially recognized 16 voluntary certification schemes under RED II such as ISCC, RSB, RedCert. Certification bodies (e.g., TÜV Süd) are recognized under different certification schemes according to their portfolio and are responsible for conducting the respective audits. In contrast with the GO, the PoS does not have a limited lifetime, however, it stays connected with a specific consignment of fuel for the audited time included in the validation even after its usage. A PoS may be used to claim state support depending on regulations in MS or to prove the fulfilment of a certain quota obligation. The renewable energy used for the intended purpose can also be counted towards the national targets (Art.3 RED II). For PoS, the beneficiary is the one obtaining production support or having to meet target obligations. Moreover, PoS will be used in the future, for example, within the European Trading Scheme (ETS) for carbon compensation. However, this has not been the case yet for RFNBO. This Deliverable focuses on the renewability via mass balancing, additionality, temporal and geographical correlation, as well as water consumption of RFNBOs. For transparency and traceability of PoS transfers, a **Union Database**<sup>1</sup> (Art. 28 (2) RED II) is aimed to be established. A scoping study identifying technical requirements and options for a Union Database was published by Guidehouse (2020). The study does not only regard the Union Database as a reporting database which is linked to the national schemes, but suggests to also establish accounts for users, which means that users can be directly connected to the database without a registry as an intermediary. This could be beneficial for MS, which have no systems to monitor the issuance and cancellation of Po in place. According to Guidehouse (2020), the Union database will be operated by the EU Commission (Guidehouse, 2020). To clearly differentiate a PoS from a GO (as defined in Art. 19 RED II), a PoS reflects the following main characteristics and information according to Art. 25-31 RED II:

- Compliance with sustainability and GHG emission savings requirements (Art. 29, 30)
- RFNBO sustainable electricity requirements according to Art. 27 (renewability, additionality, temporal and geographical correlation)
- Confirmation that the entire supply chain is documented by a mass balance system (Art. 30)
- Admissibility for meeting the renewable energy targets under Art. 3, 23 and 25 of RED II

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<sup>1</sup> Does not exist at the time of publication. But a report on the establishing a Union Database has been already published by Guidehouse

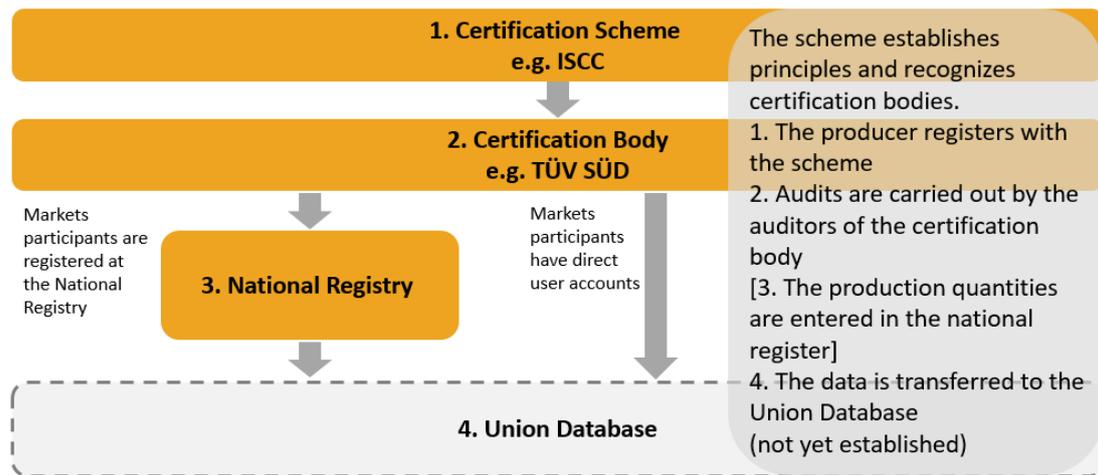


Figure 5: PoS certification process and linked competent bodies

**Mass balancing** must be carried out on a consignment by consignment basis and must ensure traceability of each consignment from its consumption to its trading stages, back to the production and finally back to the cultivation of the biomass or electricity production plant. The mass balancing system retains the sustainability characteristics assigned to a certain quantity of energy. With mass balancing, it is possible to prove compliance with the Directive's sustainability criteria and GHG emissions savings thresholds, while documenting product identity as well as its origin.

The PoS must be issued for a specific mass balancing period. According to the received survey responses, this period should be one month. RED II sets the maximum period for three months. The verification period has to be set during the initial audit and will remain the same (ISCC webinar, 2020). The European gas network should be considered as one mass balance unit. On that note, ERGaR has submitted its „ERGaR RED MB Scheme“ to the European Commission, seeking recognition as a voluntary scheme, with special focus on the mass balancing along the European gas grid. During the negotiation process, the European Commission has recognized the European interconnected gas network as **one logistical facility**. This is a cornerstone to allow mass balancing of energy volumes of renewable gases across the European interconnected gas network.

The chain of custody for mass balancing may be divided into two parts for energy carriers that are transported through a grid infrastructure:

- (1) **Mass balancing from point of production of input raw material to production of energy carrier consignment:** the chain of custody needs to be traceable from input material production until the transportation of the energy carrier (e.g., fed into the gas grid or transported by truck).
- (2) **Mass balancing from point of production to consumption of energy carrier:** the supply chain must be traceable from the energy carrier leaving the production plant until the delivery to the final customer.

For mass balancing, all substance flows must be well documented in a given time period. This applies in particular to the input and output. In case of gaseous energy carriers, most of the evidence for **mass balancing from point of production of input raw material to production of energy carrier consignment** is provided by meter data in relation with the production periods. The **mass balance from point of production to consumption of energy carrier** is mainly based on transport by road, gas grids or waterways. However, the material identity is abandoned when feeding into a mixed gas network. It is therefore no longer possible to physically trace the renewable volume in the actual gas mix.

## 4. Scope of the verification guidelines – What to verify?

Regarding our defined scope, when an energy carrier is converted into another, the input is provided in form of electricity, carbon dioxide or biomethane. In order to ensure that no information gets lost between multiple cross-sections, verification guidelines are needed.

In this Deliverable, **verification guidelines** are defined as a method to prove the renewable origin and sustainable production throughout the value chain. Verification guidelines aim to prevent fraud in the reporting that leads to GO/PoS issuance. This implies that a party, independent of the producer, shall verify the renewable origin/sustainable production and the reported measured quantities that are eligible for GO/PoS issuance. Renewable gaseous and liquid energy carriers are promoted in various MS through various instruments like subsidies, minimum purchase obligations, etc. in order to make renewable energy carriers more competitive against their fossil-based counterparts. These initiatives require verification guidelines to prove their renewable origin/ sustainable production (Velazquez Abad & Dodds, 2020). Cross-sectoral technologies appear to be especially challenging, since they entail the risk of information loss at the cross sections.

Renewable energy from wind and solar is subject to strong fluctuations. Cross- sectoral interconnection is one solution to reach more flexibility of renewable energy systems.

**Cross-sectoral concepts** link different energy sectors with one another through conversion of energy carriers. It is the integration between different parts of an energy system e.g., electricity and heat or transport. Examples for cross-sectoral concepts are the conversion from power-to-heat, power-to-gas, and cogenerated heat and power production (Thellufsen & Lund, 2017). In this context, power refers to power conveyed in the form of electricity. This deliverable limits itself by only looking at the cross-sectoral concepts: Power-to-hydrogen/synthetic methane and biomethane to bio-LNG/ biomethanol.

This document handles the needs and proposes processes related to the verification of:

- **Plausibility** of energy input and output **quantities** of the renewable gas installation
- Origin of input energy source/ **Renewability**
- **Geographical correlation** [Hydrogen] (→Glossary)
- **Temporal correlation** [Hydrogen] (→Glossary)
- **Additionality** [Hydrogen] (→Glossary)
- **Water consumption** [Hydrogen]
- **Carbon source** (fossil-based, biogenic) [synthetic methane-specific]
- GHG reduction crediting regarding CCU [synthetic methane-specific]
- Other data to be verified before reliable GO/PoS issuance
  - Information on cancelled GO/PoS

The rules against which the verification takes place depends on the following factors:

- The respective cross-sectoral gas technology
- Production through a direct/indirect connection to the input energy carrier

## 5. Method

The main task of this Deliverable is to develop guidelines in order to support EU MS to implement procedures and concepts for the verification of cross-sectoral renewable gas concepts. The main task is underpinned by the three sub-tasks depicted in Figure 6. In the first sub-task, cross-sectoral verification guidelines of various countries have been identified, described and assessed. The input of this task was generated by a survey (Annex). The survey was conducted from April 7 until September 28, 2020 and 17 responses were received. The aim of the survey was to identify verification guidelines of cross-sectoral technologies in MS where they are already in place, furthermore bottlenecks (sub-task 2) regarding the establishment of such standards have been identified. Further obstacles have been singled out in the second REGATRACE target workshop that took place in Berlin on October 22, 2019, where 22 representatives from industry, research, governmental organizations and gas registries from Germany, Austria, Belgium and Sweden participated. Based on the results generated by the workshop, the survey, and a literature review, the guidelines for innovative cross-sectoral renewable gas concepts have been developed (sub-task 3). For hydrogen verification, the reports from Guidehouse (2020) and the Global Alliance Power fuels (2020b) on the RFNBO electricity criteria were taken as a starting point for the interpretation of Art. 27 RED II requirements. Finally, these guidelines were validated by the REGATRACE project partners.

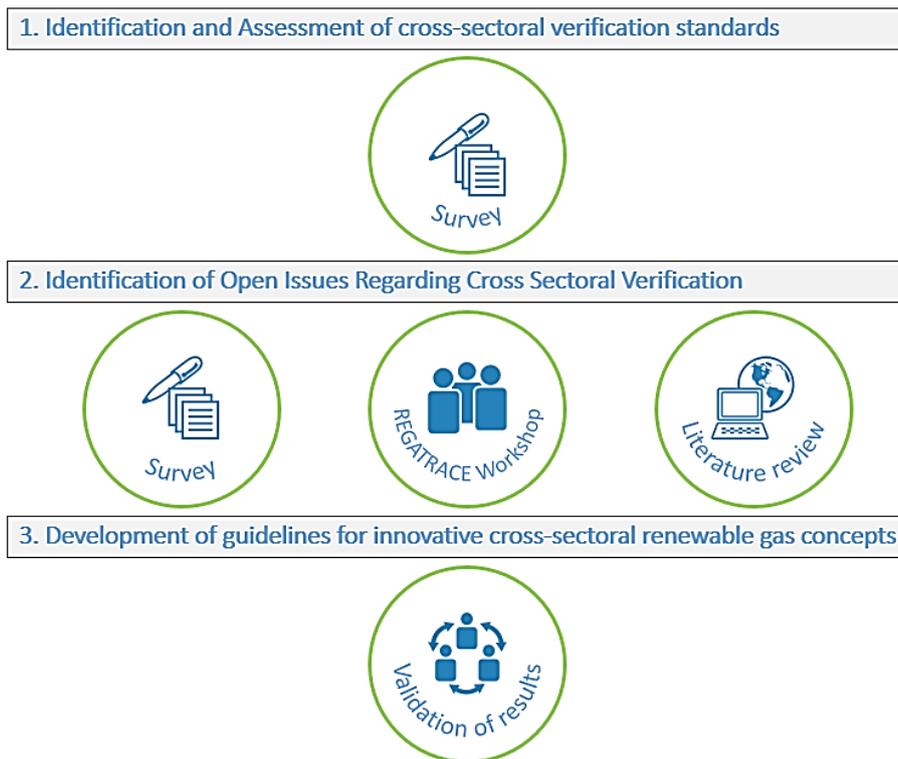


Figure 6: Method per sub-task

## 6. Results

This chapter presents the results generated by our methodology. In the first step, we identify open issues regarding cross sectoral verification guidelines. The chapter aims to shine a light on the aspects, which are still undetermined in various EU countries (Chapter 6.1.). Based on which guidelines for cross-sectoral verification and documentation of renewable gases regarding hydrogen/synthetic methane, bio-LNG, and biomethanol are presented (Chapter 6.2.). The cross-sectoral verification guidelines of different EU MS, which served as the foundation of the results section, can be found in the Annex.

### 6.1. Identification of Open Issues Regarding Cross Sectoral Gas Concept Verification

#### 6.1.1. Technology-unspecific open issues

We start off by illustrating open issues, that are not technology-specific, as shown in Table 3. Firstly, due to the increased complexity, the increased **risk of human error and omissions** needs to be taken into account when establishing guidelines for cross-sectoral verification (Velazquez Abad & Dodds, 2020). When developing such guidelines, it is important to look at standards that are implemented in the various MS to identify a common ground, since there are **no harmonized methodologies of cross-sectoral GO/PoS currently applied in Europe** (BIOSURF D3.1., 2016). Nevertheless, there are rulesets available as the EECs Rules (2019), committed to by issuing bodies of EECs Certificates (i.e. members of the Association of Issuing Bodies). The EECs Rules determine, amongst other aspects, that issuance of EECs Certificates shall only take place for an energy carrier that is actually produced, ensuring the link with the accompanying physical energy carrier conversion. They also state that, in case of energy carrier conversion, a quantity of certificates can be issued for the output energy carrier, corresponding to the measured output, on condition that an number of certificates corresponding to the input energy carrier is cancelled for the measured input into a conversion production device. The energy source mentioned on the cancelled certificates for the input energy carrier here shall be the energy source to be mentioned on the certificates for the output energy carrier. Today, this harmonized conversion rule has mainly been scoped for GOs, and its application to PoS will depend on the availability of PoS for all energy carriers involved. Only a harmonized methodology makes national registries and their verification standards compatible among other cross-linked sectors (BIOSURF D3.1., 2016).

**Double counting** refers to the multiple usage of a GO/PoS for a single produced energy unit and is a major issue in cross-sectoral validation (BIOSURF D3.1., 2016; REGATRACE D2.2., 2020).

To ensure that renewable characteristics are only claimed once and only in one end-use sector, the following aspects must be considered:

- Only one GO/PoS is originally issued and invalid GOs/PoS are cancelled, and
- GOs/PoS are not duplicated at any later stage in the supply chain, not during registration, transfer nor cancellation, and
- GOs/PoS are only allocated once for a corresponding amount of energy consumption by consumer(s), and

- No other means than GOs, respectively PoS, are used to claim the renewable characteristics of the corresponding quantity of the produced/consumed energy carrier.

Also, the **transfer of correct and readily available documents along each step of the** supply chain is especially challenging when it comes to cross-sectoral technologies, due to the various handover steps of the technologies' nature, which the validation standards need to bridge. Another major technical open issue is the lack of a harmonized **robust tracking system** of energy carrier quantities and time periods for all types of transport (e.g., public grid, road etc.), which could be realized by fully automated telemeters.

Furthermore, it is challenging to operate **a certification scheme in an economically viable way**. The wider the boundaries of the verification guidelines and the more detailed the required data, the more resources are needed for data collection, IT-infrastructure, auditing, and the higher the financial and administrative burden on involved parties. For example, when implementing a temporal correlation criterion (→ **Glossary**) for hydrogen production according to RED II Art. 27, setting the criterion at hourly billing would translate into 24 times more data compared to daily billing. This trade-off needs to be taken into account when agreeing upon verification guidelines (Velazquez Abad & Dodds, 2020). Also the **efficiency of the information transfer** of issuing cross-sectoral GOs/PoS must be taken into account in order to keep transaction costs low (BIOSURF D3.1., 2016, p. 87).

From a regulatory perspective, every MS has its individual rules in place, which are differing between countries on whether or not GOs can be issued for an energy carrier after conversion, when **state aid** has already been granted for the GO of the input energy carrier. Article 107 (1) of the Treaty on the Functioning of the European Union (TFEU) states that cross-sectoral technologies require an assessment if the respective technology in the respective country receives state aid. This article states that any aid granted by a MS or through state resources, which distorts or threatens competition by favouring certain undertakings, or the production of certain goods is, in principle, incompatible with the common market in so far as it affects trade between MS. However, this report does not claim to determine any right to receive financial support (e.g., whether hydrogen should be subsidized if the electricity consumed has already received financial state aid). This report only presents options for verification on how it can be proven that state aid has been received.

From the social-dimension, there needs to be **acceptance** by market actors of GOs/PoS for cross-sectoral technologies within the EU in order to ensure their successful implementation (BIOSURF D3.1., 2016, p. 87).

Table 3: Overview of general open issues regarding cross-sectoral verification

| Category   | Issue description  |
|------------|--|
| Technology | <p>The risk of <b>human error</b></p> <p><b>Compatibility</b> between <b>national registries</b> and sustainability compliance standards among other cross-linked sectors (BIOSURF D3.1., 2016, p. 87)</p> <p>Lack of common agreement on a methodology how to avoid <b>double counting</b> and double selling</p> <p><b>Transfer of correct and readily available documentation</b> in the chain of custody for each step of the supply chain (REGATRACE target workshop result)</p> <p>The measurement tools are likely to be different for each transportation mode (e.g. road, public grid etc.), and operated by different economical operators, rather than third party independent measurement bodies. There is a lack of a <b>robust tracking system</b> for all types of transport (CertifHy, survey, 2020)</p> |
| Economic   | <p>Challenge of creating an <b>economically viable</b> operation of a certification scheme (Velazquez Abad &amp; Dodds, 2020)</p> <p><b>Efficiency</b> of the <b>information transfer</b> of issuing cross-sectoral GOs/PoS (BIOSURF D3.1., 2016, p. 87)</p>   |
| Regulatory | <p>Uncertainty on future national legislation on whether a GO can be issued for a hydrogen/synthetic methane, bio-LNG or biomethanol produced from renewable electricity/gas that already received some <b>state or financial support</b> and for which a GO has been issued; difference between implementation in different countries /domains</p>  |
| Social     | <p><b>Acceptance</b> of GO/PoS for cross-sectoral technologies within the EU (BIOSURF D3.1., 2016, p. 87)</p>  |

### 6.1.2. Open issues regarding the verification of Hydrogen/synthetic methane

Open issues when it comes to the verification of hydrogen production throughout the supply chain, are the lack of common agreements regarding how GOs/PoS should be handled when **electricity is converted into gas**, or if hydrogen gets **injected into the gas grid**, or when facing a **diverse infrastructure** (hydrogen grid vs. mixed gas grid).

Depending on the changing relevance of hydrogen, biomethane and natural gas, also **grid configurations** will change. The options are 1) methane grid, 2) blending hydrogen and methane, and 3) hydrogen grid (Entsog, 2019). Regarding mixed grids, there also needs to be a harmonized agreement on the blending share. Right now blending shares vary from 0.1 % - 10 Vol. % in volume and, in some MS injecting hydrogen into the gas grid is simply forbidden (Hydrogen Europe, 2019). Another difficulty is that there is no harmonized methodology in place to account for **additionality** (→**Glossary**), referring to whether the certificate testifies of additional production of energy from renewable sources. At the moment there are different interpretations regarding how to establish additionality among the MS. Furthermore, in order to ensure some degree of **temporal and geographical correlation** (→ **Glossary**) between electricity production and consumption, temporal and geographical criteria must be agreed upon. It is also undetermined if synthetic fuel should be

**treated as renewable or carbon neutral** when the CO<sub>2</sub> comes from unavoidable industrial processes or flue gases. There is also a lack of harmonized PoS verification standards regarding which criteria (e.g., gas deliveries with time specifications at the different cross sections) hydrogen has to fulfil for **mass balancing**. Is renewable electricity eligible for the production of renewable hydrogen from the **public grid and/or from a direct connection**? It also needs to be agreed how to ensure that electricity related to a **Power Purchase Agreement (PPA)** is accompanied by a GO cancellation statement, since PPAs play an increasing role in Europe (e.g., in the UK, Spain). In line with European electricity disclosure legislation, following Annex 1.5 of the Internal Energy Market Directive 2019/944 (EU), PPAs should be backed with cancelled GOs in order to prove the renewable character of the purchased electricity. In the EFET CPPA template, a certificate must be handed over to prove renewable origin (EFET, 2019); in the EU and EEA such certificate shall be a GO.

Another barrier for hydrogen verification guidelines is the lack of harmonized rules and standards, i.e., regarding which **feedstock inputs** are eligible regarding PoS issuance for renewable hydrogen/synthetic methane. Should all renewable energy types and all **carbon sources** be eligible for PoS? Or should hydrogen produced from fossil or bio-based electricity be excluded from PoS issuing due to being unsustainable? If carbon source criteria are implemented, it is pivotal to develop the respective verification methodology for them: i.e., biogenic carbon or carbon which was not deliberately produced. Regarding **CCU** (fossil-based and biogenic carbon), it is not clear who gets the **carbon reduction credit** - the carbon emitter or the conversion plant operator - depending on the different carbon sources (CertifHy, survey, 2020). Current certification schemes often focus on one specific sector (e.g., transport), which can lead to loopholes that allow e.g., two production plants to claim carbon reduction for the same unit by simply getting audited by different certification bodies or personnel under different regulatory frameworks. In order to avoid this, a more coherent and cross-sectoral exchange of information amongst auditors from different certification bodies or under different certification schemes is necessary.

For hydrogen PoS, sustainability criteria need to be established, such as a **water consumption threshold**.

From a regulatory perspective, it needs to be decided in every country/domain whether a **new issuing body** is required for hydrogen GOs or whether an existing competent body can include hydrogen within its portfolio. Multiple competent bodies per MS result in a less harmonized system and increases inefficiency.

Table 4: Overview of open issues regarding verification guidelines for hydrogen/synthetic methane production

| Category   | Issue description   |
|------------|---|
| Technology | Lack of common agreement across renewable cross-sectoral gas concepts on EU level how a GO/PoS should be handled if the electricity is <b>converted</b> to gas  |
|            | Lack of agreement how the GO/PoS should be handled if the hydrogen is <b>injected into the public gas grid</b>  |
|            | Lack of agreement what information the GO/PoS should convey and what rules for usage of these GOs/PoS should be in place when a <b>diverse infrastructure</b> will be set up (hydrogen grid vs. mixed grid)   |
|            | Lack of a harmonized approach how to account for <b>additionally produced renewables</b> . Lack of harmonized standards to prove that electricity production unit and gas production unit are on the same side of the grid congestion in the electricity network (Art. 27 RED II) |

|            |   |
|------------|---|
|            | Lack of harmonized standard how to account for <b>temporal correlation</b> (Art. 27 RED II)   |
|            | Lack of harmonized standard how to account for <b>geographical correlation</b> (Art. 27 RED II)   |
|            | Undetermined if synthetic fuel should be treated as (a) <b>renewable</b> or (b) <b>carbon neutral</b> , if the CO <sub>2</sub> comes from unavoidable industrial processes (flue gases) and the electricity used by the electrolyser comes from renewable sources |
|            | Lack of agreement regarding the quality criteria the hydrogen supply chain has to fulfil for <b>mass-balancing</b> (REGATRACE target workshop result)   |
|            | Lack of common agreement on EU policy level if electricity from renewable energy sources is eligible to certify for the production of renewable hydrogen from the <b>public grid and/or from a direct connection</b>  |
| Economic   | Uncertainty if all electricity that is used for hydrogen production and is purchased through <b>PPAs</b> is accompanied by GO cancellation  |
| Regulatory | Qualifying <b>feedstocks</b> and <b>production technologies</b> for “renewable hydrogen” must be determined (Velazquez Abad & Dodds, 2020)  |
|            | Lack of common agreement if and under which constraints <b>fossil-based CO<sub>2</sub></b> can be utilized (REGATRACE target workshop result)   |
|            | Lack of a harmonized method to verify the <b>carbon source</b> (e.g., fossil-based or biogenic carbon)  |
|            | Lack of a harmonized method which guarantees that <b>CO<sub>2</sub> was not deliberately produced</b> for the production of renewable fuels   |
|            | Regarding <b>CCU</b> , it is unclear if the European Commission will credit the carbon capturer or the carbon consumer (CertifHy, survey, 2020)   |
|            | Lack of criteria that reflect <b>water consumption</b> and water stress in relation to hydrogen production via electrolysis for PoS issuance  |
|            | Dealing with <b>multiple issuing bodies</b> for different energy carriers, risking less harmonized systems and inefficiency in handling of certificates in relation with transfer and energy carrier conversion   |

### 6.1.3. Open issues regarding the verification of bio-LNG

Open issues regarding verification guidelines of bio-LNG value chains are listed in Table 5. First of all, it should be clarified if bio-LNG is significantly different from biomethane in terms of its chemical characteristics in order to decide upon the resulting **GO/PoS product** (→ **Glossary**). What **criteria** should the bio-LNG supply chain have to fulfil for **mass balancing** and how should GO/PoS be handled depending on the input coming from a **direct/indirect connection**? Should the **LNG liquefaction plant be the last element** regarding the system boundaries for mass balancing or the final utilization of bio-LNG? Furthermore, there are no guidelines available on how to conduct **mass balancing, if biomethane for liquefaction was withdrawn from several biomethane plants**. If each biomethane production plant would need to receive a biomethane PoS separately, high bureaucracy efforts would

be required. The PoS of several biomethane plants would be recombined for issuing the new PoS of a liquefaction plant. It is beneficial to look into solutions how the PoS effort could be bundled in such a case. Do PoS remain the same, or does the **GHG performance** of bio-LNG change significantly compared to its biomethane input?

Table 5: Overview of open issues regarding verification guidelines for bio-LNG production

| Category      | Issue description  |
|---------------|--|
| Technology    | Lack of common agreement how a <b>GO/PoS</b> should be handled if biomethane is liquefied  |
|               | Lack of agreement regarding the quality criteria the bio-LNG supply chain has to fulfil for <b>mass-balancing</b>                                  |
|               | Lack of agreement how the GO/PoS should be handled if the bio-LNG is produced by biomethane from a <b>direct or indirect (gas grid) connection</b> |
|               | Lack of agreement if the bio-LNG facility should be considered the <b>last element in the production chain</b>                                     |
|               | No guidelines on how to <b>mass balance</b> when biomethane is <b>obtained from several production plants</b> for liquefaction                     |
| Environmental | What additional influencing factors need to be considered in regard to <b>GHG performance</b> , when biomethane gets liquefied                     |

#### 6.1.4. Open issues regarding the verification of biomethanol

Open issues regarding the verification process of biomethanol supply chains are shown in Table 6. Also, in terms of biomethanol, the conversion process should be clarified. RED II does not foresee GOs for liquid biofuels. Thus, we solely focus on PoS for the cross-sectoral pathway from biomethane to biomethanol. So, how should PoS be handled when biomethane gets **converted** to biomethanol? Furthermore, distinguishing between biomethane, which is withdrawn from the **gas grid or sourced via a direct connection** needs to be accounted for, as well. And in terms of **GHG emissions, we aim to answer the question on how the GHG performance** of biomethane changes, if it gets converted to biomethanol.

Table 6: Overview of open issues regarding verification guidelines for biomethanol production

| Category      | Issue description   |
|---------------|---|
| Technology    | Lack of common agreement how a PoS should be handled if biomethane is <b>converted</b> to biomethanol                                       |
|               | Lack of agreement how the PoS should be handled if the biomethanol is produced by a <b>direct or indirect (gas grid) connection</b>         |
| Environmental | What additional influencing factors need to be considered in regard to <b>GHG performance</b> , when biomethane is converted to biomethanol |

## 6.2. Verification guidelines of cross-sectoral renewable gas concepts

This chapter proposes guidelines for installation and production batch audits to enable documentation of cross-sectoral renewable gas technologies regarding hydrogen, bio-LNG, and biomethanol. A strongly integrated energy sector requires registry systems with flexible attribute lists depending on different output energy carriers (REGATRACE D2.1., 2019). The requirements for verification guidelines of cross-sectoral technologies are verifiability, certifiability, applicability, comparability and predictability for project developers and investors, and coherence with existing regulations (Global Alliance Powerfuels, 2020b). Such verification guidelines must be aligned with an attribute list to provide for an integrated documentation. Cost efficiency should be kept in scope and it should be prevented that verification costs would outweigh the benefits that cross-sectoral concepts bring to the energy transition.

In the first step, it needs to be decided what the different cross-sectoral technologies require:

Table 7: Energy carrier conversion - Options of GO/PoS handling

### Indirect connection:

- a) a GO/PoS conversion, or
- b) whether the GO/PoS remains in its original form, or
- c) whether the GO/PoS remains in its original form, but lists additional attributes, or

### Direct connection:

- d) whether a GO/PoS is issued for the initially produced energy carrier, since the input energy carrier and output energy carrier of the conversion device are both directly connected and the energy carrier input may not have received a GO/PoS yet.

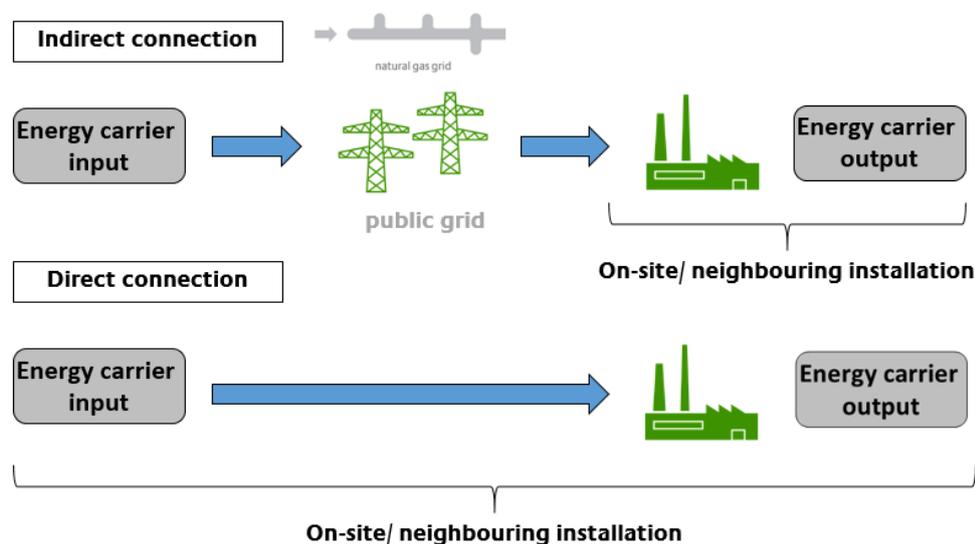


Figure 7: Indirect vs. direct connection to the conversion plant

This decision depends on the degree to which the chemical characteristics of the output energy carrier are different to the input energy carrier, and if the input and output plants are linked through a direct or an indirect connection (see Figure 8). In this Deliverable, recommendations regarding the GO/PoS

product (→ **Glossary**) after conversion can be found in Table 8. This report makes abstraction of this decision, whereas the specific rules will be set by REGATRACE D4.3.

Table 8: GO/PoS handling during energy carrier conversion

| ENERGY CARRIER        | CONNECTION TYPE            | GO  | PoS   |
|-----------------------|----------------------------|---|---|
| <b>GO/PoS product</b> |                            | → <b>Hydrogen GO</b>  | → <b>Hydrogen PoS</b>   |
| HYDROGEN              | <b>Direct connection</b>   | A first hydrogen GO is issued   | A first hydrogen PoS is issued  |
|                       | <b>Indirect connection</b> | A electricity or gas GO is converted into a hydrogen GO   | A first hydrogen PoS is issued, since an electricity PoS does not exist. However, the power input has to fulfil certain criteria (see Chapter 6.2.2.) |
| <b>GO/PoS product</b> |                            | → <b>Gas GO [liquid]</b>  | → <b>Bio-LNG PoS</b>  |
| BIO-LNG               | <b>Direct connection</b>   | A first gas GO [liquid] is issued   | A first bio-LNG PoS is issued   |
|                       | <b>Indirect connection</b> | Gas GO remains in its original form but lists additionally the aggregate state (only initial plant audit necessary) | A gas PoS is converted into a bio-LNG PoS and reflects changes in GHG emissions that result from the liquefaction process                             |
| <b>GO/PoS product</b> |                            |   | → <b>Biomethanol PoS</b>  |
| BIOMETHANOL           | <b>Direct connection</b>   |   | A first biomethanol PoS is issued   |
|                       | <b>Indirect connection</b> | [There is no GO for liquid biofuels foreseen by Art.19 RED II]  | A gas PoS is converted into a biomethanol PoS and reflects changes in GHG emissions that result from the methanol synthesis                           |

A hydrogen GO/PoS should be issued for hydrogen and a gas GO [liquid] should be issued for bio-LNG. If hydrogen has its own GO scheme or is at least identified on the GO as a separate energy carrier compared to other gases, the GO for this energy carrier can be used for hydrogen-specific applications such as fuel cells (for electricity production in hydrogen fuelled vehicles), hydrogen engines, or industrial hydrogen applications. However, some market players are in favour of a generic gas GO for hydrogen. The argument in favour of a general gas GO for all gases is that, if different gases get their own GO scheme, the gas market could become highly dissected and this might lead to an artificial scarcity per specific type of gaseous energy carrier. At the time of writing this report, this is still subject to ongoing discussions within the CEN Standard 16325 working groups. Hence, it is important to mention that the verification guidelines are flexible and easily changeable to facilitate compatibility with requirements of EN16325 which may change over time.

A gas GO [liquid] for bio-LNG requires an initial liquefaction plant verification and a plausibility check of the production input and output flows (see Chapter 6.2.3.). An additional data field for the

"aggregate state" could be implemented with an enumeration: for biomethane, it would be "gaseous"; for LNG, "liquid". This should be interpreted as the aggregation state at the place and time of production and GO issuance, as the aggregation state of the actual gas might change over the gas batch lifetime. Making data fields on a GO subject to change over their lifetime would lead to many error risks along their value chain. Therefore, it is recommended to adhere to the principle of immutability of GOs over their lifetime. In contrast, the PoS for bio-LNG requires a full verification (installation + production batch).

Due to its fundamentally different physical nature and legal status compared to its biomethane input, biomethanol should have its specific biomethanol PoS (see Chapter 6.2.4.). This Deliverable does not propose GO verification guidelines, for biomethanol, since no GO for liquid biofuels is foreseen by Art. 19 RED II.

The rules for cancelling certificates regarding the energy carrier input before issuing a new certificate after conversion, apply equally to GOs and PoS, as this measure is efficient to avoid double counting regardless of the type of certificate. In case the respective cross-sectoral gas technology requires the conversion of the GO/PoS (REGATRACE D4.3.), the following steps need to be followed in order to avoid double counting (FaStGO Task 2 Part 3, 2020).

### **1. Step: Cancelling the input energy GO/PoS for energy carrier conversion**

The energy conversion should be well documented. This documentation of the energy carrier conversion is to be recorded in the cancellation statement relating to the cancelled GO/PoS, and/or organized in the registry, which may suffice in case the cancellation takes place in the same registry as the issuance of the new GO, in order to make energy flows traceable throughout the chain of custody. The energy amount represented by the cancelled GOs/PoS should be in correspondence with measured input energy volumes from the conversion plant.

### **2. Step: GO/PoS issuance**

A new GO/PoS for the produced energy carrier should be issued, based on measured data. After conversion, the issued GO/PoS should contain additional attributes like the GO/PoS ID of the cancelled GOs/PoS.

The information required for the issuance of a GO after conversion can be found in the report FaStGO Task 2 Part 3 (2020). GO/PoS conversion requires a verification process.

The issuing body should verify cancelled GOs/PoS of input energy carriers, provided by the economic operator/account holder. If an audit is required, it shall be documented in the form of a report by an independent third-party auditor and submitted to the GO/PoS issuing body/certification scheme. Before a conversion plant starts its operation, a thorough initial inspection and conversion installation audit is required, while the energy carrier output produced should be verified on an annual basis.

#### **6.2.1. Technology unspecific verification guidelines**

In this section, verification guidelines that are technology un-specific are presented. In order to mitigate the **risk of human error** and increase the **efficiency of the information transfer** needed for issuing cross-sectoral GO/PoS, operations should be executed by smart contracts which are fully automatic (Velazquez Abad & Dodds, 2020).

**Multiple counting** of the same renewable attributes is to be avoided at all time. If renewable gases are traded within Europe along the gas grid, the GOs and PoS should be handled according to the rules of a central European Scheme (REGATRACE D2.4, 2020). A robust and transparent system should be used to avoid multiple counting in case of cross-sectoral and cross-border trade within the EU. Hence,

Art. 28 (2) RED II mandates to implement a **Union database** for documenting PoS in order to prevent fraud by successfully tracing the gaseous and liquid transport fuels and the targets they would be counted towards. The Union database is foreseen for biofuels, which require PoS. Guidehouse (2020) proposes that the database should cover the entire value chain, from the field/farm of origin to the consumption of the biofuel (dena, 2021; Guidehouse, 2020).

With regard to **mass balancing** requirements for PoS, the European gas grid should be considered as one single mass balancing unit regardless of the interconnecting entities. Consequently, GOs/PoS cannot be transferred if the corresponding installations are not connected to the European grid. This automatically excludes countries like Cyprus, Malta and Iceland (OK Power, 2018).

### 6.2.2. Guidelines for Hydrogen

In some MS one **issuing body** is responsible for GOs for several **energy carriers** (e.g., electricity and gas GOs). Other countries have an issuing body for electricity GOs and another one for gas GOs in place. The verification guidelines of hydrogen depends on the following criteria (Velazquez Abad & Dodds, 2020):

- The definition of renewable hydrogen (applies to PoS only)
- The boundaries of the system
- The chain of custody
- Emission intensity threshold (applies to PoS only)
- Eligibility of pathways

The CEN Standard 16325 is currently being updated, which may also have an effect in regard to GO verification for hydrogen. Regarding **PoS**, sustainability certification schemes such as ISCC and certification bodies (e.g., TÜV Süd) have already included hydrogen within their portfolio. Further progress on verification guidelines for hydrogen is being made by project outcomes (e.g. CertifHy) and consultation processes undertaken by e.g. L'Association Française pour l'Hydrogene et les Piles a Combustible (AFHYPAC, France), and the UK Department of Business, Energy and Industrial Strategy (BEIS, UK) (Velazquez Abad & Dodds, 2020).

#### Guidelines for issuing a GO for hydrogen/synthetic methane

When hydrogen is produced, based on electricity supplied via a **direct connection**, a hydrogen GO is directly issued when the energy carrier is being placed on the European market.

When hydrogen is produced, based on electricity supplied via an **indirect connection**, an amount of electricity GOs is to be cancelled in accordance with the measured electricity consumption and an amount of hydrogen GOs is to be issued in correspondence with the measured hydrogen production. The hydrogen GO contains information of the cancelled electricity GOs to prevent double counting, especially with regards to the energy source and any financial support received (see FaStGO Task 2 Part 3, (2020)).

Direct connection accounts for the case (1) if the input power plant being solely connected to the electrolyser (isolated direct connection), and (2) if the input power plant is directly connected to the electrolyser and the public power grid, in order to discharge any surplus electricity (Guidehouse et al., 2020). For the latter option, the developed verification guidelines only apply to the connection between power plant and electrolyser.

When a **diverse infrastructure** will be set up (pure hydrogen grid vs. mixed grid), a **hydrogen GO** could be disclosed on a pure hydrogen grid, since some sensitive applications, such as fuel cells, are simply

not compatible with gas mixes and require a pure hydrogen infrastructure (CertifHy, survey, 2020). The maximum ratio of hydrogen in the gas grid must be set by each country or grid operator, so as not to harm end consumers due to safety issues. On a mixed grid (CH<sub>4</sub>/H<sub>2</sub>) an **Energy Gas GO [Hydrogen]** would be disclosed. An **Energy Gas GO [Hydrogen]** could not be used for disclosure of hydrogen consumption from a pure hydrogen grid.<sup>2</sup>

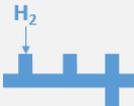
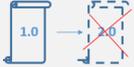
Renewable electricity bought from **PPAs** shall be eligible as a proof of delivery for hydrogen GO issuance (Guidehouse et al., 2020), only in relation with the fulfilment of the criteria regarding renewable electricity procurement according to Art 27 (additionality, temporal and geographical correlation) and accompanied by a GO cancellation.

Table 9 lists the criteria to be verified in relation with issuance of a GO for hydrogen or synthetic methane produced from electricity according to Art. 19 RED II.

Table 9: Verification guidelines for Power-to-H<sub>2</sub>/synthetic methane according to the requirements listed in Art. 19 RED II

| NO. | CRITERIA  | RED II REFERENCE    | VERIFICATION METHOD  |
|-----|---|---------------------|--|
| 1.  | <b>Identity of the installation plant</b>   | Art. 19 (7c) RED II | Initial on-site plant audit/plant layout   |
| 2.  | <b>Location of the installation plant</b>   | Art. 19 (7c) RED II | Initial on-site plant audit  |
| 3.  | <b>Type of the installation plant</b>   | Art. 19 (7c) RED II | Initial on-site plant audit/plant layout   |
| 4.  | <b>Production capacity of the installation</b>  | Art. 19 (7c) RED II | A single record of installed capacity and full hours of use shall be attached to the application e.g. plant layout (FaStGO Task 2 Part 3, 2020)  |
| 5.  | <b>Date on which the installation became operational</b>  | Art. 19 (7e) RED II | Start-date of the contract with a purchaser (e.g., gas grid operator).   |
| 6.  | <b>Date and country of issue</b>  | Art. 19 (7f) RED II | [this information is registered by an independent competent body, which makes it sufficiently reliable]  |
| 7.  | <b>Start and end dates of the production</b>  | Art. 19 (7) RED II  | Metering data of hydrogen production, including start and end dates.   |
| 8.  |  <b>Documentary evidence that the quantity of electricity used for the production was sufficient for the produced quantity of hydrogen</b> |                     | Output metering data (meter number and meter status) confirmed by an independent audit. Examination from the desk with one on-site inspection per year<br><b>Direct connection:</b> metered data from the input quantity of electricity used for fuel production |

<sup>2</sup> This issue is currently being discussed in the working group of the CEN-EN 16325 Standard. The results are expected to be published in 2021.

|     |   |   |  |
|-----|---|---|--|
|     |   |   | in a given time period [MWh] (UBA, 2017).<br><b>Indirect connection:</b> input quantity of electricity purchased by the installation in a given time period [in MWh]. Telemetry data and bills on electricity consumption from the grid operator. Proof of the cancellation of the electricity GOs.  |
| 9.  |    | <b>[If applicable]</b><br><b>Documentary evidence that the quantity of hydrogen was injected into the natural gas network</b> | Meter number, meter status and feed-in meter point must always be documented. TSO/DSO telemetry data (or invoices) (CertifHy, survey, 2020) if a metering device is available. Yearly audits are required in case there are no third-party independent metering devices.   |
| 10. |   | <b>Same energy content is only taken into account once (avoidance of double counting)</b>                                     | Art. 19 (2) RED II<br><b>Direct connection:</b> Proof that no GO has been issued for the input power. To ensure this, it must be proven that the plant is either (1) not registered in the guarantee of origin system or, (2) if registered, that no corresponding guarantees of origin have been issued for the amount of electricity used in the electrolyser at the times of the respective operating hours. This can be verified either via self-declaration or via third-party audit.<br><b>Indirect connection:</b> Confirmation of electricity GO cancellation. |
| 11. |  | <b>Financial State Aid</b>  | Art. 19 (2) RED II<br>Self-declaration and audit that no state aid was used.   |
| 12. |  | <b>Investment support of the installation</b>   | Art. 19 (7d) RED II<br>Self-declaration and audit that no state aid was used.  |
| 13. |  | <b>(Renewable) Energy Source<sup>3</sup></b>  | Art. 19 (1) RED II<br><b>For renewable energy (if this evidence cannot be provided, the energy carrier input would be regarded as fossil):</b>   |

<sup>3</sup> For PoS issuance the energy source must be renewable

**Direct connection:**

On-site audit: Plant layout including proof that the conversion plant is exclusively connected to a renewable power plant. Plausibility check via comparison with hydrogen output

**Indirect connection:**

TSO/DSO telemetering power input data (or invoices) of the grid feed-in must match the energy amount of the electricity GOs and the input meters of the electrolysis.

### Guidelines for issuing a PoS for hydrogen/ synthetic methane

For PoS, the GO criteria from the previous chapter must be verified as well as additional PoS-specific criteria, which are discussed in the following.

When hydrogen is produced from electricity supplied via a **direct connection**, a first hydrogen PoS is issued when the energy carrier has been placed on the European market.

When hydrogen is produced from electricity supplied via an **indirect connection**, a first hydrogen PoS is issued when the energy carrier has been placed on the market, since no power PoS exists. However, the power input has to fulfil certain criteria, which needs to be verified (see Table 12).

**Renewability.** This means all RE sources, except for bio-based RE should be eligible (see definition of RFNBO). GO cancellation shall be used in order to prove the origin of the electricity consumed (EECS, 2019).

Guidehouse (2020) introduces two options - that are currently under discussion to prove the **additionality of renewable energy production** (→ Glossary): (1) by new, unsubsidized electricity assets, or (2) by existing, previously subsidized electricity assets. Thus, additionality is proven by the absence of being linked to the respective subsidy scheme. Thus, a plant, which has not received a subsidy, is regarded as additional. This is the case e.g., in the UK and Germany. According to the German Renewable Energy Act (EEG), even installations that have received subsidies in the past, cannot be regarded as additional, which makes hydrogen not an attractive business case for post EEG-power plants<sup>4</sup>. It is still under discussion if existing, previously subsidized electricity plants should be considered as “additional” by the amendment of the EEG in 2021.

Also the Global Alliance Powerfuels (2020b) proposes to prove additionality by the absence of offtake subsidies for a specific renewable electricity production unit. Guidehouse et al. (2020) suggests to prove **additionality** only for the direct connection and only via the absence of received subsidies, whereas REGATRACE D4.1. suggests aside from subsidy provision (for specific MS), also to prove state aid tender participation (for specific MS) as well as the comparison of operation dates of the installations. Guidehouse et al. (2020) also identified criteria for surplus electricity (e.g. through negative spot market prices). However, this is not required by the RED II and therefore not included in this report.

<sup>4</sup> A post-EEG plant is a plant, which does not receive a subsidy under the German Energy Act (EEG) anymore.

**Temporal Correlation.** A criterion must be designed to ensure some degree of correlation between electricity production by the renewable energy plant and consumption by the electrolyser (Global Alliance Powerfuels, 2020b). Our suggestion is shown in Table 10 and is aligned with the suggestion by the Global Alliance Powerfuels (2020b) report. The Imbalance Settlement Period (ISP) accounts for 15 min. However, Global Alliance Powerfuels (2020b) recommends to gradually implement a stricter regulatory threshold for temporal correlation, since implementing a strict threshold from the beginning could disable market developments (Global Alliance Powerfuels, 2020b). For the verification process, electricity and gas production dates must be stated on the GO. Guidehouse et al. (2020) proposes four different verification possibilities: (1) contracted asset(s), full intraday matching which equals our suggesting for the time period after 2030, (2) any RES-E unit(s), full intraday matching, (3) any RES-E unit(s), partial matching which equals our suggestion for the time period 2020-2030, and (4) system level partial matching.

*Table 10: Regulatory proposal for temporal correlation (Global Alliance Powerfuels, 2020b)*

| Year of Plant Commissioning   | 2020-2025 | 2026-2030 | After 2030                        |
|-------------------------------|-----------|-----------|-----------------------------------|
| Required Temporal Correlation | Daily     | Hourly    | Imbalance Settlement Period (ISP) |

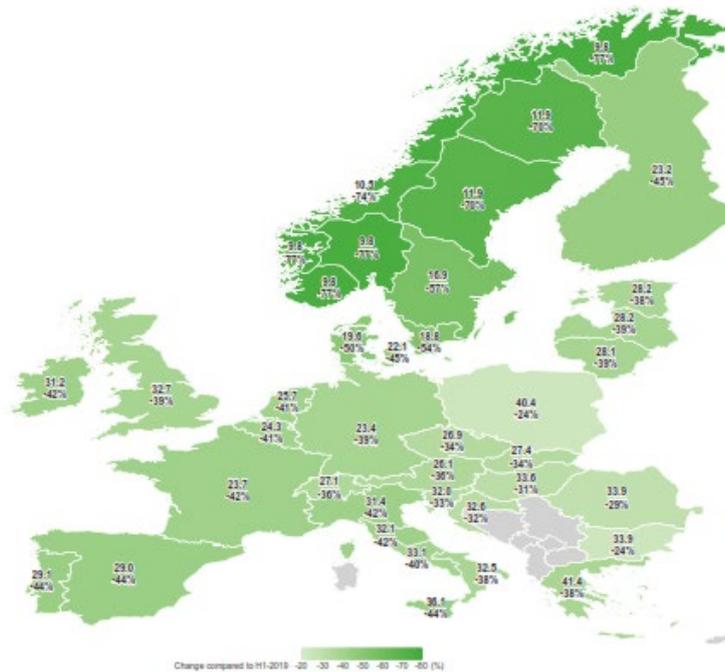
It can be noted that on a voluntary basis, as well in Europe as in the rest of the world, there are cases coming up where GOs and other energy attribute tracking certificates indicate the hour of production and investigate the concept of hourly matching of consumption with the production hour of the energy for which the GO has been issued. EnergyTag is looking into setting up a global voluntary standard for this (EnergyTag, 2020). The Danish and Dutch electricity GO issuing bodies are involved, each developing their proof-of-concept (see Appendix – Denmark).

**Geographical Correlation.** A Criterion must be designed to ensure some degree of geographical correlation between electricity production and consumption (Global Alliance Powerfuels, 2020b). Production plant and power plant should be located in the **same bidding zone**, and not be separated by permanent grid congestion (Global Alliance Powerfuels, 2020b). Aside from the same bidding, Guidehouse et al. (2020) suggests three additional options: (1) same country, (2) same side of grid congestion within one bidding zone, and (3) different zones if coupling capacity allows for it (Guidehouse et al., 2020). However, we suggest the same bidding zone, since it is simple to verify in different MS. Option (2) and (3) would allow for a strong geographical correlation, but it would be very challenging to assess. Guidehouse proposes to base the verification on ENTSO-E and ACER reporting (Guidehouse et al., 2020).

Box 1: What is a bidding zone (ACER, 2020; ofgem, 2014)?

Excursus: *What is a bidding zone?*

A **bidding zone** is defined as the largest geographical area in which market participants are able to exchange energy without capacity allocation. In Europe, MS follow different approaches on the criteria of a bidding zone. The majority of bidding zones in EU MS are defined by national borders (e.g., France, the Netherlands). Some MS have smaller bidding zones than their national borders (e.g. Italy, Norway or Sweden) (ofgem, 2014).



Source: ACER calculations based on ENTSO-E data.

Figure 1: Bidding zone configuration (ACER, 2020)

Delineation of bidding zones is either realized via “nodal pricing” or zonal pricing. ‘Nodal pricing’ is a localized price that any generator faces, which reflects the short run marginal costs of generation and transmission, taking into account network constraints. This pricing system is beneficial the more decentralized the renewable generation becomes. ‘Zonal pricing’ is the grouping of similar nodal prices. The number of zones depends on the price variations. Zonal pricing are implemented by Italy and the Nordic countries, as described above (ofgem, 2014).

**Eligible carbon sources for synthetic methane production are** carbon sources which were not deliberately produced, as stated in dena biogasregister criterion #46(b) (dena, 2018). For instance, waste fossil sources (waste flue gases from coal and natural gas power generation or similar industrial combustion processes), from biological sources (e.g., alcohol fermentation or anaerobic digestion) or from atmospheric or naturally occurring/ geothermal sources (GGCS, survey, 2020). Evidence should be provided that CO<sub>2</sub> is not used to claim a GHG credit elsewhere, and would have been otherwise emitted to the atmosphere. If not all carbon sources will be eligible, additional verification guidelines for the carbon source will be required. The CO<sub>2</sub> source could be verified/documentated by a tracking

slip/monitoring sheets including audits of the production plants, as illustrated in the French example or by specific CO<sub>2</sub> GOs (GRDF, survey, 2020).

**GHG calculations and assigning carbon reduction credits.** The emission accounting boundaries are a life cycle assessment comprising extraction and processing of raw materials until their final use excluding the transport and supply to the consumer as well as manufacturing or building on the capital, as stated in the methodology followed by Annex V or VI RED II. One of the first questions regarding GHG calculations is who receives the credits and who receives the burden? As shown in Figure 8, a steel factory (primary emitter) produces steel (product A) and off-gas including carbon dioxide as a by-product. If the emitter and the conversion plant operate under the same framework for carbon trading, the carbon dioxide would be purchased by a methane plant (CO<sub>2</sub> conversion plant) and converted to synthetic methane (product B). If the emitter falls under the ETS scheme, and he sells CO<sub>2</sub> to the conversion plant, he automatically releases CO<sub>2</sub> certificates, which he is able to sell.

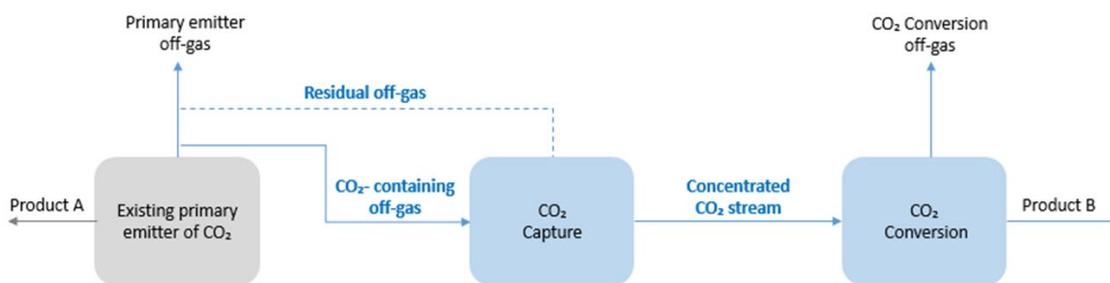


Figure 8: Schematic flow of carbon in a CCU value chain (DG ENER, 2020)

In order to answer the question “who benefits from the carbon transfer?”, DG ENER addresses different allocation shares (see Table 11). There is no standard rule in place how to account for different carbon sources (fossil-based/biogenic carbon). So far, DG ENER states that the CO<sub>2</sub> emitter is treated unchanged, while the CO<sub>2</sub> conversion plant gets the CO<sub>2</sub> reduction credited. For the direct/indirect emissions associated with CO<sub>2</sub> capture it would depend on if the CO<sub>2</sub> would have been separated either way or not. If the CO<sub>2</sub> would have been separated anyway to obtain a marketable product A (e.g., biogas upgrading to biomethane), the direct/indirect emissions associated with CO<sub>2</sub> should be allocated to the emitter. In case of the biomethane operator being the emitter, it could lead to negative CO<sub>2</sub>-emissions for the biomethane plant. If the carbon would not have been separated without its demand, emissions related to it would be allocated to the PtG plant.

*Table 11: Allocation shares of carbon burden (DG ENER, 2020)*

| ALLOCATION SHARE | DESCRIPTION   |
|------------------|---|
| <b>100:0</b>     | <p>The CO<sub>2</sub> emitter is treated unchanged<br/>The CO<sub>2</sub> conversion plant gets the CO<sub>2</sub> reduction credited</p> <p>Direct/indirect emissions associated with CO<sub>2</sub> capture:<br/>Direct/indirect emissions associated with CO<sub>2</sub> capture should be allocated to the CO<sub>2</sub> conversion plant, unless the CO<sub>2</sub> would have been separated anyway to obtain a marketable product A (e.g., biogas upgrading to biomethane). In such a case, direct/ indirect emissions associated with CO<sub>2</sub> should be allocated to the emitter.</p> |
| <b>50:50</b>     | <p>CO<sub>2</sub> emitter and CO<sub>2</sub> conversion plant each receive 50% of the total CO<sub>2</sub> reduction credits.<br/>Here it would have to be proven that both plants are equally responsible for the GHG reduction.</p>   |
| <b>0:100</b>     | <p>The CO<sub>2</sub> emitter gets credit for the CO<sub>2</sub> reduction.<br/>This allocation makes sense in an increasingly decarbonized economy; concentrated CO<sub>2</sub> would become a scarce resource and could therefore be treated as a by-product.</p>   |

The theoretical **water consumption** of hydrogen production is about 0.27 l/kWh. The actual water consumption is approximately 10-15% higher (VBI, 2015). A **water consumption** threshold in form of a **water efficiency criteria [l/kWh hydrogen output]** should be implemented. Since water stress looks different in the South of Europe compared to the North, this threshold value should be based on a global water stress map at NUT-2 level to avoid excessive water consumption. RED II does not address water consumption yet. Thus, the following water consumption criteria should be implemented in the RED II:

- The electrolyzers for the production of RFNBO must not be installed in areas with sinking water levels.
- Electrolyzers must not increase the risk of lowering the groundwater level.
- The water consumption of the electrolyser for the production of RFNBOs shall not affect the existing water supply of companies and private households with respect to the geographical correlation.

### Mass Balancing

In case of hydrogen/methanation of hydrogen, we recommend regarding the electrolyser/methanation plant as the final stage of its mass balancing. But this has not been determined yet. When hydrogen is fed into a pure hydrogen grid, mass balancing enables to distinguish green from other types of hydrogen. In this case mass balancing, can be verified as follows.

### Verification of green hydrogen mass balancing when fed into a pure hydrogen grid:

- Hydrogen supply contract and meter data must be provided along the entire chain of custody
- The delivery has been documented in a mass balance system

- Evidence that injected renewable gas amounts match extracted gas amounts
- Documentation of interface point (injection and extraction meter points)

Table 12 shows the proposed verification guidelines for issuance of PoS for conversion of electricity into hydrogen or synthetic methane.

Table 12: Verification guidelines for Power to H<sub>2</sub>/synthetic methane according to the requirements listed in RED II Art. 25ff

| NO.   | CRITERIA  | RED II REFERENCE                             | VERIFICATION METHOD   |
|---|---|--|---|
| 1.<br>   | Additional renewable energy has been used<br><b>(Additionality)</b> | Art. 27 (3) RED II                           | <p><b>Direct connection:</b> operation date of the power plant(s) and the electrolyser(s) must be disclosed.<br/>The power plants must have started operation at the same time or after the electrolyser.</p> <p style="text-align: right;"><b>Indirect connection:</b></p> <ul style="list-style-type: none"> <li>- Operation date of the power plant(s) and the electrolyser(s): the power plant must have started operation at the same time or after the electrolyser</li> <li>- For the electricity used in the electrolyser, GOs are cancelled to prove the origin of the energy source; these should be only GOs which mention that no production support nor investment support has been received for the production of the corresponding amount of energy</li> </ul> <p><u>Further evidence needs to be provided that:</u></p> <ul style="list-style-type: none"> <li>- The power plant has not received a comprehensive subsidy (proof should be issued by a competent public authority or the electricity grid operator), since commissioning date (e.g., UK, Germany)</li> <li>- The power plant has not participated in any state aid tender or received any other privileged access (e.g., feed in tariffs, feed in premiums, quota obligation) to the electricity grid since commissioning date (e.g., Germany)</li> </ul> |
| 2.<br> | <b>Temporal correlation</b>   | Art. 27 (3a) RED II<br><br>recital 90 RED II | <p><b>Direct connection:</b> [RED II does not specify any requirements for direct connections, as it ensures that the electricity is actually physically renewable]</p> <p><b>Indirect connection:</b> for the power plant, proof should be provided by the responsible TSO or DSO or a competent body. Proof of amount and time electricity was fed into the public grid and proof of electricity consumption by the electrolyser (time and</p>  |

|   |  |  |  |
|---|--|--|--|
|   |  |  | <p>amount) is needed. Comparison if the operating hours and the quantities consumed, match each other. For the timeframe 2020-2025 a temporal correlation of 24h is sufficient (Global Alliance Powerfuels, 2020b), as there are countries where 15-minute billing cannot be guaranteed yet. The production period on the gas PoS should be maximum 24 hours after the power generation.</p> <p>It will be beneficial if GOs are issued which have an hourly timestamp, indicating the hour of production, in addition to the date of production.</p>  |
| <p>3.</p>    | <p><b>Geographical correlation</b></p>   | <p>Art. 27 RED II, recital 90 RED II</p> | <p>Production plant and power plant should be located in the same bidding zone, and not be separated by permanent grid congestion (Global Alliance Powerfuels, 2020b)</p> <p>Proof of this must be obtained from the responsible electricity grid operator or market area manager. Evidence can be provided and verified by various parties:</p> <ul style="list-style-type: none"> <li>- Comparison of production device location on the GO</li> <li>- On the basis of fixed criteria of the bidding zone (auditor)</li> <li>- By issuing a declaration by a competent body</li> <li>- If the bidding zone is not defined, proof should only be provided by the competent authority by means of a declaration of distance allowances</li> </ul> |
| <p>4.</p>  | <p>In case of methanation: No deliberate generation of CO/CO<sub>2</sub> (dena biogasregister criteria #46,(dena, 2018))</p> | <p>No RED II criterion available yet</p> | <p>Proof of the emitter that the amount of CO<sub>2</sub> corresponds to the production quantity of the main product and that the emitter has not increased CO<sub>2</sub> emissions for the methanation. As proof, evidence of the emitter's CO<sub>2</sub> emissions over the last two years as well as his main product's output quantities should be submitted here.</p>   |
| <p>5.</p>   | <p><b>Carbon source (fossil-based</b></p>  | <p>No RED II criterion available yet</p> | <p>If CO<sub>2</sub> emitter and producer of RFNBO are not the same legal entity, a takeover agreement</p>   |

|   |  |  |  |
|---|--|--|--|
|  | carbon, biogenic carbon, CAC)  |  | between both parties must state the type source of the CO <sub>2</sub> that was delivered. Furthermore, the emitter must provide a self-declaration how he accounted for the sold carbon within his GHG performance calculation, in order to avoid that the same CO <sub>2</sub> amount is used for GHG crediting twice. |
|  | <b>6. Life-cycle greenhouse gas emissions savings</b><br>[g CO <sub>2</sub> eq/MJ] | Art. 28 (2; 6d) RED II; Annex V or VI RED II | GHG calculation based on RED II methodology which is verified by an independent third-party audit. (see REGATRACE D5.1 on methodology)   |
|  | <b>7. Water consumption</b>  | Art. 30 (4) RED II                           | (1) Water meter data<br>(2) Invoices of the water supply of the production period<br>Plausibility check by comparison with hydrogen output. The water consumption/hydrogen output should not exceed a set threshold (see text above). Proof must be provided by the competent authority for water supply.                |

### 6.2.3. Guidelines for Bio-LNG

Liquefied biomethane (bio-LNG) is included in the British registry (see Annex - UK). The Belgian Greengasregister is currently developing GO verification guidelines for bio-LNG. Furthermore, the German biogasregister is aiming to include bio-LNG within its portfolio by 2021. Examples of existing (national) PoS registries regarding liquid biofuels are eIna (Austria), Nabisy (Germany), Transport for Energy Register (the Netherlands), RTFO Operating System (UK), and Bioledger and Trace Your Claim (TYC) (Guidehouse, 2020).

In regard to a direct connection, GO and PoS verification guidelines for the biomethane volume need to follow the requirements set by the respective state/voluntary biomethane scheme listed in the Annex of REGATRACE D3.1. (2019) or by a certification scheme (e.g., ISCC).

The present report will solely focus on additional requirements for verifying biomethane liquefaction. In most EU countries, the **natural gas infrastructure** consists of a gas grid. However, some countries also transport biomethane via road (e.g., Sweden, Finland, Ireland).

#### Guidelines for issuing a gas GO for Bio-LNG

For bio-LNG, it has to be decided if a new GO is issued or if the biomethane GO is kept because some stakeholders argue that biomethane and bio-LNG have the same calorific value. However, this is not always the case. If biomethane is withdrawn from the gas grid, it has to be purified before liquefaction can take place. The calorific value could change through this purification process. If the calorific value of biomethane and bio-LNG differs significantly (in some cases), it is an argument in favour of a separate bio-LNG GO. This would require a separate code in the CEN standard 16325. However, as our survey has shown that the majority of the respondents are in favour of keeping the biomethane GO for bio-LNG, we present the corresponding verification guidelines:

When bio-LNG is produced through a **direct connection**, a first gas GO [liquid] is issued when the final energy carrier is placed on the European market.

When bio-LNG is produced through an **indirect connection**, the aggregation state is added to a gas GO [liquid].

Since we recommend to not issue a new GO, but keep the biomethane GO with additional information on the aggregate state, only one initial plant audit of the liquefaction plant is needed plus a proof that enough gas GOs were available for the bio-LNG production. There is no risk of double counting, if the same GO is used. Table 13 below lists the criteria to be verified in relation with issuance of a gas GO [liquid] for bio-LNG produced from biomethane according to Art. 19 RED II.

Table 13: Verification guidelines for biomethane to bio-LNG according to the requirements listed in Art.19 RED II

| NO. | CRITERIA  | RED II REFERENCE    | VERIFICATION METHOD   |
|-----|---|---------------------|---|
| 1.  | <b>Identity of the installation plant</b>   | Art. 19 (7c) RED II | Initial on-site plant audit/ plant layout   |
| 2.  | <b>Location of the installation plant</b>   | Art. 19 (7c) RED II | Initial on-site plant audit   |
| 3.  | <b>Type of the installation plant</b>   | Art. 19 (7c) RED II | Initial on-site plant audit/ plant layout   |
| 4.  | <b>Production capacity of the liquefaction installation</b>   | Art. 19 (7c) RED II | A single record of installed capacity and full hours of use shall be attached to the application e.g. plant layout (FaStGO Task 2 Part 3, 2020)   |
| 5.  | <b>Date on which the liquefaction installation became operational</b>   | Art. 19 (7e) RED II | Start-date of the contract with the customer (e.g., fuel station)   |
| 6.  | <b>Date and country of issue</b>  | Art. 19 (7f) RED II | [this information is registered by an independent competent body, which makes it sufficiently reliable]   |
| 7.  | <b>Start and end dates of the production</b>  | Art. 19 (7) RED II  | Energy metering data of liquefaction plant, including start and end dates   |
| 8.  | <b>Documentary evidence that the quantity of biomethane used for the production was sufficient for the produced quantity of bio-LNG</b> |                     | Output metering data (meter number and meter status) confirmed by an independent third-party audit. Examination from the desk with one on-site inspection per year.<br><b>Direct connection:</b> metered data from the input quantity of biomethane used for fuel production in a given time period [MWh] (UBA, 2017).<br><b>Indirect connection:</b> input quantity of biomethane purchased by the installation in a given time period [in MWh]. Telemetering data and bills on biomethane consumption from the grid operator/logistics company. |
| 9.  | <b>Financial State Aid</b>  | Art. 19 (2) RED II  | Self-declaration and audit that no state aid was used. [Note: Test not necessary, as proof of the biomethane quantity already exists]   |



|   |   |                     |  |
|---|---|---------------------|--|
| <b>10.</b><br> | <b>Investment support of the installation</b> | Art. 19 (7d) RED II | Self-declaration and audit that no state aid was used  |
| <b>11.</b><br> | <b>(Renewable) Energy Source</b>              | Art 19 (1) RED II   | <p><b>For renewable energy (if this evidence cannot be provided, the energy carrier input would be regarded as fossil):</b></p> <p><b>Direct connection:</b><br/>         on-site audit: Plant layout including proof that the liquefaction plant is exclusively connected to a biomethane plant. Plausibility check via comparison with bio-LNG output</p> <p><b>Indirect connection (grid):</b><br/>         TSO/ DSO telemetering biomethane input data (or invoices) of the grid feed-in must match the energy amount of the biomethane GOs and the input meters of the liquefaction plant.</p> <p><b>Indirect connection (road transport):</b><br/>         invoice where the amount of biomethane being transported is clearly stated and an external audit verifies the correctness of the invoice information. If the biomethane volume is produced and transported by the producer, then an external audit certifying the amount being transported is needed.</p> |

### Guidelines for issuing a PoS for Bio-LNG

For PoS, the GO criteria from the previous chapter must be verified as well as additional PoS-specific criteria, which are discussed in the following.

When bio-LNG is produced through a **direct connection**, a first bio-LNG PoS is issued when the energy carrier is being placed on the European market.

When bio-LNG is produced through an **indirect connection**, a Biomethane PoS is cancelled and a bio-LNG PoS is issued. The bio-LNG PoS contains information of the cancelled Biomethane PoS to prevent double counting.

In regard to bio-LNG PoS, liquefaction plants require high energy inputs, since biomethane needs to be cooled down to -162°C in order to be liquefied. This has a significant impact on the GHG performance of bio-LNG. Therefore, we conclude that a new PoS [bio-LNG] needs to be issued.

### GHG performance

As the **GHG emissions** in relation to the liquefaction of gas are significant and can vary considerably between technologies and concepts, a certification and verification of the liquefaction plant as well as the generated fuel are necessary, since the RED II aims to reduce GHG emissions from biofuels by 80 % beyond 2026 (Art. 29 (9d) RED II). According to Gilbert et al. (2018), liquefaction efficiency, methane yield, extent of flaring, and methane slip are the life cycle hotspots of bio-LNG.

### Mass balancing approach

Mass balancing from field to final product should take place until the last processing interface (in this case the liquefaction plant) if the production installation is the last point in the supply chain before bringing it to the market (AGCS & ERGaR, survey, 2020). Hence, the transportation of the bio-LNG is not considered, as the liquefaction plant is expected as the place of final consumption particularly within a refuelling station. If the liquefaction plant is just an intermediate step, because it will be transported further through trucks or ships, additional mass balancing till the place of final end use is required. However, the biomethane transportation is always included.

There are four documentation stages of mass balancing:

- 1) Biomass from field to biomethane plant
- 2) Conversion from biomass to biomethane
- 3) Transport from biomethane plant via e.g., gas grid to liquefaction plant
- 3) Gas extraction from the gas grid

The verification guidelines distinguish between direct connection and indirect connection (road and pipeline). The correctness of the mass balancing information must be verified by an external auditor. The following data is required for the verification process of mass balancing bio-LNG (see Table 14):

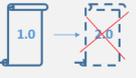
*Table 14: Required information to prove mass balancing of bio-LNG produced via a direct and indirect connection to the biomethane plant.*

| Direct connection  | Indirect connection   |
|--|---|
| <p><b>Mass balancing from field to final product</b></p> <ul style="list-style-type: none"> <li>• Evidence of sufficient quantity of gas in the direction claimed within the time frame of the mass balance</li> <li>• Evidence that there is a physical connection via a pipeline between the input site and the point of extraction on the plant layout; the consumer at the extraction point is the one who gets the PoS issued</li> <li>• Meter data of biomethane output at the biomethane plant and meter data of the biomethane input at the liquefaction plant</li> <li>• Any conversion factors that affect the final supplied quantity of gas (e.g., methane slip)</li> </ul> <p><b>Liquefaction plant via truck to fuelling station</b></p> | <p><b>Mass balancing from field to final product</b></p> <p><b>General:</b></p> <ul style="list-style-type: none"> <li>• Biomethane supply contract</li> <li>• The delivery has been documented in a mass balance system</li> <li>• Evidence of sufficient quantity of gas in the direction claimed within the time frame of the mass balance (e.g., via cancelled biomethane PoS)</li> <li>• Any conversion factors that affect the final supplied quantity of gas (e.g., methane slip)</li> </ul> <p><b>Pipeline:</b></p> <ul style="list-style-type: none"> <li>• Documentation of Interface point (injection and extraction meter points)</li> <li>• Evidence that there is a physical connection via pipeline between the</li> </ul> |

- Bio-LNG supply contract
  - The delivery has been documented in a mass balance system
- input site and the point of extraction
- Actual data for grid loss adjustments (If not available, use national average figures)
- Liquefaction plant via truck to fuelling station**
- Bio-LNG supply contract
  - The delivery has been documented in a mass balance system

Table 15 lists the criteria to be verified in relation with issuance of a PoS for bio-LNG produced from biomethane.

Table 15: Verification guidelines for biomethane to bio-LNG according to the requirements listed in RED II Art. 25ff

| NO.  | CRITERIA   | RED II REFERENCE                                   | VERIFICATION METHOD   |
|--|--|--|---|
| 1.   | The biomass fulfils the sustainability criteria according to RED II (yes/no)     | Art. 26 (2-6) RED II, Annex IX Part A and B RED II | <b>Direct connection:</b> the biomass needs to be audited according to the RED II sustainability criteria of the respective national PoS scheme<br><b>Indirect connection:</b> PoS [biomethane]   |
| 2.  | Same energy content is only taken into account once ( <b>multiple counting</b> ) | Art. 28 (1) RED II                                 | <b>Direct connection:</b> proof that no PoS has been issued for the input biomethane.<br><b>Indirect connection:</b> confirmation of biomethane PoS cancellation and specific ID numbers being transferred. The scheme operator shall allow a tracking system for the ID numbers, either public (e.g., ISCC, dena biogasregister) or upon request (AGCS & ErGar, survey, 2020). |
| 3.  | Life-cycle greenhouse gas emissions savings [g CO <sub>2</sub> eq/MJ]            | Art. 28 (2; 6d) RED II; Annex V or VI RED II       | GHG manual calculation based on RED II methodology, which is verified by an independent third-party audit.  |

#### 6.2.4. Guidelines for Biomethanol

As shown in Chapter 2.3., several biomethanol production paths exist, which makes the development of PoS verification guidelines challenging. GOs are not foreseen for liquid biofuels according to Art. 19 RED II. Available (national) PoS registries for biomethanol are the same as for bio-LNG: eINa (Austria), Nabisy (Germany), Transport for Energy Register (the Netherlands), RTFO Operating System (UK), Bioledger, and Trace Your Claim (TYC) (Guidehouse, 2020). In regard to a direct connection, PoS

verification guidelines for the biomethane volume need to follow the requirements set by a sustainable certification scheme. In the present report, we will solely focus on additional requirements for which biomethanol production has to comply with.

In most EU countries the **natural gas infrastructure** consists of a gas grid. However, some countries also transport biomethane via road (e.g., Sweden, Ireland).

### Guidelines for issuing a biomethanol PoS

When biomethanol is produced through a **direct connection**, a first biomethanol PoS is issued when the energy carrier is being placed on the European market.

When biomethanol is produced through an **indirect connection**, a biomethane PoS is cancelled and a biomethanol PoS is issued. The biomethanol PoS contains information of the cancelled biomethane PoS to prevent double counting.

### GHG emission

The GHG performance of biomethanol has strong variations depending on emissions from the provision of renewable raw materials, energy-intensive processing of the biogas to natural gas quality, and the followed methanol production path (Majer & Gröngröft, 2010).

### Mass balancing approach

Since biomethanol and fossil-based methanol have identical chemical properties, simple weighting for mass balancing purposes is sufficient. First of all, the amount of feedstock input per tonne of biomethanol output needs to be determined. In the next step, geographical and temporal system boundaries need to be defined. We propose one year as a time span in which all raw material streams with their attributed quality need to be reconciled. Evidence must be provided, showing that all production systems of the value chains are physically interconnected. This includes transportation via trucks, pipelines, ships, trains, etc. This can take place on-site or even among different countries (Ellen Macarthur Foundation, 2019). The conversion facility is regarded as the last stage for mass balancing from field to final product.

The following data is required for the verification process of mass balancing biomethanol (see Table 16):

*Table 16: Required information to prove mass balancing of biomethanol produced through a direct or an indirect connection to the biomethane plant.*

| Direct connection   | Indirect connection  |
|---|--|
| <p><b>Mass balancing from field to final product</b></p> <ul style="list-style-type: none"> <li>• Evidence of sufficient quantity of gas in the direction claimed within the time frame of the mass balance</li> <li>• Evidence that there is a physical connection by means of a pipeline between the biomethane installation (input) and the biomethanol conversion installation</li> <li>• Meter data of biomethane output at the biomethane plant and meter data of the biomethane input at the biomethanol refinery</li> </ul> | <p><b>Mass balancing from field to final product</b></p> <p><b>General:</b></p> <ul style="list-style-type: none"> <li>• Biomethane supply contract</li> <li>• The delivery has been documented in a mass balance system</li> <li>• Evidence of sufficient quantity of gas in the direction claimed within the time frame of the mass balance</li> <li>• Any conversion factors that affect the final supplied quantity of gas (e.g., methane slip)</li> </ul> <p><b>Pipeline:</b></p> |

- Any conversion factors that affect the final supplied quantity of gas (e.g., methane slip).

**Biomethanol refinery via truck to fuelling station**

- Biomethanol supply contract
- The delivery has been documented in a mass balance system

- Documentation of interface point (feed-in meter point, feed-out meter point)
- Evidence that there is a physical connection via pipeline between the input site and the point of extraction
- Actual data for grid loss adjustments (If not available, use national average figures)

**Biomethanol refinery via truck to fuelling station**

- Biomethanol supply contract
- The delivery has been documented in a mass balance system

Table 17 lists the criteria to be verified in relation with issuance of a PoS for biomethanol produced from biomethane.

Table 17: Verification guidelines for biomethane to biomethanol according to the requirements listed in RED II Art. 25ff

| No. | Criteria   | RED II reference    | Verification method  |
|-----|--|---------------------|--|
| 1.  | Identity of the installation   | Art. 19 (7c) RED II | Initial on-site plant audit/ plant layout  |
| 2.  | Location of the installation   | Art. 19 (7c) RED II | Initial on-site plant audit  |
| 3.  | Type of the installation   | Art. 19 (7c) RED II | Initial on-site plant audit/ plant layout  |
| 4.  | Production capacity of the installation  | Art. 19 (7c) RED II | A single record of installed capacity and full hours of use shall be attached to the application e.g. plant layout (FaStGO Task 2 Part 3, 2020)  |
| 5.  | Date on which the installation became operational  | Art. 19 (7e) RED II | Start-date of the contract with the customer (e.g., fuel station)  |
| 6.  | Date and country of issue  | Art. 19 (7f) RED II | [this information is registered by an independent competent body, which makes it sufficiently reliable]  |
| 7.  | Start and end dates of the production  | Art. 19 (7) RED II  | Metering data of biomethanol conversion installation, including start and end dates  |
| 8.  |  Documentary evidence that the quantity of biomethane used for the production was sufficient for the produced quantity of biomethanol |                     | Output metering data (meter number and meter status) confirmed by an independent third-party audit. Examination from the desk with one on-site inspection per year.<br><b>Direct connection:</b> metered data from the input quantity of biomethane used for fuel production in a given time period [MWh] (UBA, 2017)<br><b>Indirect connection:</b> input quantity of biomethane purchased by the installation in a given time period [in MWh]. |

|  |  |  |   |
|--|--|--|---|
|  |  |  | Telemetry data and bills on biomethane consumption from the grid operator/logistics company   |
| 9.<br>    | Same energy content is taken into account only once (multiple counting)      | Art. 28 (1) RED II                                 | <b>Direct connection:</b> proof that no PoS has been issued for the input biomethane<br><b>Indirect connection:</b> confirmation of biomethane PoS cancellation and specific ID numbers being transported. The scheme operator shall allow a tracking system for the ID numbers, either public (like ISCC, dena biogasregister or upon request (AGCS & ERGaR, survey, 2020)   |
| 10.<br>   | Financial State Aid  | Art. 19 (2) RED II                                 | Self-declaration and audit that no state aid was used   |
| 11.<br>   | Investment support of the installation                                       | Art. 19 (7d) RED II                                | Self-declaration and audit that no state aid was used   |
| 12.<br> | Renewable energy has been exclusively used (Renewability)                    | Art. 27 (3b) RED II, recital 90 RED II             | <b>Direct connection:</b><br>On-site audit: Plant layout including proof that the conversion plant is exclusively connected to a biomethane plant. Plausibility check by comparison with biomethanol output.<br><b>Indirect connection (grid):</b> TSO/ DSO telemetry biomethane input data (or invoices) of the grid feed-in must match the number of biomethane PoS and the input meters of the conversion plant.<br><b>Indirect connection (road transport):</b> invoice where the amount of biomethane being transported is clearly stated and an external audit verifies the correctness of the invoice information. If the biomethane volume is produced and transported by the producer, then an external audit certifying the amount being transported is needed. |
| 13.<br> | The biomass fulfils the sustainability criteria according to RED II (yes/no) | Art. 26 (2-6) RED II, Annex IX Part A and B RED II | <b>Direct connection:</b> Needs to be audited according to the sustainability criteria of the respective national PoS scheme<br><b>Indirect connection:</b> biomethane PoS  |
| 14.<br> | Life-cycle greenhouse gas emissions savings [g CO <sub>2</sub> eq/MJ]        | Art. 28 (2; 6d) RED II; Annex V or VI RED II       | GHG manual calculation based on RED II methodology, which is verified by an external auditor.   |

## 7. Discussion

This study develops verification guidelines for power-to-hydrogen/ synthetic methane and biomethane to bio-LNG/ biomethanol. In Europe, there needs to be consistency of GO and PoS schemes regarding various energy carrier conversion pathways. This is particularly relevant if an electricity GO or a biomethane GO should validate the production of renewable hydrogen, bio-LNG, or biomethanol. Harmonized verification guidelines of cross-sectoral technologies can promote cross-border trade and facilitate sector coupling.

In order to address the questions stated in the introduction, the **major hurdles of cross-sectoral verification guidelines** have been identified as follows: *a lack of agreement regarding the GO/PoS handling with respect to energy carrier conversion, diverse infrastructures, or mass balancing, a lack of harmonized verification methods, lack of compatibility among national registries, and a lack of a robust tracking system for all types of transport* e.g. realized by full-automated telemeters (Chapter 6.1.).

Another (technology-unspecific) issue which rekindles the debate around verification guidelines is if a **GHG value** should be included in the GO. We recommend doing so, by adding an optional data field on the GO. In Estonia, GOs can be used to contribute to the national renewable energy targets under Art. 3 RED II (see Annex- Estonia). That would require the redesign of both systems. The topic on GHG methodologies of power-to-methane plants and their different feedstock pathways is further elaborated in REGATRACE WP5.

The upcoming delegated act, national interpretation and implementation of RED II, as well as modifications in the legal framework conditions create further uncertainties.

This report distinguishes between technology-unspecific and specific barriers and guidelines. Moreover, it also differentiates if the conversion plant is directly or indirectly connected to the input energy carrier plant. RED II does not account for this distinction.

The energy carrier to be mentioned on the **GO** after energy carrier conversion into hydrogen should be hydrogen (**hydrogen GO**). For bio-LNG the gas GO should add the aggregate state to the methane GO that has been converted into LNG. Consequently, the GO product would be named **gas GO [liquid]** for bio-LNG. For biomethanol no GO scheme is foreseen by Art. 19 RED II. However, if the GO for bio-LNG should remain the same, then it needs to be decided what happens with the validity of one year regarding the biomethane GO. We propose that the validity period continues as before and does not start again when the biomethane is liquefied, in line with the provisions of the draft EN16325 at the time of writing this report.

The **PoS product (→Glossary)** after conversion should be a **hydrogen PoS** for hydrogen, a **bio-LNG PoS** for bio-LNG, and a **biomethanol PoS** for biomethanol (Chapter 6.2.). Note that we propose only one out of a range of options. For instance, market players from the hydrogen field are in favour of rolling out the concept of a hydrogen GO, whereas other voices promote a general gas GO to be issued for all gaseous energy carriers. This report makes abstraction of the name of the energy carrier to be mentioned on the GO. It acknowledges that the regulatory framework should clarify, which GO can be used for which type of energy consumption. The developed verification guidelines are, however, relatively flexible towards the GO/ PoS product.

We developed practical guidelines of the type of information that needs to be verified - based on Art. 19 (**GOs**) and Art. 25-31 RED II (**PoS**) requirements - when converting power-to-hydrogen/ synthetic methane (Chapter 6.2.2.), biomethane to bio-LNG (Chapter 6.2.3.) and biomethane to biomethanol (Chapter 6.2.4.).

This Deliverable has shown that the stricter the list of eligible inputs for the respective energy carrier, the higher the transaction costs. For instance, a limited list of carbon sources, would require an individual verification system for such. Transaction costs could create a hurdle for the market uptake of renewable gas technologies. Thus, it is recommended to thoroughly assess if verification standards can be introduced and tightened along with the installed capacity of cross-sectoral renewable gas technologies.

In order to avoid **multiple counting**, measures at different stages of the verification and documentation process of renewable gases must be taken. It starts with the verification and registration of renewable gas installations and their production output and it ends with the proper cancellation of the GO/PoS towards one single consumer/ beneficiary. This report includes guidelines for cross-sectoral technologies that reduce the risk of multiple counting. With regard to cross-sectoral technologies it is important to emphasize that, if the GO/PoS of the input energy carrier is converted to a new product after the energy carrier conversion, the GO/PoS of the input energy carrier needs to be cancelled. Issuing and cancelling GO/PoS in the same system reduces the risk of multiple counting. Therefore, it is recommended to foster cooperation on information exchange between all involved entities to establish a robust, transparent and fraud resistant mechanism on national and international level. Cross-sectoral renewable gas concepts require linking the various certification schemes based on the strengths of each (see REGATRACE D4.2).

The certification systems have to ensure to prevent multiple counting, since the current legislation requests certification systems for individual application purposes such as disclosure (Art 19), sustainable fuels (Art. 25-31) and gross final consumption (Art 3).

Stakeholders are requesting the European legislation to support a holistic system which considers to prevent double counting already on legislative level and does not leave this task to the design of certification systems only.

Moreover, it is advised by biomethane registry operators for PoS that the European gas grid shall be considered as one logistic facility for **mass balancing** (AGCS & ERGaR, survey, 2020). ERGaR is already in negotiations with the European Commission to establish this approach for biomethane that is transferred across borders via the gas grid.

In order to account for the impacts of different definitions of “**renewable hydrogen**” an in-depth analysis of different hydrogen pathways is needed (Velazquez Abad & Dodds, 2020). REGATRACE D5.3. develops guidelines on Power-to-methane sustainability certification accounting for different energy and carbon sources. Based on our survey, we conclude that most stakeholders are not in favour of allowing power produced from biogas within the GO portfolio of hydrogen/ synthetic methane, since this method would be inefficient and would unlikely be taken up (GGCS, survey, 2020).

In regard to PoS verification guidelines of hydrogen/synthetic methane, a **water consumption threshold** should be implemented on NUT-2 level, since water stress is not the same in North and South Europe. This threshold value should be based on a water stress map at a global level. The ADVANCEFUEL project aims to identify the sustainable potential for RESfuels based on a spatial analysis. Spatial layers were developed for GHG emissions, erosion risk, water consumption and biodiversity. A water balance approach was used to determine the impacts on local water quantity (Vera et al., 2020). A similar approach could be used as a starting point in order to identify water consumption threshold on e.g., NUT-2 level in order to ensure that hydrogen production does not harm local water resources.

According to RED II Art. 27(3), by December 31, 2021, the Commission shall adopt a delegated act, setting out the rules for sustainable electricity used for the production of RFNBOs, such as additionality, geographical and temporal correlation.

So far, there are no requirements in RED II concerning the **carbon source** for the methanation of hydrogen. Furthermore, some stakeholders only want renewable sources to be allowed for the production of renewable gases (Landspersky, survey, 2020). However, it is not clear if that only includes biogenic carbon or also carbon produced as a by-product. RED II should clearly define, which carbon sources are eligible for renewable energy production and how different carbon sources should be accounted for within the GHG methodology by clearly stating who gets the carbon reduction credited. The carbon accounting methodology presented by DG ENER (2020) suggests that the emitter is treated unchanged. However, that would not create any incentive for the emitter to trade carbon. In any case, this Deliverable proposes to add the suggested methodology by DG ENER within RED II in order to ensure harmonized carbon accounting for CCU and avoid double counting of carbon credits.

The strength of the method applied to generate the presented results is that various operators of electricity and biomethane registries participated in the development of this report. Hence, the report draws from long-term experiences, which aims to guarantee results that ensure a high level of robustness. The weakness of the applied method is that it is often not clear whether the survey responses are based on a well-founded opinion of the respective company/organization on the topic of cross-sectoral verification guidelines or rather reflect a personal opinion.

BIOSURF D3.1. proposes guidelines to establish biomethane registries, where they do not yet exist and addresses challenges regarding title transfer of certificates. As a follow-up, the present Deliverable proposes guidelines to validate the renewable origin/sustainability of cross-sectoral technologies. Regarding verification guidelines for hydrogen/synthetic methane, the revision of the CEN Standard 16325 is currently under development and it is expected to be finalized and published in the first half of 2021. REGATRACE goes beyond the CEN Standard by also covering biomethanol. On October 13, 2020, the European Commission DG ENER C1 organized a stakeholder meeting on the delegated act on the methodology to determine the renewability of electricity used to produce RFNBOs (Art. 27 RED II). Hereby, the authors addressed three verification cases: (1) average grid electricity, which is not part of the delegated act and therefore not covered by this Deliverable, (2) direct connection, and (3) renewable grid electricity (Guidehouse et al., 2020). Matching with the Global Alliance Powerfuels (2020b) findings, Guidehouse et al. (2020) also conclude to increase requirements over time concerning renewability, additionality, temporal and geographical correlation in order to avoid disabling market developments at an early stage of hydrogen market entry.

REGATRACE D4.2, D4.3 and D4.4 also focus on cross-sectoral verification and build upon the work carried out by REGATRACE D4.1. REGATRACE D4.2 compares certification schemes for various energy carriers (ERGaR, AIB, CertifHy) which shall facilitate the cross-border transfer of such certificates. REGATRACE D4.3 will provide a set of harmonized rules for GO handling in relation with energy carrier conversion. D4.4 identifies technical and organisational strategies to enable a coordinated process for handling of GOs in relation with energy carrier conversion. In a next step, the developed verification guidelines should undergo an assessment in order to see, how common the different pathways, we investigated, actually are in practice. For instance, are there biomethanol conversion plant operators who purchase biomethane? Or does it solely take place via a direct connection due to economic feasibility? Or does biomethane not only get transported via road and the public grid, but also via rail? And if so, are the amounts transported via rail sufficient enough to justify the development for verification guidelines for such a pathway? For instance, regarding LNG terminals logistics for railway

is foreseen according to a report on the LNG Strategy of the German Federal County Lower Saxony, which is currently being prepared.

GOs and PoS are instruments relevant for **marketing purposes** within the EU. For imports from third countries outside the European Union or EEA for which no GOs are recognized by the EU, only the PoS is the relevant instrument for the certification of the renewable characteristic of an energy carrier. In order to further refine the presented verification guidelines of this report, they need to be tested on real-life business model/pilot cases.

## 8. Conclusion

The analysis presented in REGATRACE D4.1., describes identified *open issues* (chapter 6.1.) and develops *hands-on verification guidelines of Guarantees of Origin (GOs)* (according to Art. 19 RED II) or *Proofs of Sustainability (PoS)* (according to Art. 25-31 RED II) issuance for renewable cross-sectoral gas concepts (chapter 6.2.) where no or only little approaches exist.

We developed guidelines for *GO issuance* for the following technology pathways: (1) *Power-to-hydrogen/synthetic methane* and (2) *biomethane to bio-LNG*. Biomethanol was not covered for GO issuance since GOs for liquid fuels are not yet foreseen by RED II.

For *PoS issuance* we developed guidelines for the technology pathways: (1) *Power-to-hydrogen/synthetic methane*, (2) *biomethane to bio-LNG* and (3) *biomethane to biomethanol*. Regarding PoS issuance of hydrogen, our results build upon the results of the Global Alliance Powerfuels (2020b) and Guidehouse (2020), which aim to further refine the sustainable electricity criteria for electricity used for the production of RFNBOs, according to Art 27. RED II. Our verification guidelines for hydrogen built upon those results and suggest clear verification methods how those criteria can be proven.

GOs and PoS are instruments relevant for the European Union Market, while PoS are the relevant instrument when importing from third countries.

*A Delegated Act* in accordance with RED II Art. 27(3) is expected by 30 December 30<sup>th</sup>, 2021 at the latest. It is expected to further refine sustainability criteria regarding hydrogen/synthetic methane production with a special focus on additionality, temporal and geographical correlation according to Art 27. RED II. The *CEN Standard EN16325* is also expected to be finalized in 2021. This Standard will give more clarity regarding the *GO product*, which results from conversion of hydrogen/synthetic methane and bio-LNG. Although this report makes suggestions regarding the GO product (chapter 6.2.1), the developed verifications are relatively flexible towards the final decision what GO end product should be assigned to the respective energy carrier.

- The results of this report provide the following suggestions to policy-makers: On a *European level, one scheme* shall be used per market pathway, including collaboration agreements between the schemes for regular data exchange (see REGATRACE D.2.2)
- Recommendation for *CEN 16325* technical working group to issue *hydrogen GOs* for hydrogen and not establish a general gas GO for H<sub>2</sub>, since a general gas GO cannot be applied for hydrogen-specific applications
- *GO product* (→ **Glossary**) after conversion for bio-LNG should add the aggregate state (gas GO [liquid])
- The *PoS product* (→ **Glossary**) after conversion should be a hydrogen PoS for hydrogen; a bio-LNG PoS for bio-LNG; and a biomethanol PoS for biomethanol (Chapter 6.2.).
- *Sustainable electricity criteria* should be further refined within Art.27 RED II according to the results stated by Guidehouse (2020) and Global Alliance Powerfuels (2020b)
- It is recommended that a future evolution of the European legislative framework clearly defines which *carbon sources* are eligible for renewable energy production and how different carbon sources should be accounted for within the *GHG methodology* by clearly stating who gets the carbon reduction credited.

## 9. Glossary

In the following, we define reoccurring terminologies, which are essential for understanding this Deliverable:

### **Additionality**

The additionality criteria ensures that additional demand for renewable electricity is met by additional supply. And that the demand for powerfuels does not interfere with the electricity production that is reserved for the electricity sector (Global Alliance Powerfuels, 2020b).

### **Blending wall**

Blending wall is the share of renewable fuel, companies are allowed to blend with fossil fuels. For instance, M15 stands for a biomethanol share of max. 15 % in the total fuel mix.

### **Chain of Custody**

Refers to the process of tracing the origin of products throughout the value chain (ECOS, 2020).

### **Cross-sectoral concepts**

Cross-sectoral concepts link different energy sectors with one another through conversion of energy carriers. It is the integration between different parts of an energy system e.g., electricity and heat or transport. Examples for cross-sectoral concepts are the conversion from power-to-heat, power-to-gas, and cogenerated heat and power production (Thellufsen & Lund, 2017). In this context, power refers to power conveyed in the form of electricity.

### **Delegated Act**

The adoption of decisions in the form of non-legislative acts. Delegated acts are adopted in the following cases:

- either amending or supplementing legislation (delegated acts) or
- on aspects which are often highly technical but essential for the implementation of that basic act (implementing decisions).

In regard to RED II, the delegated act is expected until the 30 June 2021 and will supplement RED II.

### **Geographical correlation**

Geographical correlation refers to a spatial limitation regarding the extent to which the production of powerfuels contributes to the need for additional grid capacity in order to avoid producing hydrogen in Europe from electricity that was i.e. produced in North Africa (Global Alliance Powerfuels, 2020b).

### **GO/PoS product**

By GO/PoS product this deliverable refers to the title of the GO which will result from the input energy carrier GO.

### **Mass balancing**

In order to document compliance with sustainability criteria and greenhouse gas savings in production and supply, market players are required to use mass balance systems. This will allow:

- To mix different supplies of liquid or gaseous renewable fuels with different sustainability criteria
- Assigning information on the sustainability characteristics and sizes of a given delivery to the mixture
- The sum of all deliveries taken from the mixture has the same sustainability characteristics in the same quantities as the sum of the deliveries added to the mixture.
- Liquid or gaseous renewable fuels can be distinguished from fossil fuels in the mixture.

### **Temporal correlation**

Temporal correlation refers to the temporal link between the production of the energy carrier input and energy carrier output. The aim is to avoid issuing certificates for hydrogen based on electricity, which was generated after the hydrogen (Global Alliance Powerfuels, 2020b).

### **Verification Guidelines**

Verification guidelines are defined as a method to prove renewable origin/ sustainable production throughout the value chain. A verification guideline aims to prevent fraud in the reporting that leads to GO/PoS issuance. This implies that a party, independent of the producer, shall verify the renewable origin/sustainable production and the reported measured quantities that are eligible for GO/PoS issuance. Renewable gaseous and liquid energy carriers are promoted in various states through subsidies, minimum purchase obligations etc. in order to make renewable energies more competitive against fossil-based energy carriers. These provided incentives, require verification guidelines to prove their renewable origin/ sustainable production (Velazquez Abad & Dodds, 2020). Cross-sectoral technologies appear as especially challenging, since they entail the risk of information loss at the cross sections.

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## 11. Annex

### 11.1. Identification and Assessment of cross-sectoral verification standards AT, CH, DE, DK, EE, FI, FR, NL, UK

This chapter aims to describe the experience of market actors involved in the issuing process of GOs/PoS (issuing bodies, auditors, expertse, etc.) in regard to cross-sectoral documentation of renewable gases in various countries. The GO registries are described in detail in the Annex of REGATRACE Deliverable 3.1. as well as EU BIOSURF D3.1. The underlying objective of this chapter is to describe already existing pathways of cross-sectoral verification and documentation standards and to identify best practices, which the developed guidelines in Chapter 6.2. are based on.

#### Austria

##### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

The Austrian Regulation on Gas Consumer Disclosure (Gaskennzeichnungsverordnung, G-KenV) mandates the Austrian Regulator E-Control, current issuing body for power GOs, to be the issuing body for gas GOs. Annex 1 of the regulation lists the technical codes (attributes) to describe the respective energy carrier. This list includes renewable gas from biogas/biomethane, synthetic gas from gasification and renewable gas from electrolysis. Therefore, the organization to document GOs from synthetic gases do exist in Austria.

##### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

Austria has no verification standards for hydrogen and synthetic methane in place yet.

##### ***Verification standards for issuing a GO for bio-LNG***

Austria has no verification standards for bio-LNG GO issuance in place yet.

##### ***Verification standards for issuing a PoS for bio-LNG***

There is no specified methodology for mass balancing bio-LNG established in Austria at this point. If the bio-LNG shall be used as transport fuel, the rules of FQD have to be applied.

#### Belgium

In Belgium the regional authorities (Flanders, Brussels, Wallonia) are responsible for guarantees of origin for renewable electricity and gas. However, when it concerns bio-fuels (or RFNBO's) the federal authority is competent. Today only in Flanders legislation is fully compliant with the RED II. In Wallonia and Brussel legislative work has been initiated, to be compliant with the RED II by 1st of July 2021. In Wallonia a Guarantee of Origin exist which is issued by the Walloon administration but adaptations to the system (and legislation) are necessary to make it compliant with the RED II. Hereunder the Flemish system for GO's is explained, with some additions on bio-LNG.

##### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

In Flanders a Gas GO can be issued for all green gasses (hydrogen, biomethane, synthetic gas etc.). The registration is performed by two bodies (i.e., Fluxys BE as production registrar and the VREG as production coordinator). In order to account for cross-sectoral technologies, the Gas GO includes an attribute to indicate the output gas of the Gas GO. The issuing of the GO is typically performed by the

production coordinator which is the Flemish regulator (VREG) In Wallonia this system is not in place at this moment.

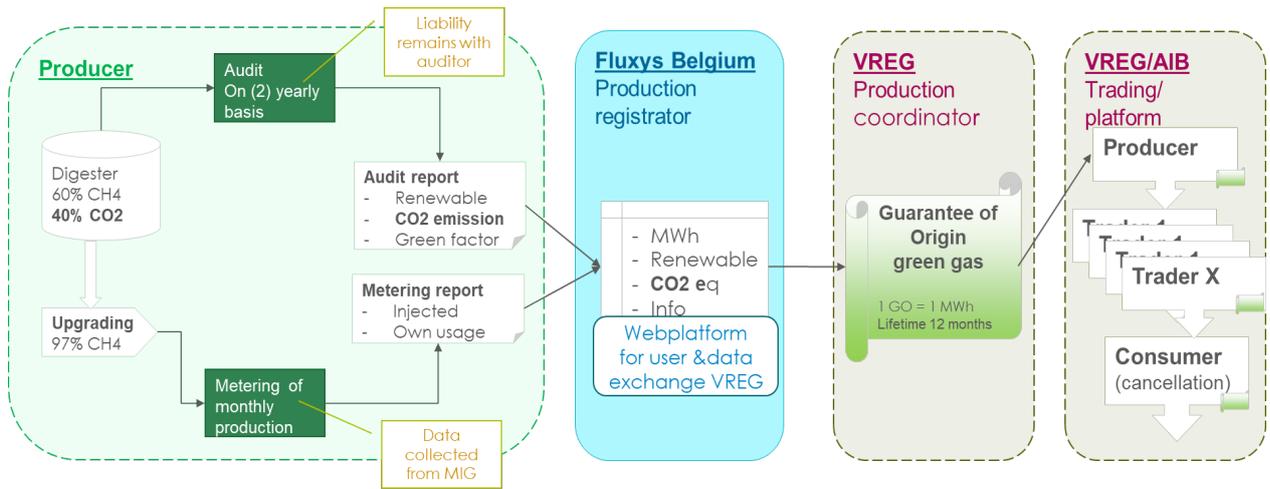


Figure 9: Process for GOs regarding biomethane in Flanders (Fluxys, 2020)

As illustrated in Table 18, biomethane produced via a direct connection to the respective plant requires (i) the green factor of the input streams (feedstock) and (ii) the determination of the non-renewable utility streams (own usages relevant for the process) which are subtracted from produced amount. For biomethane the green-factor is determined by the OVAM (Flemish Waste Agency).

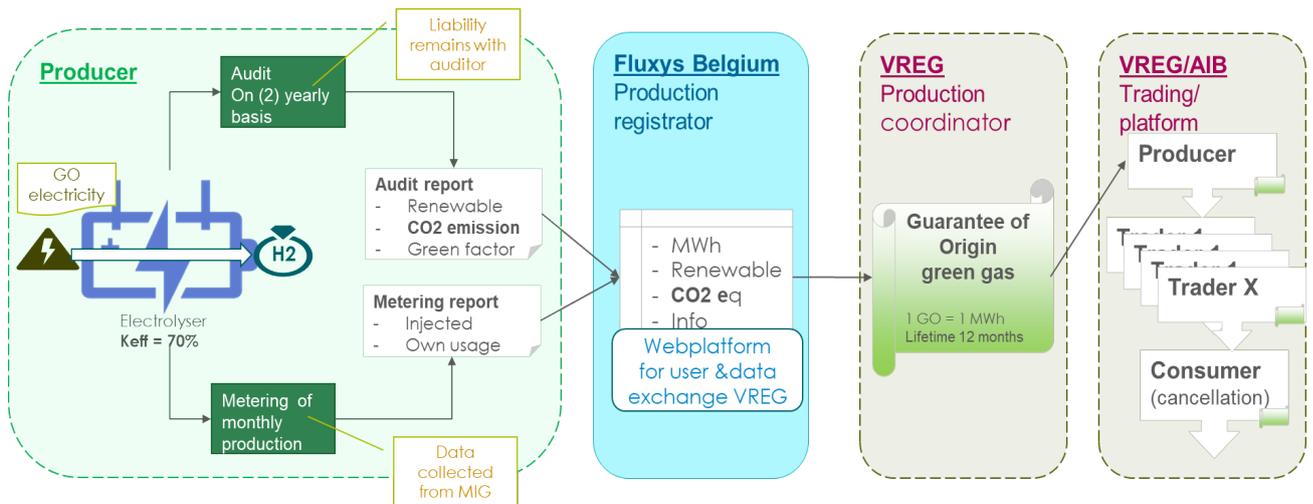


Figure 2: Process for GOs regarding hydrogen in Flanders (Fluxys, 2020)

For renewable hydrogen production the green factor of the input stream is determined by the amount of renewable electricity that is used taking into account the efficiency factor ( $K_{eff}$ ) referring to the process of the conversion. The renewable electricity can only be proven either based on metered data of an on-site renewable electricity production or for electricity coming from the electricity grid via GO for renewable electricity, but never based on a default renewable value of the electricity mix in Flanders.

Table 18: Belgian verification methods irrespective of the gas output (e.g. hydrogen, synthetic gas, biomethane etc.)

| Pathway                           | Verification method   |
|-----------------------------------|---|
| Direct connection to electrolyser | $K_{eff}$ of the conversion process and the green factor of the input electricity |

|                                    |                |
|------------------------------------|----------------|
| Indirect connection to electrolyse | Electricity GO |
|------------------------------------|----------------|

In Belgium, the production of electricity above 5 MWe and gas above 20 MW are telemetered by the distribution system operator (DSO) or transition system operator (TSO). In reality, only PV for households are not telemetered, although with the introduction of smart meters - as already the case in Flanders - this might change. As gas production and conversion installations have capacities above these thresholds, the gas part will always be telemetered. The data are allocated in energy [kWh] and are typically transferred to the TSO for grid balancing purposes on an hourly basis. For its activity as the production registrar for gas Fluxys BE also receives the monthly aggregated and validated data for gas of the renewable production and conversion, but not yet for electricity. When renewable hydrogen is produced on hydrogen grids not operated by natural gas operators, Fluxys as production registrar, can demand the hydrogen operator to provide the metered data. The validated metered gas volume is registered by Fluxys typically 2 months after production, due to the validation process. Once validated the production registrar performs the calculation of the renewable energy illegible for GO's based on the parameters, and send the result to VREG.

The production registrar assigns a conservative  $K_{\text{eff}}$  to each listed gas volume either based on historical data from input electricity, output gas and utility consumption or on monthly basis when requested by the producer based on the monthly metered electricity production for the process (only if compliant metering is available). If a plant and its gas volumes are listed for the first time, the  $K_{\text{eff}}$  is conservatively determined by manufactories data of the installation and data from similar installations but it is possible for the gas producer to improve his  $K_{\text{eff}}$  by providing the relevant data. For the determination of the parameters (greenfactor, utility parameters and efficiency parameters) a maximum life-duration of two years is used, as every two years a new full audit is obligatory by law. However, the production registrar can decide to perform intermediate checks and adapt the parameters on shorter notice if they have changed. Regarding the **Power-to-Gas conversion**, every type of electricity from the grid can be used as long as it has a valid electricity GO. If the electrolyser is connected via a direct connection to an on-site renewable power production plant, no GO for electricity are issued. However, the synthetic gas or hydrogen which is produced on-site can receive a GO green gas, as long as the power production can be considered renewable (e.g PV or Wind). For this purpose, Belgium has rules in place for indicating the renewable character by a green factor. For instance, an incinerator for household waste receives a green factor of 47.78 %, while a wind turbine or PV receives a green factor of 100%. The green factor for a specific energy carrier is determined from the ratio of the renewable part, where (Fluxys, 2020):

- the renewable on-site source of the relevant energy carrier can be directly linked to the process and no GOs are claimed for that energy carrier
- the green factor can never exceed 100% and it only applies to the specific energy carrier

The green factor of the input streams can be determined 'by default' or on the basis of the biomass ratio (Fluxys, 2020).

- When determining 'by default', a fixed percentage is assumed, which can be unequivocally demonstrated as a renewable source (e.g., 47.78% for household waste incineration), and has been proven by the auditor or legal basis
- When the green factor is determined based on the biomass ratio, reference is made to the Public Waste Agency of Flanders (OVAM) regulations for the determination of the green factor input streams.

- When the producer has its own production of renewables (heat, electricity, gas) on his site, which he does not bring in for the granting of GOs, he can use these to increase his corresponding green factors for utility flows (own usages). He can only do this for the equivalent energy carrier and must be able to demonstrate this at the time of verification by an auditor.

The validity of the green factor can range from one month to two years (the maximum validity is an inspection report). The validity of each green factor is determined by the production registrar on the basis of the advice of the auditor responsible for the applicable inspection report based on a binding advice of OVAM (Fluxys, 2020).

GOs for a given energy carrier can be used to increase the green factor of the input streams of the same energy carrier, provided that an efficiency factor  $K_{eff}$  is taken into account (Fluxys, 2020),

- either by a default efficiency factor of the renewable gas production process which is determined by the production registrar based on the information provided by the producer and his auditor (Fluxys, 2020),
- or by an efficiency factor determined from the monthly measured primary fuel consumption as input stream for the produced gas (Fluxys, 2020)

Renewable electricity from other EU countries is eligible, if they fulfil certain criteria. For instance, Sweden's electricity GO's are not accepted by VREG in Flanders. In Belgium, the state of **financial support** is already listed as an attribute on the GO gas but does not hold any objection to issue a GO.

The legislator provides for a mandatory audit of raw materials and processes every two years, including metering installations. The metering instruments relevant for the calculation must be calibrated and approved by an accredited auditor. Meters owned by the DSO or TSO do not need to be audited every two years, as these parties already have a specific legal obligation to measure. The audit must be carried out by an independent auditor who has the necessary experience in this field. Up to today, the legislator does not provide any regulation of the expertise for green gas auditors. The regulatory authorities approached the production registrar to establish its own rules for the approval of the auditor for the independent audit. This plan is still work in progress today.

In order to link electricity GOs with gas GOs, the following general formula is proposed:

$$GO\ gas = \left( (Locally\ produced\ gas - Grey\ own\ usage) * Green\ factor\ (if\ any) + GO\ electricity * K_{eff} \right) - Grey\ additions(if\ any)$$

This formula allows the producer to introduce electricity GOs for the purpose of demonstrating grid electricity use to be renewable. The formula also accounts for the fossil energy which has been used in the process. Fossil gas has a green factor of zero. It is reflected in the final allocation of the green part of the metered gas output (Fluxys, survey, 2020). The gas gross quantity is measured on a monthly basis in kWh at the upper calorific value. If they are measured remotely by the grid operator (telemetered), the grid operator will forward the data to the production registrar. If this is not possible, the producer can enter the data himself into the system of the production registrar (measured manually) (Fluxys, 2020). In such case, the production registrar will impose a regular verification on site of the data by an auditor.

#### **Verification standards for issuing a PoS for hydrogen/synthetic methane**

Today for gas GOs only the **PoO (proof of origin)** is mandatory. There is a field (attribute) for CO<sub>2</sub>e emission (in g/kWh) but it is optional. For bio-fuels however a PoS is mandatory for the product

declaration in the biofuel registry of the federal government. GOs cannot be used for registration of biofuels. . The additionality aspect of the utilised renewable electricity is not considered for the calculation of the gas GO, but this will probably need to be adapted once these rules are clearly defined in the delegated act of the EU commissions expected in 2021.

#### ***Verification standards for issuing a GO for bio-LNG***

In Belgium, there are no explicit regulations in place yet regarding bio-LNG. However, the federal government can recognize bio-LNG as a biofuel when it complies with the product declaration as described in the relevant federal law. A proof of sustainability issued by a EU voluntary scheme (e.g. ISCC, RecCert) is compliant with the product declaration. The conversion from the gasgrid to the LNG Terminal for bio-LNG is based on the liquefaction process-unit at the Terminal. This liquefaction is certified under a EU voluntary scheme.

#### ***Verification standards for issuing a PoS for bio-LNG***

In Belgium, although bio-LNG is not explicitly defined in the law when it is used as a bio-fuel from biomass it can be illegible as an advanced biofuel when it complies with the mass balancing principle and the product declaration (being fulfilled by the PoS). For bio-CNG and bio-LNG used as biofuel mass balancing is required.

### Denmark

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

Currently there are no GOs for electricity-based gases in Denmark. RED II is currently being transposed into Danish law. Energinet has been nominated as GO issuing body for electricity and gas. Denmark are implementing GO systems for grid based distribution and use – for electricity, gas and heating. For hydrogen or synthetic methane from renewable sources injected into the gas grid Energinet will issue GOs documenting the renewable origin of the gas. Energinet has decided to start with developing GOs for synthetic methane only on the basis of biological **carbon sources**. But if authorities agree, Energinet is open to also issue GOs for other carbon sources.

It is unclear if, when or how a verification process of hydrogen/synthetic methane for non-grid distribution and use will be implemented. Currently it is possible to receive both **financial support** and have GOs issued for biomethane. The Danish Energy Agency is modifying subsidy levels accordingly to ensure that biomethane production is not over-subsidized – as required by the Renewable Energy Directive (Art.19 (2)).

Energinet is developing a new concept which is being tested with hourly electricity GOs from which source, location and **hourly correlation** between renewable electricity production and hydrogen production from an electrolyser can be documented. Energinet considers this concept capable to document requirements for producing renewable fuel of non-biological origin (RFNBO) for electricity from grid connected electrolysers for which the European Commission shall develop a methodology by the delegated act. The system is tested in full scale in collaboration with more than 50 electricity market actors including two hydrogen producers.

Regarding the **geographical correlation**, Energinet has as a point of departure chosen to split along the division in two Danish power market areas. However, if a geographical criterion will be agreed upon in Europe, Energinet is ready to modify their concept accordingly. The geographical criterion must reflect that the electrolyser is using power on the same side of a bottle neck.

This concept will be integrated into the Danish GO system.

***Verification standards for issuing a GO for bio-LNG***

Denmark does not have GOs for bio-LNG. It will only be developed, if there is a market need and authorities decide to develop such a system

## Estonia

***Verification standards for issuing a GO/PoS for hydrogen/synthetic methane***

In Estonia, the institution that is responsible for renewable electricity and biomethane GOs (Elering) will also be responsible for issuing GOs for synthetic gases.

Estonia is aiming to combine (replace) biomethane PoS certificates with GOs, since biomethane producers enter the corresponding data (incl. GHG value) into the biomethane registry that is then attached to the GO. Currently, biomethane producers can enter the PoS certificate numbers into the registry. In Estonia, biomethane GOs are not connected to the physical fuel supply. However, consumption of biomethane can be proven through GOs. It is important that the amount of biomethane produced and the amount consumed are equal in the system (Estonian gas system). Furthermore, issuing biomethane GOs, cancellation of the GOs, issuing of biomethane transport statistics certificates - on the basis of the cancelled GOs - and their usage take place in the same registry in Estonia. Regarding **mass balancing** of synthetic gases, Estonia has yet not the respective rules in place.

***Verification standards for issuing a GO/PoS for bio-LNG/biomethanol***

Estonia does not have verification standards for bio-LNG nor biomethanol in place yet, there is no legislation on that subject available yet.

## Finland

***Verification standards for issuing a GO/PoS for hydrogen/synthetic methane and bio-LNG***

Finland has a biomethane GO registry in place for biomethane injected to the gas grid. The Finnish biomethane registry does not comply with the requirements given in RED II.

Finland is currently implementing a gas GO system according to RED II that should be in use by summer 2021. According to the proposal, the gas GO can be issued to **compressed biogas (CBG)**, **liquefied biogas (LBG)** and renewable **hydrogen**. The guarantee of origin is granted on the basis of the energy content. The gas GO can be issued to off-grid-biomethane as well. The GO is separated from the PO. Some Finnish market players are in favour to attach a **GHG value** to the GO. In order to avoid double counting, the PoS is linked to the physical gas unit. Regarding **state aid** there is no decision made yet, but Finland has strict laws in place to avoid double funding, thus the electricity input of RE, which already received state aid is unlikely.

## France

All the information mentioned in this section are under negotiations at national level. The system finally approved (likely in 2021) could be different of what is mentioned in this chapter. The regulation under negotiations only concerns hydrogen. Synthetic methane is not mentioned in the regulation. Information given in this section leads to the assumption that the same mechanisms will be used for synthetic methane as biomethane and hydrogen in France in the future.

**Verification standards for issuing a GO for hydrogen/synthetic methane**

The French Government is currently negotiating over the regulations on GOs for hydrogen. The responsible authority for verification and documentation of Power-to-Gas GOs depends on the various tasks. For energy measurement, electricity and gas grid operators will be the ones in charge. Regarding the timing and the location at the beginning of the supply chain (electricity), the issuing body of the electricity GO registry (for now Powernext in France) and after conversion (gas), the issuing body of the gas GO registry (GRDF - Gaz réseau distribution France until end of March 2023) will be the issuing authorities. The French Government has not yet taken a position, if the exchange of information between gas and electricity should be made on a declarative basis or by interconnecting the respective registries. It is considered as likely, that the issuing authority for gas GOs will also be in charge of issuing GOs for hydrogen. Purchase of renewable electricity from the public grid and from a direct connection will be allowed for issuing a hydrogen GO. Also cross-border trading will be allowed, since it is explicitly stated in the RED II. **PPA** will be eligible for GOs as well. The French Government is considering developing a concept for tracking hydrogen production:

- a) If renewable/low carbon hydrogen is not mixed with other gases or hydrogen (fossil for example), the hydrogen production can benefit from a **guarantee of traceability**;
- b) If renewable/low carbon hydrogen is mixed with other gases or hydrogen (fossil for example), the hydrogen production can benefit from a **GO**.

This classification applies irrespective of transportation (trucks, grid etc.).

In order to prove that the **electricity** being used is renewable, only the GO would be sufficient, if the power comes from the grid. When **converted** into gas, the electricity GO should be cancelled. In that case, the creation of the GOs electricity is under production device control. If there is a direct connection between the electricity plant and the electrolyser, another tracking document with audits of the two plants would be required (mass balancing, renewable sources etc.). The French government may allow in the future to issue GOs for synthetic gases, even if they are produced from renewable electricity, which received **state aid**. In order to avoid **double counting**, the GOs may be (as it is the case for biomethane from 2021) the property of the state that can sell it to market actors by an auction mechanism. The **carbon origin** and volume will be certified by other traceability documents which France has already in place for biomethane feedstocks. It is a tracking slip/monitoring sheet, which includes audits of the production plants of these feedstocks. Gas actors hope that in each case if there is any injection into the gas grid, synthetic gas will be linked with a gas GO, whatever will be the source of production of the electricity, including bio-based electricity (**transport**). When hydrogen gets injected into the grid, some gas actors hope that a gas GO will be issued (and a hydrogen or electricity GOs will be cancelled in consequence). At the moment of the injection into the grid. The GO may contain information on the energy content, the feedstock used, the number of hydrogen or electricity GOs being cancelled and the type of production (synthetic gas in this case). It should be possible to include the **GHG value** to the GO. Some market actors want the GO to contain the RED II criteria attested by the PoS in the GOs for more transparency for the consumer. The French gas sector has developed an Excel-based GHG methodology to adapt the RED II GHG methodology to the French biomethane production. The idea is to have a user-friendly solution in place where the producer will only have to enter key data (e.g., volume of feedstock) in order to calculate the GHG value of his produced gas volumes. Market players are in favour of using standard values, but if only manual calculations of GHG values will be eligible, France has already an excel-based solution in place.

It has not been decided which **carbon sources** should be eligible for the production of renewable hydrogen.

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

In order to claim that renewable properties have only been used once, the GOs and POs could be linked without allowing separate selling of the two documents for the same production unit (**double counting**). A tracking slip can be used to prove the origin of the CO<sub>2</sub> used in the methanation process.

#### ***Verification standards for issuing a GO for bio-LNG***

France has no GOs for bio-LNG in place. France does not have yet bio-LNG installations.

### Germany

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

The German Renewable Energy Act (EEG 2012) addresses the generation of “storage gas”. The regulation regards the natural gas grid as a storage facility. Consequently, in 2013 dena was approached by market actors to create a basis for mass balancing of Power-to-Gas technologies in the biogasregister. Thus, dena ordered a legal report on existing framework conditions for PtG. Therefore, the EEG and Energy Industry Act already address PtG. The registered three PtG plants have installed capacities between 60 to 360 Nm<sup>3</sup>/h. All registered PtG plants combined, produce approximately 3 GWh per year. Hydrogen may only be placed on the market if it meets the DIN EN 17124 standard (10. BImSchV §9a).

Quality Criteria for PTG according to the biogas registry catalogue (dena, 2018):

- Documentary evidence that the quantity of electricity used for the production was sufficient for the produced quantity of hydrogen (criteria #4)
- Documentary evidence that the quantity of storage gas/hydrogen was actually fed into the natural gas network (criteria #6)
- Mass balancing up to the feeding into the natural gas network (criteria #27)
- Gas exclusively from renewable-based electricity (criteria #44)
- Temporary storage prior to the electricity grid (criteria #45)
- No deliberate generation of CO/CO<sub>2</sub> (criteria #46)
- The facility for generating storage gas is continuously operated exclusively with renewable energies (criteria #48)
- Additional information from PtG plants regarding verification
  - Electricity consumption capacity (kW)
  - Origin of Electricity
  - Electricity consumption in kWh
  - Water consumption in Nm<sup>3</sup>
  - Nominal power of the electrolyser (Nm<sup>3</sup> Output hydrogen)

Up to now, the capacities and competences of issuing bodies for German electricity GOs (HKNR) do not meet the requirements for issuing GOs for gas. **Renewable electricity** is eligible from direct and indirect connections to the electrolyser, as stated in dena criterion #47 biogas (dena, 2018). But only the latter requires a GO. PPAs also require issuing and cancelling of GOs for disclosure of electricity from renewable sources. Electricity from other EU MS is eligible for GOs. If hydrogen/synthetic

methane is injected into the gas network or used as a transport fuel, hydrogen/synthetic methane produced from biogas is eligible, as stated in dena criterion #44(b) (dena, 2018). A gas GO can still be issued if the renewable electricity has already received **state aid**, but the hydrogen/synthetic methane can consequently not be used as sustainable renewable gas with an emissions factor of zero for emissions reporting (double support). During the **conversion** from power to gas, the electricity GO is handled by the electricity network operator without an independent third-party audit. For the gas GO, gas network operators report voluntarily to the dena biogasregister. The verification consists of two steps. First, the installation (electrolyser) gets audited (one initial audit). And when issuing a certificate, an independent third-party auditor proves the documentation of the respective production batch. **Carbon** which was deliberately produced for PtG is not eligible, as stated in dena criterion #46(b) (dena, 2018).

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

PoS requirements for hydrogen/synthetic methane still need to be defined.

#### ***Verification standards for issuing a GO for bio-LNG***

No verification standard for bio-LNG GOs are currently available in Germany. Dena biogasregister aims to include bio-LNG within its portfolio by 2021.

#### ***Verification standards for issuing a PoS for bio-LNG and biomethanol***

The Federal Office for Agriculture and Food (BLE) operates a web-based Sustainable Biomass System for **liquid** and **gaseous biofuel PoS**, called Nabisy (German abbreviation for Sustainable Biomass System). The Nabisy PoS can be used to credit an emission reduction according to EU Directive 2009/28/EC. Furthermore, the Nabisy PoS is required in order to receive biofuel subsidies under the EEG (BLE, 2011). Nabisy PoS can be transferred into biogasregister GOs, but not the other way around, since the German biogasregister is not recognized as a national registry by the Germany government.

### Ireland

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

In Ireland, GOs for renewable electricity are being issued by the Single Electricity Market Operator (SEMO). Gas Network Ireland (GNI) is currently in process of being appointed to the Issuing Body for gas GOs in Ireland under the Green Gas certification Scheme (GGCS). It is envisaged that the GGCS will be able to adapt and facilitate GO's as the issuing body for synthetic gas in the future. Both market players are considered suitable for this purpose. Ireland still does not produce electricity-based gases at commercial scale, however there is a demonstration project producing hydrogen at small scale currently being developed. Thus, the distinction of direct or indirect connections to the electrolyser and to what degree this is considered in the respective GOs has not yet been determined. If power is purchased from the public grid, a GO is required. It is also eligible to purchase power from other EU countries. SEMO is part of the AIB hub.

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

Gas Networks Ireland (GNI), as the gas grid operator and gas authority, is developing **mass balancing** processes for biomethane injected into the grid. For synthetic gas, however, necessary measures would still need to be determined. The issuance of PoS should be monthly but with scope to allow for corrections in later months. In regard to mass balancing, it could be argued that the European gas

network should be regarded as one mass balance unit, since a centralized system minimizes or eliminates the risk of **double counting**.

### Italy

In 2018, Italy adopted its Biomethane Decree which aims for a renewable energy share in the transport sector of 9% until 2020 (Eyl-Mazzega & Mathieu (eds.), 2019). The GSE allocates the certificates (CICs -"Certificati Immissione in Consumo"). The CIC demonstrates compliance with sustainability requirements and is a tool to track the progress on set renewable energy targets. The CIC certificates are issued for a period of 20 years. One CIC accounts for 10 Gcal conventional biofuel/biomethane and 5 Gcal advanced biofuel/biomethane (double counting). At the moment, there is no GO registry in place, in Italy. Currently, the biomethane decree is under revision and an update on the implementation of a GO registry for biomethane is expected.

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

Synthetic methane production by the Power-to-Gas technology is covered by the Italian Biomethane Decree. According to the Italian regulation the biological **origin of CO<sub>2</sub>** is considered as pre-condition for treating the product as „biomethane“.

#### ***Verification standards for issuing a GO/PoS for bio-LNG***

There is no GO scheme in place in Italy. But given that in the the decree treats gaseous biomethane and liquefied biomethane in the same way, it is presumed that the GOs will also be released for liquefied biomethane. The importance of LNG in Italy is steadily increasing. Italy has already 22 LNG stations in place and 1000 heavy vehicles are powered by LNG. The objectives of the Decree 205/2016 have been translated into the National Energy Strategy 2017, in which is stated that LNG should cover half of the sea bunkering and 30% of heavy goods transport until 2030 (Eyl-Mazzega & Mathieu (eds.), 2019).

### The Netherlands

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

The Dutch certification system regarding renewable gases include PtX options like hydrogen (REGATRACE D3.1., page 88). In the Netherlands, CertiQ is the issuing body for electricity GOs and Vertogas is the issuing body for gas GOs. Vertogas has been appointed by the Ministry of Economic Affairs and Climate to develop the certification process/system for the issuance of GOs for hydrogen as issuing body. There are several topics that need further assessment/discussion for the cooperation and information exchange between Vertogas and CertiQ to ensure a robust process for the issuance of hydrogen GOs.

### Spain

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

The issuing authority for electricity GOs is the “National Commission for Markets and Competition” (CNMC) by designation of the Spanish Energy Ministry (Ministry of Ecological Transition). The Spanish Energy Ministry is currently deciding who will be responsible for issuing renewable/synthetic gas GOs. Additionally, a voluntary scheme for biomethane GOs is planned, which

is not yet implemented. The purchase of renewable energy from the public grid will be eligible for renewable/synthetic gas GO issuance. It is still undecided if PPAs will be eligible for GOs or not.

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

In Spain, the biomethane PoS are in their planning phase, however not yet implemented.

#### Switzerland

Since Switzerland is not a member of the EU, nor the European Economic Area, it is not subject to the RED II. Negotiations in regard to cross-sectoral verification standards are ongoing. The relevant legislations such as the CO<sub>2</sub> law, the Federal Energy law and the law regarding electricity markets as well as the enactment of a new gas market law are in various stages of the legislative process. This chapter also draws on assumptions regarding future developments.

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

Electricity GOs are issued by Pronovo AG, which is a national clearing office with a legislative mandate. Clearing for renewable gas injected into the gas grid or for renewable gas which is used in decentralized, off-grid, fuelling stations is performed by VSG which operates under a mandate of the Federal Customs Authority.

There is currently no actual linkage between the electricity GOs to the gas GOs (currently no physical GOs are issued but respective accounts credited). The current procedure is that the electricity GO gets cancelled as it would be for any other purpose and the corresponding amount of renewable gas injected into the gas grid is entered into the respective account with the clearing office.

Purchasing electricity from the public grid for hydrogen production is possible, but currently not economically viable, due to the electricity network fees. The consumption of electricity, which has been produced on-site on the other hand may be economically attractive, as these amounts of electricity are not subject to network fees. GOs from other EU MS are eligible, however practically it might also not be economically feasible. Furthermore, fiscal incentives for the use of renewable gas as motor fuel are linked to certain sustainability criteria. PPAs are in principle also eligible for GO issuance, however the same economic constraints as already described above might arise.

Hydrogen may be entered into the gas clearing as renewable, if the power it has been produced from is verifiably renewable (GO or on-site renewable production).

Regarding the **conversion from power to gas**, the specific rules for issuing an electricity GO as well as those for injecting renewable gas into the gas grid apply.

In principle, there is no systematic restraint that would exclude biobased electricity from hydrogen GO issuance. Verification and documentation of the carbon source by means of a LCA is desirable as this is a requirement for fiscal incentives and may also be needed in the context of reporting issues. The use of fossil energy when producing renewable gases should certainly be documented. However, there might be political and reputational issues arising, if fossil energy is used for the production of synthetic gases. Furthermore, they will not qualify as renewable under any administrative framework (fiscal or regulatory requirements).

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

According to VSG, **double counting** should be prevented with one single dedicated issuing body per country. There are no systematic distinctions from the mass balancing procedure used for conventional biogas and PtG. Thus, the methanation plant would also be considered a mass balancing unit. Currently, plant operators report on a monthly basis to the clearing office.

European renewable gas trade should be realised by an electronic hub system linking the national bodies. In order to meet national fiscal or other regulatory requirements, the physical cross-border transfer of the gas is currently deemed essential by the authorities, however, this requirement may be waived under certain conditions, if a cross border transfer of GO is recognized on EU level.

Additionality of the electricity production is not seen as a specific requirement, rather sustainability criteria taking into account LCA of the process and comparing it to a fossil baseline. A temporal correlation benchmark of 15 minutes is regarded as sufficient. It is yet undecided which carbon sources should be eligible for PtG. However according to VSG, carbon from unavoidable industrial processes and biobased carbon should definitely be counted as renewable.

#### ***Verification standards for issuing a GO for bio-LNG***

Bio-LNG will probably not be primarily produced within Switzerland but rather imported into the country in its liquefied state. According to VSG, the biomethane GO should be cancelled and a LNG GO should be issued, but no additional audit is required.

#### ***Verification standards for issuing a PoS for bio-LNG***

There is no mass balancing method for bio-LNG in place and will also not be developed within the foreseeable future. The timeframe of PoS issuance should be as long as possible, since storage space is available compared to electricity.

### United Kingdom

#### ***Verification standards for issuing a GO for hydrogen/synthetic methane***

Since the UK is now a third country, they are no longer obliged to adopt the RED II within their national regulatory framework. Therefore, the UK government also does not aim to establish new issuing bodies for GOs or have an existing issuing body expand its scope to include hydrogen/synthetic methane. However, there is a privately run registry, the Green Gas Certification Scheme (GGCS) who may wish to issue GO if and when they start to be produced at scale. While they would be free from government regulation, they have indicated they would seek to adopt best practice from around Europe as their verification standards and likely require expert audits of hydrogen/synthetic methane production facilities and production volumes.

Depending on any emerging best practice, there is a good chance that the GGCS would allow the purchase of renewable electricity from the public grid as an input into renewable gas production. A GO would likely be the method of proving the renewable source, however, because of Brexit it is uncertain if a non-UK GO could be used. To protect the credibility of hydrogen/synthetic gases as renewable, the GGCS may take a cautious approach and limit this method to the use of UK GOs only and also require that the GO was part of a broader Power Purchase Agreement (PPA). A methodology for distinguishing between excess renewables and additional renewables, is also desired.

Regarding the verification standard, the GGCS approach is to allow self-reported information that is independently audited at a later stage.

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

The RTFO guidance sets out the requirements for proving the sustainability of renewable transport fuel and in the vast majority of cases producers and suppliers chose to use a voluntary scheme recognised by the European Commission to evidence and create PoS within those Schemes rules.

Verification standards of ISCC, being the most widely used voluntary scheme, are detailed elsewhere in this report.

The recognition of PoS as representing hydrogen/synthetic methane that qualifies as a renewable fuel will be based on Quality Criteria for PTX within the UK Renewable Transport Fuel Obligation (RTFO), which has the following principles;

- If a RFNBO includes a carbon input, e.g., synthetic methane, the carbon can come from waste fossil sources (for example, waste flue gases from coal and natural gas power generation or similar industrial combustion processes), from biological sources (e.g. alcohol fermentation or anaerobic digestion) or from atmospheric or naturally occurring/geothermal sources. The carbon must not be deliberately produced for the purpose of producing a RFNBO.
- Where naturally occurring or geothermal carbon sources are utilised, evidence must be provided to the administrator that these emission sources have not been increased by the extraction of the carbon, or that any additional emissions have been included within the extraction emissions.
- Where biogenic carbon sources are utilised, evidence should be provided to the Administrator that this carbon is not already being used to claim a GHG credit in the original bioenergy supply chain and would otherwise have been emitted to the atmosphere.
- In accounting for the consumption of electricity not produced within the fuel production plant, the GHG emission intensity of the production and distribution of that electricity shall be assumed to **be equal to the average emission intensity of the production and distribution of electricity in the country as measured from previous years i.e., not in year live data.**
- By derogation from this rule, producers may use an average value for an individual electricity production site for electricity **produced by that site**, if:
  - the electricity production site is **not connected** to the electricity grid and is connected to the fuel production plant; or
  - the electricity production site is connected directly to the fuel production plant and the electricity grid, and can evidence that the annual electricity generation that **would have been lost** due to local grid capacity constraints has been consumed by the fuel production plant instead; or
  - the electricity production site is connected directly to the fuel production plant and the electricity grid, and the fuel production plant can evidence that their consumption has been provided by the electricity production site **without importing electricity from the wider grid.**

#### ***Verification standards for issuing a GO for bio-LNG***

The UK government has never appointed an issuing body to issue gas GO and as the UK is now a third country, they will not be obliged to adopt the RED II within their national regulatory framework. Therefore, the UK government also does not aim to establish new issuing bodies for GOs or have an existing issuing body include bio-LNG within its scope. However, there is a privately run registry, the GGCS, which issues GoO for biomethane in both gaseous and LNG form.

The GGCS approach is to issue the same GO to a unit of biomethane regardless of if it is gas or liquid. If it moves between a gaseous and liquid state the GO is not altered, since the GO represents energy content, not the chemical state of the energy. However, the GO will indicate the “delivery type” at the point of production for example “grid delivery” which indicates it is a gas or “delivery as bio-LNG” if it was liquefied.

The GGCS also publishes guidance around the allocation of GO to LNG consumers which states that

the LNG must have been sourced from a facility connected to the grid either in liquefaction or gasification mode. It must not be sourced from a LNG source that is not connected to the grid in anyway.

#### ***Verification standards for issuing a PoS for bio-LNG***

The RTFO guidance sets out the requirements for proving the sustainability of renewable transport fuel and in the vast majority of cases producers and suppliers chose to use a voluntary scheme recognised by the European Commission to evidence and create PoS within those Schemes rules. Verification standards of ISCC, being the most widely used voluntary scheme, are detailed elsewhere in this report.

The recognition of PoS as a tool for mass balancing bio-LNG, will be based on Quality Criteria within the UK Renewable Transport Fuel Obligation (RTFO).

The case for mass balancing when gas is liquefied directly from the grid is clear. The case for being able to achieve a mass balance where the LNG is from an import terminal has been discussed with the RTFO administrator. Their current opinion is that the LNG terminal at the Isle of Grain is part of the UK gas grid and you can therefore mass balance biomethane from its injection as a gas to its withdrawal as LNG from the terminal at the Isle of Grain. They are determining the status of LNG terminals on a case by case basis.

#### ***Verification standards for issuing a PoS for biomethanol***

The RTFO guidance sets out the requirements for proving the sustainability of renewable transport fuel and in the vast majority of cases producers and suppliers chose to use a voluntary scheme recognised by the European Commission to evidence and create PoS within those Scheme rules. Verification standards of ISCC, being the most widely used voluntary scheme, are detailed elsewhere in this report.

Recognition of that PoS is determined by the “Renewable Transport Fuel Obligation (RTFO) guidance: 2020”. This document contains information for biomethane or fuels for which biomethane is an intermediary in (Chapter 3.49) and set out their view on mass balancing, which follow the European guidance on the topic. The guidance directly addresses the topic of biomethane transported via the grid.

#### **CertifHy**

CertifHy is a voluntary issuing body for hydrogen GOs on EU-level. The system is currently in a pilot phase. CertifHy is based on a Book&Claim system. Furthermore, the certificate requires a 60% GHG reduction compared to grey hydrogen. Hydrogen is only eligible for a CertifHy certificate if it was produced by 100% renewable energy. The current pilot-process operates as follows: Once a plant becomes registered, hydrogen producers are able to get hydrogen GOs issued for their production amounts. However, they get only 90% of the total amount issued, while the remaining 10% get issued after the annual audit.

Since CertifHy has yet no Transition System Operator (TSO) in place, the economic operator needs to provide proof that the renewable electricity GO got cancelled, in order to request CertifHy to issue a H<sub>2</sub> GO. This process is checked annually by an auditor. According to CertifHy, a hydrogen GO can still be issued even if the renewable electricity input has been granted **state aid**, since RED II mentions “Member States shall ensure that when a producer receives financial support from a support scheme, the market value of the guarantee of origin for the same production is taken into account appropriately in the relevant support scheme (Art. 19 (2))”. According to CertifHy also biobased

electricity should be eligible for hydrogen GO issuance. As required by RED II, the primary energy source must be traceable throughout the supply chain. How this will be implemented has not yet been decided.

When hydrogen gets injected into the grid, it becomes part of a gas mix. Consequently, CertifHy is in favour of transferring the H<sub>2</sub> GO into a gas GO when injected into the public gas grid. One major reason for that is, that gas from the public grid can only be used for gas application, while it would for instance destroy a fuel cell. Thus, if hydrogen is injected into the public gas grid, a hydrogen GO should be cancelled and a gas GO should be issued. CertifHy is also in favour of adding a **GHG value** in form of standard values to the GO. Regarding **mass balancing**, the main issue is that no independent 3rd party metering devices are yet available. The metering devices are likely to be different for each transportation pathway (e.g., road, public grid), and operated by economic operators, rather than third party independent metering devices. A robust tracking system for all types of transports is needed. According to CertifHy, the entire gas distribution network (including tube trailer) should be considered as a mass balance unit (or “one logistical facility”, cfr RED2 Art. 30). In order to verify temporal and geographical correlation, a separate method should be developed for gas which is transported via the grid and gas which is transported via road. Furthermore, CertifHy is in favour of linking GOs with Pos.

#### ISCC

The International Sustainability and Carbon Certification (ISCC) is a global sustainability certification scheme for bioenergy, food, feed and chemical/technical applications. The scheme covers the entire value chain from biomass production to end use (ISCC, 2019a).

#### ***Verification standards for issuing a PoS for hydrogen/synthetic methane***

##### **Quality Criteria for PTG according to ISCC:**

Each supply chain step must be certified under ISCC. Hereby, the following information must be provided:

##### **Sustainability Declaration – Product related information:**

- Name, address, certification scheme and certificate number of issuing party
- Date of dispatch of the sustainable material
- Name and address of recipient
- Related contract number
- Unique number of sustainability declaration
- Type of sustainable material, including raw material
- Country of origin of raw material
- Quantity of sustainable material
- GHG information
- Claims, statements and add-ons
- Chain of Custody information
- Statement that the sustainability criteria according to Art. 17 (3) to (5) RED were not taken into account\*

#### ***Verification standards for issuing a PoS for bio-LNG***

2019 ISCC listed 54 certified biomethane plants. Recently, ISCC issues the first EU certificate for a liquefaction plant, processing biomethane to bio-LNG. The bio-LNG is produced by Gasum in Sweden (ISCC, 2019b). Deliveries from other certification schemes must comply with the ISCC standards in order to be accepted. The verification of the fulfilment of this requirement must be subject of each audit.

### ***Verification standards for issuing a PoS for biomethanol***

ISCC certifies biomethanol (ISCC, 2019a).

11.2. Questionnaire of the survey which aims to identify verification standards of cross-sectoral technologies per country

## **1 Electricity-based gases**

### **1.1 Guarantees of origin - GO**

#### **1.1.1 General questions**

1. Who will be responsible for the verification and documentation at the beginning (electricity) and end (gas) of the conversion process with regard to energy measurement, timing and location?
2. Will the issuance of GO for synthetic gases require the creation of a new issuing body in your country or will the institution responsible for electricity GO be able to issue GO for synthetic gases?

#### **1.1.2 Electric power source**

1. In the case of electricity-based gases, what types of electricity delivery options are allowed in your country to issue a GO for this type of gases? Purchase of renewable electricity from the public grid and/or from a direct line?
2. If it is permissible to purchase electricity from the public power grid, must an electricity GO be required as proof of the electricity's renewable property? If so, can the electricity GO also come from another EU country?
3. Would **renewable** electricity bought from a power purchase agreement (PPA) be recognized as such if used for the production of a synthetic gas and would the latter qualify for a GO?
4. Which criteria should be used for certification and verification of the electricity origin, i.e. renewable sources, excess electricity from renewable sources, etc.?
5. Can a gas GO be issued for a synthetic gas produced from renewable electricity that already received some state or financial support and for which a GO has been issued?

### **1.1.3 Conversion of power to gas (PtG)**

1. How can the measurement and verification of the energy content, source and location during each conversion step for the production of synthetic gases be assured in your country? Is an independent audit required for each conversion step?
2. How can electricity GO and gas GO be linked together when a synthetic gas has been produced from a PtG facility and for which a GO should be issued?
3. Should it be possible to issue a gas GO if the synthetic gas was produced with electricity generated by a biogas (or biomethane)-fired power plant?

### **1.1.4 Transport of synthetic gases produced through PtG processes**

1. Consider a situation where synthetic hydrogen is injected into the grid and a GO is issued for its amount and energy content. If this hydrogen mixes with the gas in the grid, what would happen with its GO? Will its GO be transferred or translated into its gas equivalent when the same amount and energy content of gas is withdrawn from the grid? Or should the GO remain in its original form (as hydrogen) and only be used for hydrogen applications?
2. If synthetic gases or biomethane are liquefied (bio-LNG), how would the GO be issued for the liquefied gas? Would it be necessary to cancel the GO issued for its gaseous form before issuing the GO for its LNG version? Or would a new issuing and verification process be necessary?

### **1.1.5 Carbon source and GHG savings**

1. Even if guarantees of origin cannot be used to credit an emission reduction (e.g., ETS), should it still be possible to include a GHG value on the GO for reasons of transparency for the final consumer? Should only standard values be used or should manual calculations of GHG values also be allowed?
2. For the methanation of hydrogen, should quality criteria for the CO<sub>2</sub> source apply in the context of GO (i.e., carbon capture usage, carbon air capture, carbon only from biogenic sources, no deliberate generation of CO<sub>2</sub>, among others). How can the CO<sub>2</sub> source be verified and documented?
3. Should the use of fossil energy for the production of renewable gases energy be taken into account on the GO? For example, electricity partially generated through fossil fuels and later used for producing the renewable gas. If so, which energy sources would be suitable?

## **1.2 Proofs of Sustainability - PoS**

### **1.2.1 General questions**

1. How can it be demonstrated that the renewable properties are claimed only once and only in one end-use sector? What is the experience from your country/institution?

### **1.2.2 Mass balancing**

1. Which measures are taken into consideration in your country for the mass balancing of synthetic gases?
2. Would a methanation plant be considered a mass-balancing unit and, if so, would it be responsible for issuing the PoS?
3. Which time frame is appropriate for the issuing of PoS of gaseous and liquid renewable fuels, e.g., one month, one quarter, one year?
4. If renewable gases are traded via the gas grid between EU MS, how can the PoS be preserved and/or transferred together with the traded gas? Which conditions should apply to gas trading in order to preserve the PoS?
5. Does the synthetic gas have to be delivered across the border for balance sheet purposes? Or should the European gas network be regarded as a mass balance unit?
6. How would a PoS be handled if the renewable gas associated to it is traded and transported from one EU MS to another, depending on the transport means (grid, truck, etc.)? How can double counting be avoided?

### **1.2.3 Sustainability criteria**

1. In your country, how is it verified and certified that the electricity generation of a renewable power plant is truly additional? Which types of evidence can be considered for proving the additionality (i.e. building permission, emissions control permission, proof of commissioning date)?
2. How should the temporal and geographical correlation of the production of green hydrogen with renewable electricity be addressed if the hydrogen was transported via the public gas grid? Is a 15-minute period for the simultaneous production acceptable or should the time intervals be longer?
3. What evidence can be used to verify and check the simultaneous production of electricity from the power generation unit and green hydrogen by the electrolyser? What could be a suitable geographical criterion (i.e., within national borders or a 200 km distance with cross border possibility, or both criteria together)?

### **1.2.4 Carbon source**

1. Which kind of CO<sub>2</sub> source is eligible for the production of renewable gases of non-biological origin, i.e., carbon air capture, CCS, CCU?
2. If the CO<sub>2</sub> comes from unavoidable industrial processes (flue gases) and the electricity used by the electrolyzer comes from renewable sources, will the synthetic fuel be treated as (a) renewable or (b) carbon neutral?
3. How can it be guaranteed that the CO<sub>2</sub> was not deliberately produced for the production of renewable fuels? Which verification options exist to check that matter?

4. Is the CO<sub>2</sub> from thermal incineration of biomass and the anaerobic digestion and separation of CO<sub>2</sub> from biogas eligible for the production of renewable gases? What proof is needed and how can it be documented?

## **2 New bioenergy sources (Bio-LNG)**

### **2.1 Guarantees of origin - GO**

#### **2.1.1 General questions**

1. GO have no effect on the crediting of renewable energies towards national targets under Article 3 RED II. How do you assess this requirement with regard to GO for Bio-LNG?

#### **2.1.2 Transport of Bio-LNG**

1. If biomethane is liquefied (bio-LNG), how would the GO be issued for the liquefied gas? Would it be necessary to cancel the GO issued for its gaseous form before issuing the GO for its LNG version and being transported? Or would a new issuing and verification process be necessary?

#### **2.1.3 Carbon source and GHG savings**

1. Even if GO cannot be used to credit an emission reduction (e.g., ETS), should it still be possible to include a GHG value on the GO for transparency reasons to the final consumer?
2. If you answered positively (a “yes”) to the previous question, should only standard values be used or should manual calculations of GHG values also be allowed?

### **2.2 Proofs of Sustainability - PoS**

#### **2.2.1 General questions**

1. How can it be demonstrated that the renewable properties are claimed only once and only in one end-use sector?

#### **2.2.2 Mass balancing**

1. How can the mass balancing be assured when withdrawing bio-LNG produced from biomethane? Is there a methodology already for this in your country? If so, please give a brief explanation of it.
2. Which measures are taken into consideration in your country for the mass balancing of biomethane and bio-LNG? Have you developed national and/or regional standards?
3. Is there a difference of mass balancing between Bio-LNG transported off-grid and biomethane transported through the gas grid?
4. Should the LNG facility be considered the last element in the production chain? If so, should a PoS be issued for the biomethane arriving at the facility? Or is it enough that the LNG facility issues a PoS when the bio-LNG leaves the facility? What is the situation in your country regarding this matter?

5. Considering the previous question, do you consider there is a lack of uniform EU standards for verification?
6. Which time frame is appropriate for the issuing of PoS of gaseous and liquid renewable fuels, e.g., one month, one quarter, one year, etc.?

### **2.2.3 Sustainability criteria**

3. How are the sustainability characteristics from biomethane preserved when producing bio-LNG? Will an independent audit be necessary for this in order to issue a PoS for the bio-LNG?

### **2.2.4 Biomethane to bioliquids**

1. If the biomethane is injected into the gas grid and liquefied at a later stage, how can its sustainability be claimed when liquefied and transported?
2. Which additional conversion, compression and transport activities must be considered for the GHG emissions calculation of biomethanol and bio-LNG?