Development of Standardisation Processes for Biomethane

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GREENMEUP

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Executive Summary

GreenMeUp – Green Biomethane Market Uptake is a Horizon Europe project that aims at providing a basis for policy-makers and stakeholders to develop more informed renewable energy policies and country-tailored market uptake measures, in order to improve and complement existing biomethane policy in Europe.The core activity of GreenMeUp is to reduce the gap between countries with higher rates of biomethane production and countries with lower development rates, by analyzing and comparing their framework conditions and market dynamics and promote enabling policies and measures at country level. The project aims at providing societal acceptance of the biomethane value chain through science-based evidence and tools

The following document provides an overview about European Standardisation for biomethane. Including an overview of four CEN working groups as identified by the project consortium. After an introduction to making standards in Europe, the following CEN Working groups are anallysed in details with regards to their background, scope of work and specifications.

CEN Working Group/Technical Committee	Name of relevant Standard	Description
SECT/SF GAS I/JWG GQS	Gas quality standard – EN 16726	This standard specifies gas quality characteristics, parameters and their limits, for gases classified as group H that are to be transmitted, injected into and from storages, distributed and utilized.
CEN/TC 408	Natural gas and biomethane for use in transport and biomethane for injection in the natural gas grid EN16723-1 and EN 16723-2	Standardization of specifications for biomethane as fuel for engines and of biomethane for injection in the natural gas grid, including any necessary related methods of analysis and testing.
CEN/CLC/JTC14/WG5	Guarantees of origin related to energy -EN 16325	Standardization in the field of energy management within the energy transition framework in close coordination with CEN/CENELEC sectorial strategy
CEN/TC 223	Soil improvers and growing media - CEN/TS 17732:2022	standardization of two types of material used in agriculture. Compost and digestate properties when used in fertilizing products

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Introduction

In 2003, the European Directive 2003/55/EC authorized the injection of gases derived from unconventional sources into the natural gas grid, provided that such gases can be technically and safely introduced and transported within the natural gas system[1]. Notably, prior to the directive, countries like Germany, Austria, and the Netherlands had already been incorporating biomethane into their natural gas grids. Additionally, Sweden and Switzerland were early adopters of biogas-to-biomethane conversion in the early 1990s, marking them as pioneers in this upgrading process. At the end of 2012, nine out of the eleven countries producing biomethane in Europe were already injecting into the gas grid[2].

The standardisation of biomethane injected into the gas grid became part of the conversation as more countries started upgrading biogas into biomethane. Different standards for injection were developed at the national level with varying parameters and concentrations. Hence the standard of quality and what was acceptable differed between countries. Such developments gave rise to the work of the standardisation group of CEN TC234/WG9 on "Injection of non-conventional gases into the natural gas network" based on an earlier report by Marcogaz.[3]

Furthermore, in the absence of CEN standards for biomethane the European Commission took the initiative to issue Mandate M/475: "Mandate to CEN for standards for biomethane for use in transport and injection in natural gas pipelines". This work was undertaken by CEN Technical Committee (TC) 408. The mandate was to allow the provision of two standards for biomethane applications; one for biomethane use in internal combustion engines (transport) and the other for biomethane injection in the natural gas grid. The objective was to improve market access, provide a good precondition for free trade, and to enhance legal and technical security.

In this deliverable, an overview of the CEN Mandates, as well as relevant information on the scope of work of four CEN working groups of importance for the biogases industry are analysed, in order to enhance the development of standardisation processes. The scope of this deliverable does not cover scientific details or measurements related to the topics discussed.

[1] European Directive 2003/55/EC
[2] BIOSURF Deliverable 3.7
[3] WG-Biogas-06-18 D497 Final Recomm marcogaz Biogas 011206...

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Making standards for Europe

The establishment of European Standards plays a crucial role in solidifying the Single Market and enhancing the competitive edge of European businesses, thereby fostering the prerequisites for economic expansion. These standards serve as a valuable mechanism for streamlining international trade, encompassing transactions within Europe's single market, and extending to global commerce. A standard is a technical document designed to establish a norm or guide, offering a collectively agreed-upon and replicable method for accomplishing a task. They emerge from the collaboration of diverse stakeholders, including manufacturers, consumers, and regulators involved in a particular material, product, process, or service. The mutual benefits of standardization include enhanced product safety and quality, along with decreased transaction costs and prices for all parties involved.[4]

CEN, the European Committee for Standardisation, is an association that brings together the National Standardization bodies of 34 European countries. Hence one European standard replaces 34 national standards. It is officially recognized by the European Union (EU) but their operations goes beyond the EU region. It provides a platform for the development of European Standards and other technical documents in relation to various kinds of products, materials, services, and processes. **CENELEC**, the European Committee for Electrochemical Standardization, is the association that brings together the National Electrochemical Committees. The European standards developed by the CEN and CENELEC are made by experts and established with a consensus. The application of the standards is voluntary, but they can also be mandated by EU regulations. [4]

European standards are tools used to comply with European legislation. Most standards developed by CEN and CENELEC are in direct response to specific requests issued by the European Commission. Such standards are meant to ensure that specific products or services are in line with European legislation (EU Directive). Through Regulation (EU) No 1025/2012, the three European Standardisation Organisations (CEN, CENELEC and ETSI) may receive a request to produce European harmonised standards in support of EU legislation and policies[4]. For example, the European Commission gave the CEN the Mandate to develop an European standard for a quality specification for biomethane as fuel for vehicle engines and to be injected into the natural gas pipelines. CEN/TC408 developed the standard based on the mandate M/475, taking into consideration the work of the TC234 WG 11 with the mandate on gas quality.

[4] https://www.cencenelec.eu/european-standardization/european-standards/

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CEN standardisation work of importance for the biogases sector

The GreenMeUp consortium selected four crucial CEN working groups related to the biomethane industry for a detailed analysis of their scope and activities. These groups elaborated below provides key input regarding biomethane standarsdisation in Europe, most espcecially in relation to markert uptake and grid injection. The technical committee on soil improvers specifically targets standards (that in part) inlcudes the use of digestates, thereby providing a holistic analysis on biomethane end uses. In the sections below we will see more on:

- SECT/SF GAS I/JWG GQS (relates to Gas quality standards for biomethane injection into the grid)
- Natural gas and biomethane for use in transport and biomethane for injection in the natural gas grid - CEN/TC 408
- CEN/CLC/JTC14/WG5 "Guarantees of Origin related to "energy".
- CEN/TC 223 "Soil improvers and growing media"

2.1 Gas Quality Standards - SECT/SF GAS I/JWG GQS

Background

The mandate (M/400) for gas quality standards was given to CEN in relation to the Directive 2003/55/EC of the European Parliament and of the Council *on the creation of a competitive single European gas market*[5], to establish technical rules for the design and operational requirements of gas facilities; inlcuding storage, transmission and distribution systems. The objective is to enhance interoperatability of systems across member states.

The mandate outlined a set of parameters, including the Wobbe Index, oxygen, total sulfur, CO2, among others. The standard aimed to tackle concerns related to quality, nomination and matching processes, and the harmonization of units.

[5] 2007_01_16_mandate_gas_quality_en_0.pdf (europa.eu)

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Specifications

At the time of writing (January 2024), the EN16726 is under revision. The current EN16726 came into force in 2015 without the Wobbe-Index, despite the mandate M/400. From 2016-2022 a study phase took place on the possible Wobbe-Index requirements in the CEN Sector Forum Gas. The revision process is taking place beween 2022-2025 and the main need for the revision is to include a parameter for the Wobbe Index. However, all parameters were investgated for revision need and the following are subject to change:

1. Wobbe Index,
2. Hydrogen content and adapated minimum value for relative density,
3. Oxygen (to facilitate renewables),
4. Sulfur,
5. Methane number.

One of the major points under discussion is the oxygen limit for injection of biomethane into the gas grid. The permissible oxygen content in the gas grid has emerged as a challenge among grid operators, Transmission System Operators (TSOs), and Distribution System Operators (DSOs) across various countries. According to prEN 16726 (draft standard), the maximum allowed oxygen content stands at 1% mol/mol at network entry and interconnection points, and a more stringent 0.01% mol/mol for sensitive installations like underground gas storage.[6] In certain cases, when a sensitive end-user or case is demonstrated, a threshold of 0.001% mol/mol is applied.

Different countries implemented separate national standards, resulting in different oxygen level requirements between countries. This poses a challenge for cross border flows. For example, in Denmark, the legislation limits oxygen levels for biomethane injected into the grid to 0.5% mol/mol at entry points and transit and 0.1% at storage points. Italy has an oxygen limit up to 0.6% mol/mol for biomethane injected into the gas grid. Whiles France has lower tolerance of 0.001% mol/mol on hourly basis as illustrated in Figure 5 below.

In Estonia, gas injected to the grid is required to meet certain conditions such as[7]: the Oxygen content cannot exceed 0,5mol% on injection point. Precise amount of oxygen in the injected gas is regulated between the producer and grid operator (in their contract), and the temperature of injected gas has to be between 0-40°C. The Gas quality requirements are set in place in conditions where absolute pressure is 110,325kPa and temperature is 20°C.

[6] 0.01% is 100ppm according to the Gas Quality standard EN 16726.
[7] Sulphur content in biomethane is zero, since all biomethane has to be pre-treated to avoid corrosion and damage in the upgrader. H2, silica content and Wobbe index is not measured at the moment in Estonia.

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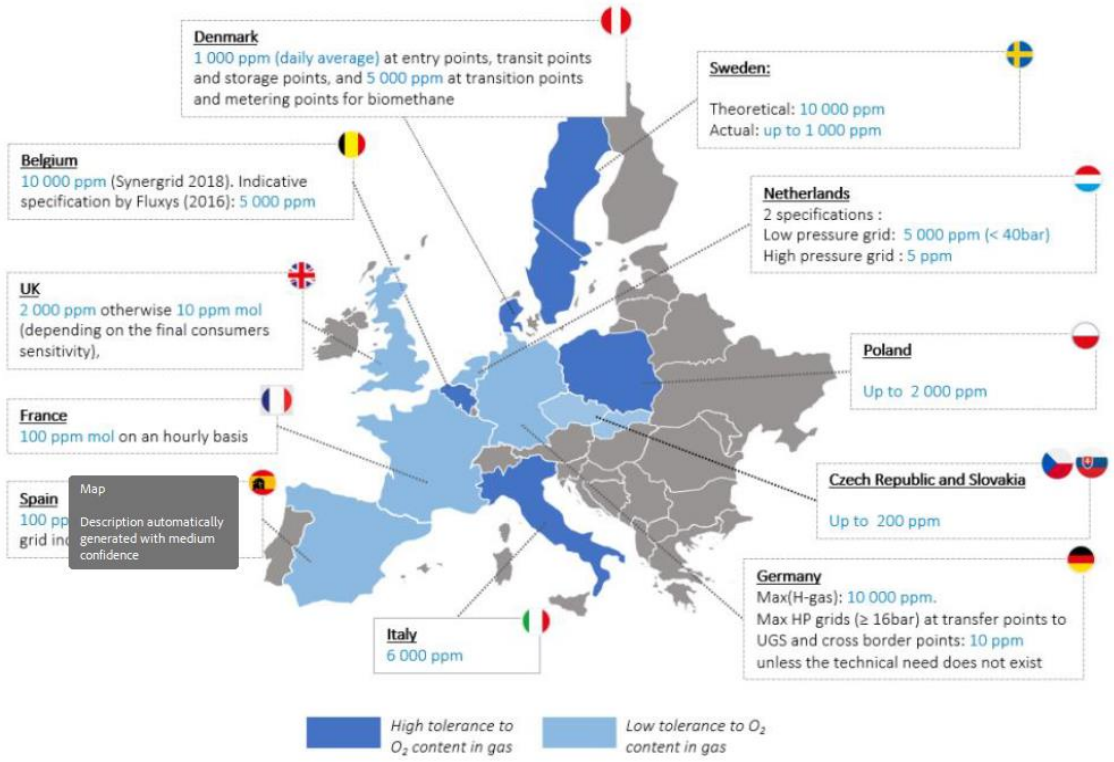

Figure 1 Tolerance for Oxygen content in bioemthane injected into the gas grid. (source: Marcogaz)

Elevated oxygen levels in the gas grid might lead to corrosion in both underground and above-ground facilities, as well as the formation of "black powder" in high-pressure grids. There are also risks of combustion, change in gas quality due to reaction and oxidation and possible microbial growth in in the gas storage environment.[8] Hence some grid operators, TSOs and DSOs have been looking into processes such as catalytic deoxygenation and other ways to reduce oxygen levels during upgrading treatments or how to treat H_2S without adding O_2.

Next to the revised oxygen requirements, the updated standard EN16726 will incorporate normative recommendations for the Wobbe Index and the review the parameters present in the current standard, including EU funded research by end of 2024 on

- Impact of oxygen in UGS and on pipes
- Impact of sulfur on engines
- Impact of hydrogen on H2 tanks

[8] Perla G. Haddad *et al* Biological, geological and chemical effects of oxygen injection in underground gas storage aquifers in the setting of biomethane deployment,Science of The Total Environment, Volume 806, Part 3, 2022,

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It is expected that the hydrogen content will be introduced as a new parameter. A public consultation and inquiry was ongoing between December 2023 and March 2024 at the time of writing this report. The technical committee is set to conclude the draft by October 2024, with the full publication scheduled for April 2025.

2.2 Natural gas and biomethane for use in transport and biomethane for injection in the natural gas grid - CEN/TC 408

Background

This European Standard was prepared by CEN/TC 408 in response to the European Commission standardization mandate M/475. The Mandate requested the development of quality specifications for biomethane to be used as a fuel for vehicle engines and to be injected in natural gas grid. The CEN Technical Board (BT) later expanded the scope of the standard to including any necessary related methods of analysis and testing. It however excludes production process, source and the origin of the source. Since the Mandate referred to two different applications CEN TC/408 resulted in two standards, Part 1 Biomethane for injection into gas grids and Part 2 Biomethane in use in transport.

The CEN TC408 had several organisations nominated from 17 countries with additional collaboration from seven European organisations and associations; EBA, Marcogaz, Afecor, Farecogaz, GIE, ENTSOG and NGVA Europe.

Specification

Standard EN 16723 has been prepared by Technical Committee CEN/TC 408 "Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network",

The work of CEN/TC 408 took under consideration the work on natural gas quality undertaken by CEN/TC 234 (Gas Infrastructure)[9] in response to Mandate M/400[10] on "Natural Gas Qualities". It also considered the parameters defined and specified in EN 16726[11](first published in 2015); which specifies gas quality characteristics, parameters, and their limits, for gases classified as "Group H" that are to be transmitted, injected into and from storages, distributed and utilized. This is due to the fact that, there are common

[9] "Standardisation in the field of gas pipeline infrastructure for gaseous energy carriers and blends thereof from the input into the on-shore transmission network up to the inlet connection of gas appliances; This includes related functional requirements for injection, transmission, compression, pressure control, storage, blending, gas treatment, odorisation, distribution, measuring, and associated installation pipework, as well as related requirements such as safety, gas quality, sustainability, environment and emissions. Within the scope of CEN/TC 234, gaseous energy carriers and blends describe gases which are in the gaseous state when conveyed in the gas pipeline infrastructure such as hydrogen, hydrogen rich, and methane rich gases, dimethyl ether (DME) and propane and butanes used for combustion and/or as feedstock, excluding steam and compressed air";
https://standards.iteh.ai/catalog/tc/cen/cc25e361-921b-4ba1-822b-21062c37a4c0/cen-tc-234

[10] https://law.resource.org/pub/eu/mandates/m400.pdf

[11] "This European standard specifies gas quality characteristics, parameters and their limits, for gases classified as group H that are to be transmitted, injected into and from storages, distributed and utilized. https://standards.iteh.ai/catalog/standards/cen/2c15cc1a-ff60-4611-b913-842a1ac2926a/en-16726-2015a1-2018

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parameters between natural gas and biomethane such as Oxygen, Sulphur and Carbon Dioxide which were defined in EN 16726. On the other hand, there are some gas qualities which are unique to biomethane such as siloxanes, terpenes, amines etc. Which were included in the EN 16723 -1 and EN 16723-2 when it was first published in 2017.

EN 16723 consists of the following two parts, under the general title "Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network":
— Part 1: Specifications for biomethane for injection in the natural gas network. (EN16723-1)

— Part 2: Automotive fuel specifications. (EN16723-2)

Table 1 shows the most critical values for key parameters for important standards for part 1.

Table 1 Part 1 - Critical values for Key Parameters

Parameter	Unit	Limit values[a]	
		Min	Max
Total volatile silicon (as Si)	mgSi/m3	-	0,3 to 1
CO	% mol	-	0,1
NH3	mg/m^3	-	10
Amine	mg/m	-	10

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The key objectives of Mandate 475 are shown schematically in Figure 2 below.

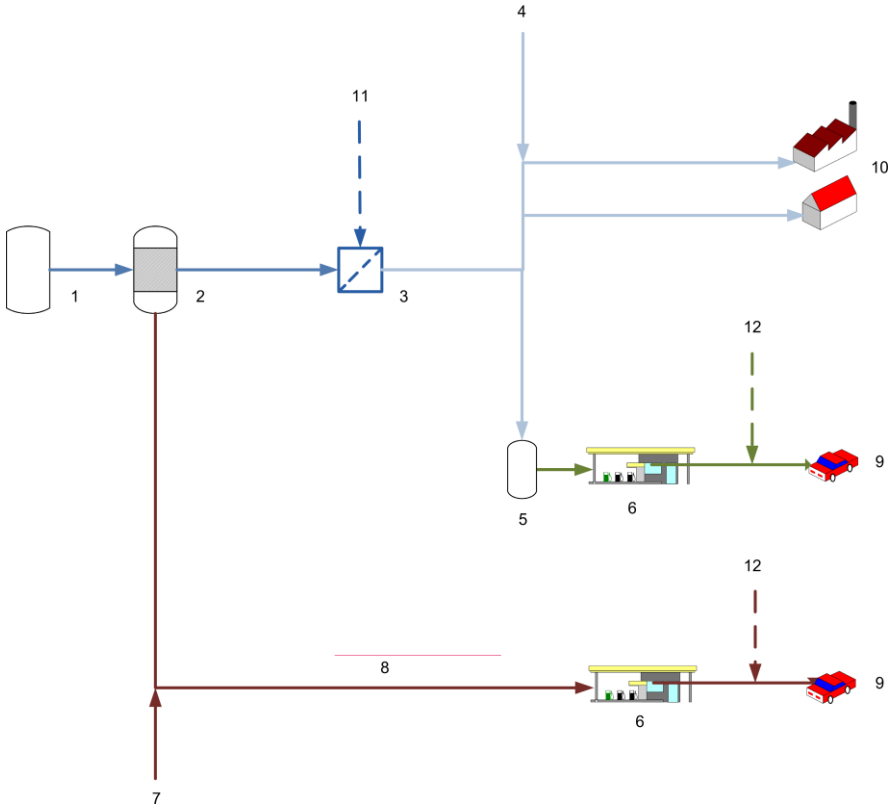

Figure 2 M475: Representation of flows and uses of biomethane and natural gas[12]

Key

1	biogas from digestion or thermochemical process	7	non-grid sourced natural gas.
2	upgrading	8	local dedicated infrastructure
3	injection into the gas grid	9	automotive use
4	natural gas grid	10	domestic and industrial use
5	conditioning	11	Part 1: grid specification
6	refueling station	12	Part 2: automotive specification

There is a development of analysis of unique components found in biomethane. The work on prEN 16723-1 and prEN 16723-2 started in August 2023. While the revised standard is expected to be published around October 2025.

[12] https://cdn.standards.iteh.ai/samples/59781/51764e0b9f1c436f860c50fb7d12b38b/SIST-EN-16723-1-2017.pdf

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Research work with European Gas Research Group

The European Gas Research Group[13], GERG, carried out a study in 2016 with the aim to identify, for different trace level compounds, the associated acceptable threshold for gas appliances and infrastructure based on literature reviews and experimental programs, and thus feed the standards updates discussions with tangible elements (GERG biomethane project Phase 1).

Following this work, GERG established a close cooperation with CEN TC/408 in further improving and developing the standards for biomethane for injection in the natural gas network[14]. The EC funded projects aimed at revision of the standards for, and therefore, removal of barriers to the deployment of biomethane into gas networks and vehicles.

GERG performed experiments on the impact of siloxane on heavy duty vehicles engines and industrial boilers and literature surveys on the impact of sulphur on vehicles, impact of oxygen on underground gas storages and health impact of biomethane. Siloxanes can create technical problem to biomethane applications when they deposit on surfaces in appliances or engines. It was found that although siloxanes do deposit on surfaces in boilers and engines their impact on performance is limited. The presence of Sulphur in biomethane (mainly H_2S) can lead to failure of the catalyst. The health impact study showed that biomethane doesn't have any impact on health[15]. The work showed that there is a knowledge gap on sulphur and oxygen impact on gas facilities. The key results of the GERG project Phase 2a have been presented in various fora (see e.g., footnote[16]). However, the research work needs to be continued to provide further reliability in blending biomethane with natural gas.

Furthermore, the Project BIOSTAR2C[17] - "Removing Technical Barriers to Biomethane Standardisation Phase 2C" which started on 01/01/2023 aims to remove the barriers that impede biomethane use into gas networks and vehicles. This project activities will be in line with the Biomethane Industrial Partnership's target to increase annual production and use of biomethane to 35 billion cubic metres by 2030.

[13] https://www.gerg.eu/
[14] https://www.gerg.eu/projects/biomethane/trace-components-in-biomethane/
[15] GERG: Biomethane trace compounds and their potential impact on European gas industry, Final report Phase 2b, 16/12/2022
[16] https://www.gerg.eu/wp-content/uploads/2019/12/GERGBiomethaneProject_TraceComponents_EGATEC.pdf
[17] https://cordis.europa.eu/project/id/101112475 & https://www.gerg.eu/projects/biomethane/biostar2c-removing-technical-barriers-to-biomethane-standardisation-phase-2c/

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2.3 Guarantees of Orign related to energy - CEN/CLC/JTC14/WG5

Background

A Guarantee of Origin is an "*electronic document which has the sole function of providing evidence to a final customer that a given share or quantity of energy was produced from renewable sources*", according to Directive 2018/2001[18]. Article 19 of this Directive is the legal basis for systems of guarantees of origin. This article stipulates that the official purpose of Guarantees of Origin (GO) is to prove to final consumers the actual share of energy from renewable sources[19]. Systems of GO must be set-up by Member States. They have already been implemented for electricity from renewable sources since 2003-2004.

The new Renewable Energy Directive 2018/2001 extended the obligation to gases and heating and cooling. It thus became relevant to biomethane production. Biomethane has the same chemical composition as natural gas, making it impossible to trace it physically once it is injected in the natural gas grid. GO for biomethane are the instrument to prove the "renewable value" of the gas supplied to an energy consumer compared to gases of non-renewable origin. All Member States are this legally required to set-up registries of renewable gas GO. Additionally, the Directive also commands the recognition of GO from other Member States, opening the door to cross-border trade and the emergence of a European renewable gas market.

The Directive 2018/2001 also added the obligation for compliance of the GO systems with the standard EN 16325. Considering EN 16325 had previously been suited only for renewable electricity, Directive 2018/2001 was the starting point of the revision process of EN 16325.

Multiple Member States have developed guarantee of origin registries, while in a few other countries industry-led registries remain. (see Table 2). In general:

1 Biomethane Guarantee of Origin = 1 MWh biomethane

The European biomethane **Guarantee of Origin** are valid for 1 year.

Figure 2 shows a schematic of flows and uses of biomethane and indicates the most significant transborder flows and trade for biomethane[12].

[18] Article 2.1 point (12).
[19] See Article 19.1 of Directive 2018/2001.

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However, a pan European cross border trade of GO is still missing, because of – among other reasons – the lack of harmonisation of the GO for biomethane and the lack of single cross-border transfer scheme.

- Different practices and requirements in the content of GO - and of renewable gas certificates set up by voluntary industry-led initiatives – hinder the cross-border transfer of GO/certificates between renewable gas registries of EU countries.
- In the past, a few bilateral agreements between registries allowed for trustworthy and transparent title transfer of renewable gas certificates. They are now two different schemes enabling cross-border transfer: the ERGaR CoO Scheme and the AIB Gas Hub, but both schemes overlap each other in terms of geographical scope, and they do not cover yet all EU countries.

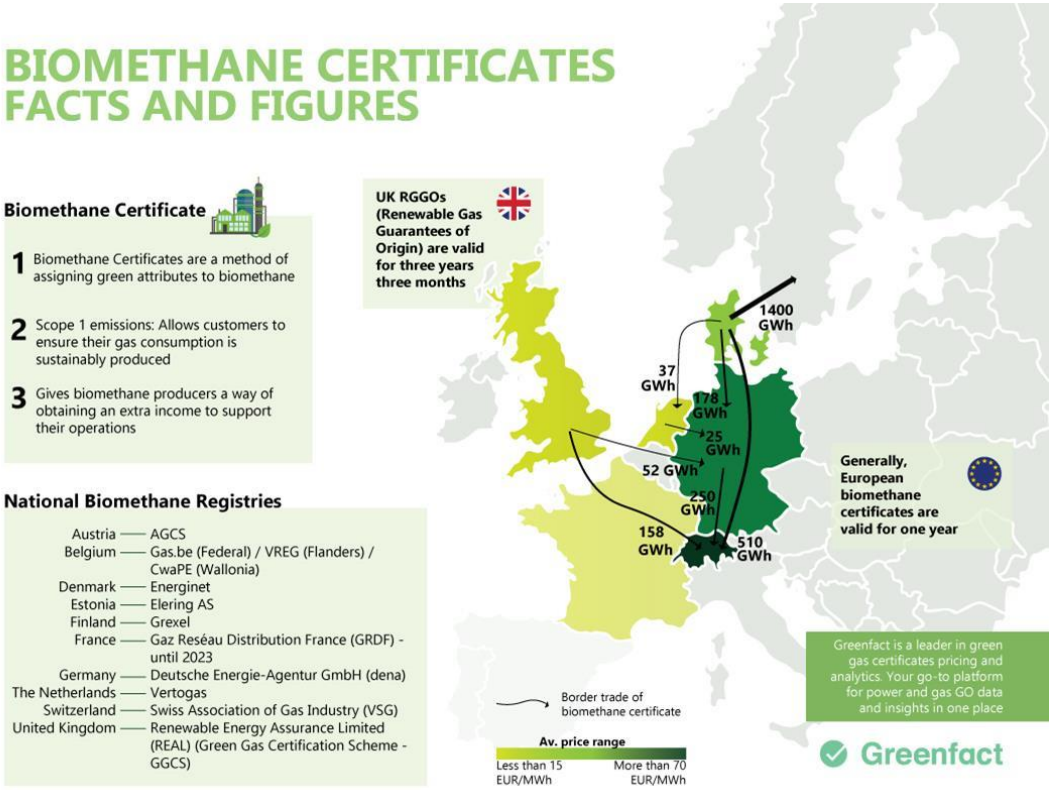

Figure 3 Biomethane Certificates, Facts and Figures[20]

[20] https://portal.greenfact.com/Page/all-about-biomethane-certificates

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Table 2 National Biomethane Registries[20]

	Government Mandated	Registry Admin(/Registry Name)	Website
Austria	No	AGCS	biomethanregister.at
Belgium	Yes	Gas.be (Federal) VREG (Flanders) CwaPE (Wallonia)	https://www.gas.be/ https://www.vreg.be/ https://www-cwape-be
Denmark	Yes	Energinet	https://en.energinet.dk
Estonia	Yes	Elering AS	https://elering.ee/en
Finland	Yes	GasGrid/Grexel	https://gasgrid.fi
France	No	Gaz Réseau Distribution France (GRDF) - until 2023	https://www.grdf.fr/grdf-en
Germany	No	Deutsche Energie-Agentur GmbH (dena)/biogasregister	biogasregister.de
Netherlands	Yes	Verticer	(2023 - soon to be vertiCer)
Spain	Yes	Enegas	gdogas.es
Switzerland	No	Swiss Association of Gas Industry (VSG)	https://gazenergie.ch/de/
United Kingdom	Yes	Renewable Energy Assurance Limited (REAL)/Green Gas Certification Scheme (GGCS)	https://www.greengas.org.uk/

Specification

The original CEN standard dealing with guarantees of origin (EN 16325:2013+A1:2015[21] published on 17/05/2016) addressed and specified the requirements for Guarantees of Origin of Electricity from all energy sources.

It has been decided in 2020 to revise the standard to extend the scope to all possible guarantees of origin under prEN 16325 "*Guarantees of Origin related to energy - Guarantees of Origin for Electricity, gaseous hydrocarbons, Hydrogen, and heating & cooling*"[22,23].

This standard will establish the relevant terminology and definitions, requirements for registration, issuing, transferring and cancellation in line with the RED and Cogeneration. This standard will specify how to create accounts and associated ownership rights. This

[21] https://genorma.com/en/project/show/cen:proj:61159
[22] https://genorma.com/en/project/show/cen:proj:76236
[23] "pr" mean draft European standard. The Working Group (WG) drafts the text of the standard. The Technical Committee (TC) decides when the draft is sufficient mature to be sent to the national members for the public Enquire stage as a Draft European Standard 'prEN". During enquire anyone may comment to the draft.

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standard will also cover measuring methods and auditing procedures. This standard will specify the requirements on the issuing bodies and on the auditing bodies.

The work is ongoing; however, the draft Standard provides a strong indication of the final standard. The final revised EN standard is expected to be adopted by the end of 2024 at the latest.

2.4 Soil Improvers and growing media - CEN/TC 223

Background

The scope of the working group CEN/TC223 on soil improvers and growing media is to provide standardization of two types of material used in agriculture, horticulture, gardening and landscaping. 1) Soil improvers, that is materials, which may have been composted or otherwise processed, added to soil mainly to improve its physical condition without causing harmful effects. 2) Growing media, that is materials in which plants are grown. Lime products and materials used solely as plant nutrients are excluded. The CEN/TC 223 is formed by different subcommittees and working groups, such as: WG 3 'Sampling', WG 4 'Analytical Methods', WG 5 'Microbiology', WG 6 'Harmonization', and WG 8 'Physical Contamination'

CEN/TC 223 is related to the EU regulations on fertilizing products, as soil improvers and growing media are considered fertilizing products under the EU Fertilizing Products Regulation (FPR). The FPR aims to harmonize the quality and safety of fertilizing products in the EU market and sets out rules for placing fertilizing products on the market, including soil improvers and growing media. CEN/TC 223's standards and technical specifications can be used to demonstrate compliance with the FPR. Additionally, CEN/TC 223's terminology standard defines terms used in the field of soil improvers, growing media, compost, fresh crop digestate, and digestates, which can be useful for complying with other EU regulations related to these products

Specifications

At the time of this writing interlaboratory studies are being conducted by CEN/TC 223/WG 4 under 'Analytical methods' to test the standards related to the Fertilizing Products Regulation (FPR) and ensure their accuracy and consistency across different laboratories. These studies involve testing digestate solid and digestate liquid in different laboratories to verify the validity of the methods and parameters defined in the standards. The parameters to be tested include nutrient content such as nitrogen and phosphorus. CEN/TC 223/WG 8 'Physical contamination' is also condusting studies on Solid digestate (0 – 25 mm) and liquid digestate (0 – 5 mm) and the results will be incorporated into the interlaboratory study of the following standard WI00223112 that is being developed.

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Annex 1

Standards and quality specifications under EN 16723

Nº	Title	Description
1	EN 16723-1:2017 Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network - Part 1: Specifications for biomethane for injection in the natural gas network	This European Standard specifies the requirements and test methods for biomethane at the point of entry into natural gas networks.
2	EN 16723-2:2017 Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network - Part 2: Automotive fuels specification	This standard specifies the requirements and test methods for natural gas, biomethane and blends of both at the point of use as automotive fuels. This standard applies to the previously mentioned fuels irrespective of the storage state (compressed or liquefied).

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