

BIOMAPE

Biomethane Market Acceleration and Uptake in Europe

D2.1 | Updated guidelines for establishing national biomethane registries for certificate management

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Executive Summary

This deliverable provides updated, implementation-oriented guidelines for the establishment and operation of national biomethane registries for certificate management. Developed within BIOMAPE Task 2.1, it supports countries in designing registry systems that can serve different certificate types, market pathways and regulatory requirements, while enabling national and European cross-border certificate trade.

Biomethane registries are becoming essential infrastructure for renewable gas market integration. Once renewable gas is injected into the gas grid, its environmental, sustainability and compliance-related value will not be physically traced and must instead be documented through certificates and associated registry processes. Registries therefore play a central role in issuing, transferring, cancelling and certificates, documenting auditing procedures and results, preventing double counting and double claiming, and supporting market trust, regulatory implementation and cross-border ownership transfer.

The report situates registry development within the evolving European policy framework. It examines the interaction of biomethane certificate systems with the Renewable Energy Directive, Guarantees of Origin, Proofs of Sustainability, national support schemes, transport fuel quotas, blending obligations, ETS-related use cases and the emerging Union Database. The analysis shows that European policy ambition for biomethane is high, but that market uptake remains constrained by uneven national implementation, fragmented support systems, certification barriers and insufficient coordination between registry infrastructures.

To ground the guidance in current European practice, BIOMAPE conducted a country mapping combining questionnaire responses and desk research. The mapping covers 18 European countries, including BIOMAPE Focus and Lead countries, and analyses their policy instruments, market dimensions, certificate and registry systems, key challenges and recommendations. It reveals a highly heterogeneous landscape: some countries operate mainly Guarantee of Origin issuing bodies, others maintain biofuel or sustainability databases, while several mature markets are characterised by parallel systems serving different policy purposes. The mapping also identifies recurring needs for clearer coordination between certificate systems, stronger safeguards against double counting, better alignment of registry data with national compliance schemes, preparation for future Union Database interaction, and more interoperable data exchange structures for cross-border trade.

A central contribution of the report is the development of a compilation of seven registry system types, ranging from GO issuing bodies and biofuel registries to hybrid systems, parallel systems, production databases, data centres and fully integrated registry systems. The analysis shows that no single model fits all national contexts. However, narrow single-purpose systems are less future-proof than modular architectures built on a reliable production-data foundation. The report therefore recommends a phased, modular and production-data-centred pathway for national registry development. New and evolving registries should first establish a reliable core for documenting production facilities, operators, injection points, metered production and injection volumes. On this basis, countries can progressively add certificate modules for Guarantees of Origin, Certificates of Origin, Proofs of Sustainability and national compliance instruments, while keeping their legal functions and claims clearly separated. Interoperability should be considered from the outset through harmonised attribute structures, robust certificate identifiers, clear transaction logic and clearly specified data exchange formats and

interfaces. Strong governance, operator neutrality, auditability and correction procedures are likewise essential.

The guidelines provide the analytical foundation for BIOMAPE's continued support to the Focus countries Hungary, Serbia, Slovenia, Portugal and Ukraine. In the next project phase, the findings will inform country-specific assistance on registry setup, IT-system needs, operational processes and cross-border ownership transfer testing.

Overall, the report concludes that national biomethane registries should be understood not as narrow administrative tools, but as strategic market infrastructure that supports policy effectiveness, market transparency, regulatory credibility and the gradual development of a more integrated European renewable gas market.

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List of Acronyms and Abbreviations

PROJECTS AND ORGANISATIONS

ADEME	French Agency for Ecological Transition	AGCS	AGCS Gas Clearing and Settlement AG
AGEN-RS	Energy Agency of the Republic of Slovenia	AIB	Association of Issuing Bodies
APPB	Associação Portuguesa de Produtores de Bioenergia	ATEE	ATEE Club Biogaz
BGF	Biogasfonds / Swiss Biogas Fund	BIOMAPE	BIOMethane Market Acceleration and Uptake in Europe
BIOSURF	EU-funded BIOSURF project	BLE	German Federal Office for Agriculture and Food
BMK	Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology	CARBURE	French platform for biofuel and sustainability reporting
CEGH	Central European Gas Hub	CRU	Commission for Regulation of Utilities, Ireland
DEA	Danish Energy Agency	DESNZ	Department for Energy Security and Net Zero, United Kingdom
EBA	European Biogas Association	EEGO	Entidade Emissora de Garantias de Origem, Portugal

EEX	European Energy Exchange	EPA	Environmental Protection Agency, Ireland
EPEX	EPEX SPOT / European Power Exchange	ERGaR	European Renewable Gas Registry
EXAA	Energy Exchange Austria	FOEN	Swiss Federal Office for the Environment
FURS	Financial Administration of the Republic of Slovenia	GME	Gestore dei Mercati Energetici, Italy
GNI	Gas Networks Ireland	GRDF	Gaz Réseau Distribution France
GSE	Gestore dei Servizi Energetici, Italy	GTSOU	Gas Transmission System Operator of Ukraine
ICE	Intercontinental Exchange	ISCC	International Sustainability and Carbon Certification
ISINNOVA	BIOMAPE project coordinator	MEKH	Hungarian Energy and Public Utility Regulatory Authority
NABISY	German sustainable biomass system / database	NEURC	National Energy and Utilities Regulatory Commission, Ukraine
NORA	National Oil Reserves Agency, Ireland	REAL	Renewable Energy Assurance Limited
REA	Renewable Energy Association	REGATRACE	REnewable GAs TRAdE Centre in Europe
REN	Rede Elétrica Nacional, Portugal	RGFI	Renewable Gas Forum Ireland
SAEE	State Agency on Energy Efficiency and Energy Saving of Ukraine	SDES	Service des données et études statistiques, France
SEAI	Sustainable Energy Authority of Ireland	SFOE/BFE	Swiss Federal Office of Energy
SPP / SPPD	SPP-distribúcia, Slovakia	UABIO	Bioenergy Association of Ukraine
UBA	Umweltbundesamt / Federal Environment Agency, depending on national context	UNDP	United Nations Development Programme
VSG	Swiss Gas Industry Association		

EU LAW, POLICY, REGULATION

CAP	Common Agricultural Policy	CAPEX	Capital expenditure / investment support
CBAM	Carbon Border Adjustment Mechanism	CEEAG	Climate, Energy and Environmental Aid Guidelines (European Commission)
CEN	European Committee for Standardization	CISAF	Clean Industrial Deal State Aid Framework (Competition Policy)
CSRD	Corporate Sustainability Reporting Directive	DORA	Digital Operational Resilience Act
EC	European Commission	EEA	European Economic Area
ESRS	European Sustainability Reporting Standards	ETS	Emissions Trading System
ETS1	EU ETS for stationary installations / aviation / maritime as applicable	ETS2	Separate carbon market for buildings, road transport and additional sectors
EU	European Union	EU ETS	European Union Emissions Trading System
GBER	General Block Exemption Regulation / Rules	GDPR	General Data Protection Regulation
GHG	Greenhouse gas	GHGP	Greenhouse Gas Protocol
IR	Implementing Regulation	MRV	Monitoring, Reporting and Verification
MRR	Monitoring and Reporting Regulation	NECP	National Energy and Climate Plan
NIS2	Directive on measures for a high common level of cybersecurity across the Union	RCF	Recycled Carbon Fuel
RED	Renewable Energy Directive	RED II	Directive (EU) 2018/2001, recast Renewable Energy Directive
RED III	Directive (EU) 2023/2413 amending RED II	RFNBO	Renewable Fuel of Non-Biological Origin
SBTi	Science Based Targets initiative	TFEU	Treaty on the Functioning of the European Union
TRIS	Technical Regulation Information System	UDB	Union Database

CERTIFICATES, REGISTRIES, SUPPORT SCHEMES AND MARKET INSTRUMENTS

BC	Book-and-Claim	BPC	Biogas Production Certificate; used as English rendering alongside CPB
CIC	Certificati di Immissione in Consumo	CoO	Certificate of Origin
CPB	Certificats de Production de Biogaz	EECS	European Energy Certificate System
FiP	Feed-in Premium	FiT	Feed-in Tariff
GGE	Green Gas Unit	GGCS	Green Gas Certification Scheme
GGSS	Green Gas Support Scheme	GO	Guarantee of Origin
GoO	Guarantee of Origin; appears in source titles and should be standardised against "GO"	GO-IB	Guarantee of Origin Issuing Body
HBE	Hernieuwbare Brandstofeenheden	HVE	Alternative term used in the report for Dutch renewable fuel units; standardise
IB	Issuing Body	MB	Mass Balancing
PoO	Proof of Origin	PoS	Proof of Sustainability
RGGO	Renewable Gas Guarantee of Origin	RGGOs	Renewable Gas Guarantees of Origin
RHO	Renewable Heat Obligation	RTFC	Renewable Transport Fuel Certificate
RTFO	Renewable Transport Fuel Obligation	UER	Upstream Emission Reduction

ENERGY CARRIERS, UNITS AND TECHNICAL TERMS

bcm	Billion cubic metres	CBG	Compressed Biogas
CCS	Carbon Capture and Storage	CHP	Combined Heat and Power
CNG	Compressed Natural Gas	GWh	Gigawatt-hour
LBG	Liquefied Biogas	LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas	MJ	Megajoule
MW	Megawatt	MWh	Megawatt-hour
Nm ³	Normal cubic metre	TWh	Terawatt-hour

COUNTRY CODES

AT	Austria	CH	Switzerland
DE	Germany	DK	Denmark
FR	France	HU	Hungary
IE	Ireland	IT	Italy
LT	Lithuania	NL	Netherlands

NO	Norway	PT	Portugal
RS	Serbia	SE	Sweden
SI	Slovenia	SK	Slovakia
UA	Ukraine	UK	United Kingdom

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BIOMAPE in a nutshell

The European Union's ambition to achieve climate neutrality and enhance energy security depends on the accelerated deployment of renewable energy solutions that are technologically mature, economically viable and socially accepted. Biomethane is increasingly recognised as a strategic renewable energy carrier, capable of delivering immediate greenhouse gas emission reductions, advancing circular economy pathways, strengthening rural development and enhancing energy system resilience.

Despite its strong potential, **biomethane deployment across Europe remains uneven**. National policy frameworks vary considerably, market instruments are not always interoperable, and cross-border trade of biomethane certificates remains limited. At the same time, social acceptance challenges can delay or hinder project development, particularly where communities lack transparent information and meaningful participation opportunities.

BIOMAPE (BIOMethane Market Acceleration and Uptake in Europe) responds to these challenges by accelerating the production and use of biomethane across Europe, fostering market development and supporting the EU's energy transition. The project brings together research organisations, industry associations, registry operators, market actors, public authorities and civil society representatives to address technical, regulatory and social barriers in a holistic and integrated manner.

The project is structured around four interconnected pillars: (i) a multi-level geographical dimension addressing local, national and EU-level challenges; (ii) social acceptance, placing citizens and communities at the centre of the transition; (iii) a policy dimension supporting coherent and effective biomethane market development; and (iv) comprehensive support and transferability, ensuring scalability and long-term impact. These pillars are underpinned by multistakeholder and multidisciplinary approaches as cross-cutting themes, ensuring robust stakeholder engagement and the integration of diverse expertise at every stage.

Operationally, BIOMAPE is organised into three main activity packages: Biomethane Certificates and Cross-border Trade; Biomethane Policy and Market Development; and Biomethane Social Acceptability. Over its three-year duration, the project will support the creation and strengthening of biomethane registries for certificate management in five countries (Hungary, Serbia, Slovenia, Portugal and Ukraine), facilitating transparent and efficient cross-border trade. It will further contribute to improving and harmonising biomethane policies, with the objective of increasing the share of renewable energy in final energy consumption by 2030 and beyond.

A strong focus on stakeholder engagement will include participatory activities such as workshops, site visits and the establishment of Biomethane Social Acceptability Groups in eight countries (Austria, Hungary, Ireland, Serbia, Slovenia, Portugal, Ukraine and the United Kingdom of Great Britain and Northern Ireland). These actions will address public concerns, improve community acceptance of biomethane technologies and foster inclusive governance models.

By strengthening market mechanisms, enhancing policy coherence and promoting social acceptance, BIOMAPE will lay the groundwork for a robust and transparent biomethane market across Europe, while fostering international cooperation and knowledge transfer within and beyond Europe.

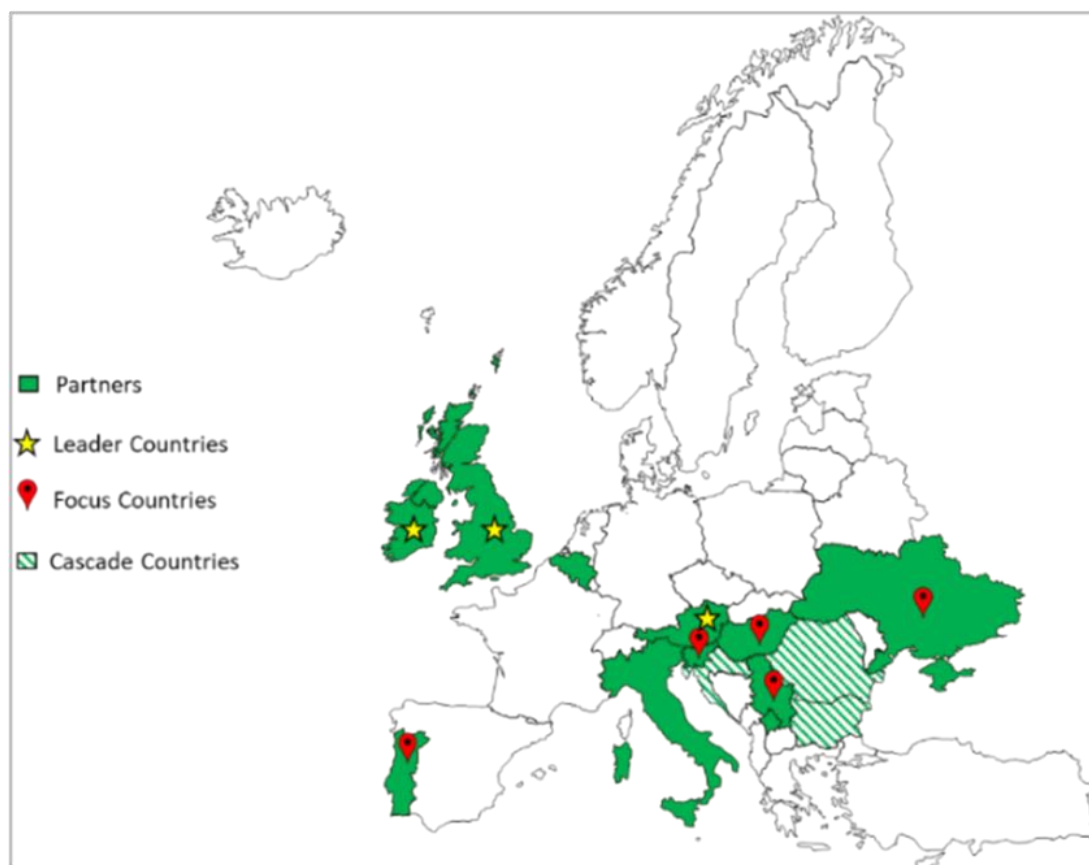


Figure 1: BIOMAPE Consortium

1 Scope of updated registry guidelines

This deliverable provides updated, implementation-oriented guidance for the establishment and operation of national biomethane registries for certificate management. It has been developed under BIOMAPE Task 2.1, which supports BIOMAPE Focus countries (Hungary, Portugal, Slovenia, Serbia, Ukraine) in setting up registry systems that can serve different certificate types and market pathways, including Guarantees of Origin, Certificates of Origin, Proofs of Sustainability, transport biofuel obligations, subsidy schemes, ETS-related uses, and other national compliance frameworks. In doing so, the report builds on earlier EU-funded work under BIOSURF and REGATRACE while updating the analysis to reflect the more advanced and more complex regulatory and market landscape of 2026.

Biomethane registries increasingly function as a critical interface between energy policy, sustainability certification, compliance markets and cross-border certificate trade. Registry design can no longer focus only on the issuance of Guarantees of Origin for disclosure purposes. Instead, national systems must be capable of managing different certificate logics, preventing double counting and double claiming, supporting transparent market transactions, and remaining interoperable with European schemes and emerging EU-level infrastructures such as the Union Database in the future. These requirements are especially relevant for countries that are still establishing their biomethane markets and can therefore avoid design choices that later require costly system revisions.

To ground the guidelines in current European practice, BIOMAPE conducted a structured mapping of national biomethane support schemes, certificate systems and registry arrangements. The mapping combines primary information gathered through a dedicated BIOMAPE questionnaire with targeted desk research. The questionnaire was distributed among BIOMAPE Lead countries and Focus countries and circulated more broadly through the networks of EBA and ERGaR. In total, 15 responses, covering 14 European countries were received, among them:

- four organisations act as registry operators, including:
 - ◆ AGCS Gas Clearing and Settlement AG – AT,
 - ◆ dena Deutsche Energie-Agentur (German Energy Agency) – DE,
 - ◆ Amber Grid – LT,
 - ◆ SPP-Distribucia – SK,
- eight organisations are national associations or industry forums, including:
 - ◆ Association of Swiss Gas Grid Network Operators – CH,
 - ◆ ATEE Club Biogaz – FR,
 - ◆ Hungarian Biomethane-Biogas Association – HU,
 - ◆ Renewable Gas Forum Ireland (RGFI) – IE,
 - ◆ the Norwegian Biogas Association – NO,
 - ◆ Associação Portuguesa de Produtores de Bioenergia (APPB) – PT,
 - ◆ Serbian Biogas Association – RS,
 - ◆ Bioenergy Association of Ukraine (UABIO) – UA, and

- for Sweden, the Swedish Energy Agency and Swedish Gas Association (Energigas Sverige), replied to different parts of the questionnaire.

A few additional organisations have answered specific questions and responded partly to the questionnaire. Remaining gaps were filled through desk research, drawing in particular on AIB Domain Protocols, the EBA Statistical Report 2025, the ERGaR Country Library 2026 and relevant project literature.

The analysis assesses how national certificate and registry systems interact with the evolving European regulatory framework and with country-specific policy instruments. Particular attention is given to the relationship between registries and national subsidies, quota systems, blending obligations, transport biofuel compliance, ETS requirements and the Union Database. Where the future implementation pathway remains uncertain, especially in relation to the Union Database, the report identifies the relevant design implications and emphasises the need for flexible, modular and interoperable registry architectures.

The report proceeds from policy context to practical registry implementation. It first explains the regulatory and market environment in which biomethane certificates operate, then introduces the main renewable gas certificate types and their attribute structures. Subsequent chapters discuss registry business processes, governance principles, functional and non-functional system requirements, interoperability with external systems, and architecture options for national registries.

Chapter 2 Key Findings and Registry Design Implications was included at the beginning of the report as a service to readers. It provides highlights and key findings from each report section and allows the reader to follow up by jumping to the chapter of main interest. This way, the report can be read and studied at readers convenience.

The gathered data provide the basis for the continued work with BIOMAPE focus countries within work package 2. Throughout the project lifetime, guidance and support will be provided to BIOMAPE focus countries taking into account their respective national legal frameworks. A dedicated package of activities will be implemented by partners from Leader countries (under AGCS coordination) to support focus countries (through BIOMAPE partners, ministries, energy regulators and energy agencies) in setting up biomethane registries for certificate management with special focus on IT-system setup. Support actions, based on the insights gained from this report will culminate in the training on cross-border ownership transfer tests. The recommendations are intended to support public authorities, designated bodies registry operators and other stakeholders involved in the establishment or further development of national biomethane registries for certificate management.

2 Key Findings and Registry Design Implications

2.1 Introduction

The European biomethane market is entering a new phase of development since biomethane is increasingly embedded in a complex European policy framework involving renewable energy targets, greenhouse gas reduction obligations, transport fuel quotas, consumer disclosure, the EU Emissions Trading System, sustainability certification, and cross-border certificate trade. This development increases the strategic positioning of national biomethane registries as a central element for energy market integration. They are no longer merely administrative systems for issuing certificates, but form essential market infrastructure for the reliable documentation, allocation and use of the renewable and sustainability attributes of biomethane / renewable gases.

The BIOMAPE mapping of national support schemes, certificate systems and registry architectures confirms that European countries have followed markedly different pathways. Some countries operate dedicated registries for Guarantees of Origin, others maintain biofuel or sustainability databases, and some have developed hybrid or parallel systems that reflect historically grown national support frameworks. Several countries are now starting to establish registries, while others are already facing the challenge of coordinating multiple systems and certificate types. This diversity demonstrates that there is no single existing European model that can simply be copied by all countries. At the same time, the mapping shows a clear need for more coherent design principles, especially for countries currently creating or substantially reforming their registry infrastructure.

The central finding of this report is therefore that future-ready biomethane registries must be designed as modular, production-data-centred and interoperable systems that can support multiple certificate types and policy purposes over time. A registry architecture that is limited to one narrow purpose, such as only the issuance of Guarantees of Origin or the handling of national certificates for a national support scheme, may satisfy an immediate legal requirement, but risks becoming insufficient as the biomethane market develops and as additional policy uses are defined. By contrast, a system that establishes a robust production-data foundation, provides flexible certificate management, and enables structured interfaces with national and European schemes that can support market growth, policy implementation and cross-border trade in a durable manner.

2.2 Why biomethane registries matter in the current policy context

Biomethane registries have become an essential interface between energy production, market transactions and regulatory compliance. Once injected into the existing gas infrastructure, the renewable gas molecules blend with fossil natural gas and other gases in the network. The economic, environmental and regulatory value of biomethane must therefore be documented through electronic certificates and associated registry business processes. Registries provide the infrastructure for issuing, transferring, splitting, cancelling/retiring and auditing such certificates and for ensuring that the same renewable attribute is not claimed more than once.

The role of registries has expanded considerably as biomethane policy has evolved. Historically, registries were often associated with voluntary green gas markets or with dedicated national support schemes. Today, they increasingly need to interact with several distinct but overlapping policy domains:

- **Regulated, but non-compliance market: consumer disclosure**, where Guarantees of Origin document that a given quantity of energy was produced from renewable sources;
- **Regulated and compliance markets:**
 - ♦ **transport fuel obligations, national blending obligations and RED sustainability compliance**, where Proofs of Sustainability and mass-balancing rules determine eligibility for quota fulfilment or other compliance mechanisms;
 - ♦ **national subsidy and support schemes**, which may require specific data on production, feedstocks, injection volumes or use pathways;
 - ♦ **carbon pricing and ETS-related applications**, where biomethane may be relevant for emissions accounting if the applicable documentation and sustainability conditions are met;
- **cross-border certificate trade**, where the reliable transfer and mutual recognition of certificate data are prerequisites for market integration.

The result is a market environment in which multiple certificate instruments coexist. Table 1 summarises how EU policy frameworks and European cross-border transactions translate into concrete registry requirements. Guarantees of Origin, Certificates of Origin and Proofs of Sustainability fulfil different functions and are not interchangeable. In addition, several countries have developed national compliance certificates, such as biogas production certificates, quota units, transport fuel certificates, or other scheme-specific instruments. The BIOMAPE country mapping shows that these instruments are closely linked to national policy choices and differ considerably in their regulatory logic, documentation requirements, and tradability.

Table 1: Registry alignment with EU frameworks

Framework	Key Requirement	Registry Action
RED III (Art. 19)	GOs for biomethane/RFNBOs	Issue GOs with standardised attributes (energy carrier type, source).
RED III (Art. 30)	Mass balance for gaseous fuels	Track physical and attribute flows separately but in parallel.
MRR 2024 (Art. 39)	Zero-rated biomethane for ETS	Flag RED-compliant certificates for ETS reporting.
UDB (Art. 31a)	EU-level traceability of renewable fuels and related sustainability documentation	Prepare modular interfaces and data structures for alignment with UDB-related reporting and traceability requirements

This diversity has direct implications on registry design. A registry must not only issue certificates, but also ensure that certificate types are clearly distinguished, that attributes are consistently managed, and that overlaps between schemes do not lead to double counting or double claiming (for details see chapter 6.5). In countries where several certificate systems exist in parallel, the lack of coordination between registries can lead to significant risks concerning market integrity. In countries where registry infrastructure is still being developed, the opportunity exists to avoid such fragmentation from the outset by establishing systems that are functionally broader and structurally more adaptable.

Registries are therefore a prerequisite for both market trust and policy effectiveness. Without reliable registries, support schemes become harder to administer, cross-border certificate trade remains constrained, and compliance claims become more vulnerable to uncertainty or contestation. Their economic relevance is particularly pronounced in renewable gas markets: in biomethane transactions, the value associated with sustainability attributes and compliance eligibility can represent a substantial share of the overall product value and, in some market segments, may exceed the value of the physical gas itself. This differs from electricity markets, where Guarantees of Origin usually account for only a minor share of the total monetary value of the energy consignment. Inefficiencies in renewable gas certificate systems can therefore have direct effects on producer revenues, transaction costs, cross-border trade, and the competitiveness of certified biomethane in compliance markets. Conversely, well-designed registries can reduce transaction costs, increase transparency, improve data availability for authorities and investors, and support the gradual creation of a more integrated European renewable gas market. Registry quality is consequently not only an administrative issue, but an important factor for market development.

2.3 European policy ambition and remaining barriers to biomethane market uptake

The EU policy framework has established a strong strategic direction for biomethane market development. The REPowerEU Plan and the Biomethane Action Plan recognise biomethane as an important contribution to energy security, domestic renewable gas supply and defossilisation, and set the political ambition (non-binding) of reaching 35 bcm of annual biomethane production by 2030. At the same time, the wider EU regulatory framework increasingly links biomethane to renewable energy targets, transport compliance, sustainability documentation, carbon pricing, and cross-border market integration.

However, the analysis in this report indicates that policy ambition has not yet been translated into a fully coherent and sufficiently coordinated market-enabling framework. A central challenge is the gap between high-level European targets and the diversity of national implementation pathways. While the EU sets a common strategic direction, many of the instruments that directly shape biomethane investment and market access remain nationally defined, including subsidy schemes, quota systems, tax incentives, blending obligations and certificate eligibility rules. This creates uneven market conditions and complicates the emergence of a truly integrated European biomethane market.

The identified barriers can be grouped into two interconnected levels. At the **policy level**, market development is constrained by gaps between targets and actual deployment,

insufficiently binding or unevenly implemented measures, and limited coordination of national policy frameworks. At the **organisational level**, barriers arise from certification and cross-border trade constraints, permitting procedures, and the absence of sufficiently coordinated registry infrastructures. These organisational barriers are particularly relevant for this report, because they directly affect whether biomethane volumes can be documented, transferred, and recognised reliably across different market and compliance pathways.

Figure 2 summarises the main obstacles currently hindering biomethane market ramp-up. It shows that registry and certificate coordination are not isolated administrative issues, but part of a broader set of market-enabling conditions that must be addressed alongside policy stability, investment incentives and permitting reform.

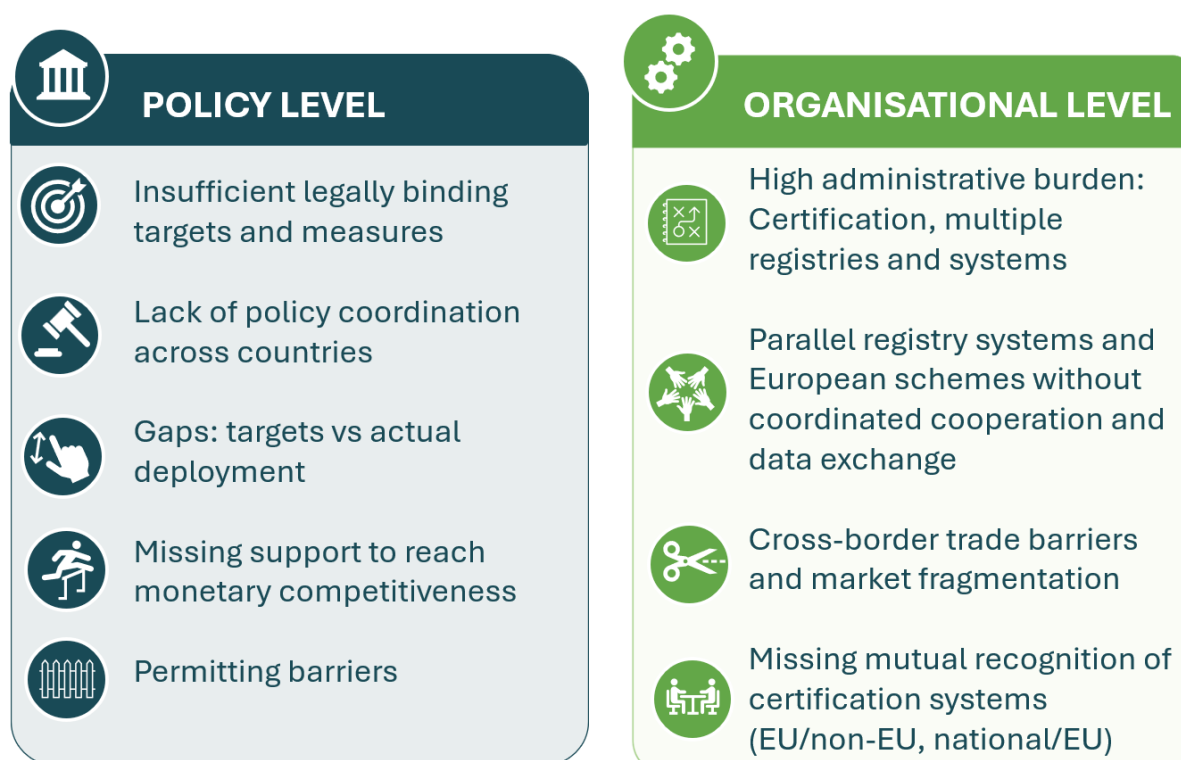


Figure 2: Overview of identified obstacles to biomethane market ramp-up

Against this background, biomethane market integration requires a combination of clear policy signals and operational market infrastructure. National and European policy frameworks need to create stable demand and investment conditions, while registry and certificate systems must provide the trusted documentation layer that enables compliance, market access, and cross-border trade. Figure 3 illustrates these interdependent requirements for biomethane market integration and uptake.

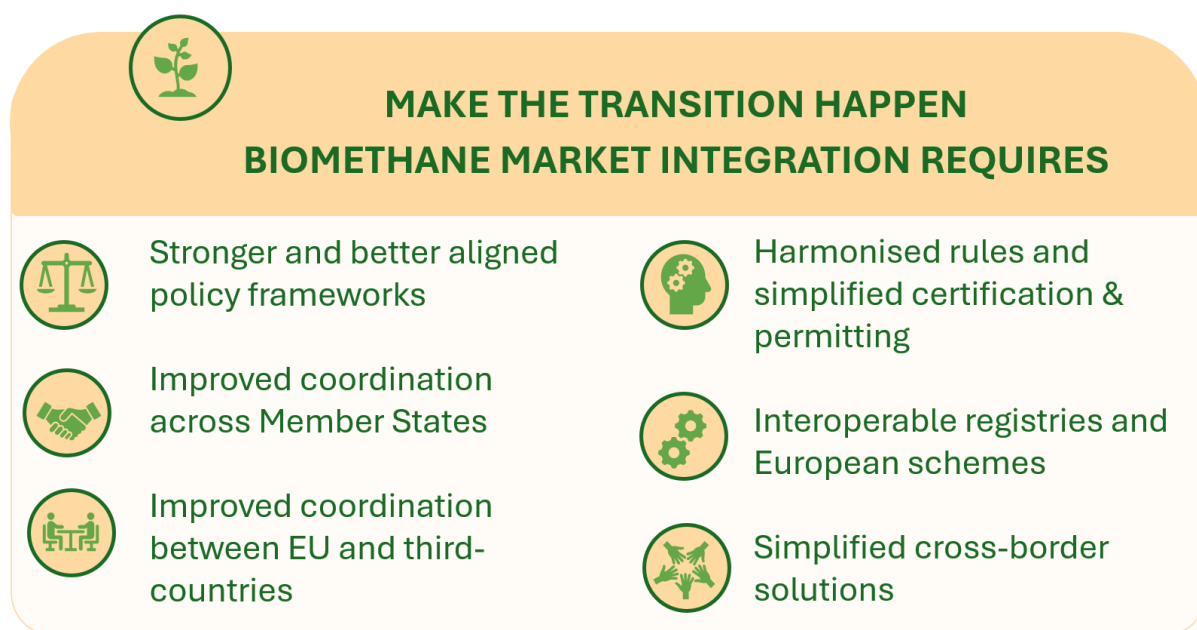


Figure 3: Requirements for biomethane market integration and uptake

For the purpose of this report, the key implication is that registry development should not be viewed in isolation from the wider European policy environment. Registries cannot by themselves close the gap between political ambition and market deployment, but they are a necessary component of a functioning biomethane market. Without coordinated and interoperable registry infrastructures, even well-designed policy instruments may face practical implementation barriers, and the economic value of biomethane may remain difficult to realise across national and European markets.

2.4 Cross-country findings from the BIOMAPE mapping

2.4.1 Introduction into cross-country mapping results

The BIOMAPE project overs a detailed country analysis, called "country mapping". The introduction of this report (chapter 1) provides details on data research and participating countries. The analysis of this country mapping confirms that national biomethane certificate and registry systems across Europe are highly heterogeneous, as is shown in Table 5. This heterogeneity does not merely reflect different stages of market maturity, it also results from different policy priorities, institutional traditions and support instruments. Countries have developed registry systems in response to the immediate needs of their domestic markets, often before a coherent European framework for renewable gas certificate management existed.

2.4.2 *Diverse policy frameworks lead to diverse registry requirements*

The comparison of national frameworks reveals that biomethane support is no longer dominated by one single policy model. While feed-in tariffs and production support remain relevant in some countries, the broader tendency is toward **demand-side and market-based instruments**, such as:

- transport fuel quotas and greenhouse gas reduction obligations;
- renewable gas or biomethane blending obligations;
- tax incentives or exemptions;
- ETS-related carbon cost advantages;
- public or private consumer disclosure markets;
- investment support combined with market-revenue pathways.

This shift affects certificate management. Production-based support schemes typically require reliable production and injection data. Transport obligations require sustainability documentation, greenhouse gas intensity data, and mass-balancing logic. Disclosure systems rely on Guarantees of Origin and book-and-claim transferability. ETS-related uses and industrial defossilisation claims may require further attributes and clearly defined evidence along supply chains. A registry that only serves one of these pathways may therefore become increasingly disconnected from the broader biomethane market.

2.4.3 *European market integration remains constrained by national fragmentation*

The mapping also highlights structural tension between **European market ambitions** and **nationally organised support systems**. Biomethane certificates are increasingly traded across borders, yet eligibility for national support, quotas or tax treatment is often tied to country-specific rules. This creates a fragmented landscape in which the same biomethane consignment may be:

- tradable as a certificate across borders,
- eligible for certain voluntary or disclosure claims,
- but not necessarily eligible for a specific national quota, subsidy or tax advantage in another country.

The need for harmonised data exchange and interoperable certificate systems is therefore growing and has to integrate alongside national regulatory frameworks. Registries need to manage them transparently by documenting the relevant attributes in a way that allows receiving systems and market participants to assess eligibility.

2.4.4 *National registry landscapes can be classified into recurring system types*

The BIOMAPE mapping shows that national registry landscapes can be classified into seven recurring system types, which differ in their scope, regulatory purpose, data depth and degree of integration:

1. **Guarantee of Origin Issuing Bodies**, focused on GO issuance and disclosure markets (in 6 of 18 countries researched);
2. **Biofuel registries or databases**, focused on sustainability documentation and RED-related compliance (in 5 of 18 countries researched, but never only this type, always overlapping with type 4 parallel systems);
3. **Hybrid systems**, combining several functions within one institutional or technical framework (in 3 of 18 countries researched);
4. **Parallel systems**, in which separate registries serve separate policy purposes (in 5 of 18 countries researched);
5. **Production databases**, documenting biomethane production and injection volumes independently of immediate certificate requests;
6. **Data centres**, which consolidate or coordinate information from several existing systems;
7. **Fully integrated registry systems**, combining production data, certificate management, compliance functions and external interfaces in one overall architecture.

The mapping of Table 2 shows that many countries currently operate Type 1 Issuing Body (IB), Type 3 Hybrid systems, or Type 4 Parallel Systems. These models reflect existing national policy frameworks and can serve their immediate purposes effectively. However, they differ significantly in their ability to provide a comprehensive overview of biomethane production, coordinate multiple certificate types, and support future market development.

Biofuel databases (type 2) offer robust sustainability accounting but are often highly sector-specific and not designed to support broader renewable gas market functions. Examples are the eIna system of the Austrian Environmental Agency (Umweltbundesamt GmbH, UBA) or the NABISY system of the German Federal Office for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung, BLE). Other countries collect data via ministries or governmental agencies. There is no country which has such biofuel databases as stand-alone system but is always parallel with other systems.

A trend can be observed toward hybridisation, as seen in France, where market participants can switch between two user interfaces depending on if they are marketing their EU-GOs or national certificates (CoA).

Several countries are gradually expanding originally separate registry functions in order to enable the management of multiple certificate types within a shared technical environment. Examples are VertiCer in the Netherlands, Pronovo in Switzerland or Amber Grid in Lithuania. This reflects growing recognition that renewable gas markets can no longer be administered efficiently through isolated sectoral systems alone.

At the same time, several countries still operate parallel infrastructures, with Austria and Germany being prominent examples, especially where GO disclosure schemes, national biomethane registries, and biofuel databases have developed under different competent

authorities. Austria is the only country who provides the bases for data exchange by law between all three existing systems (IB, biofuel registry, national registry) but in practice only two of them (biofuel and national registry) have established a cooperation agreement. In the Netherlands, an interconnection is anticipated between certificate systems. Also, Italy and UK operate different registry systems or separate certificate schemes which are documented in parallel systems without interconnectivity. These fragmented arrangements potentially lead to duplicated data collection, limited interoperability, and increased administrative effort for market participants.

An important finding is that comprehensive Type 5 production databases and Type 7 fully integrated registry systems do not exist, even though they provide the strongest foundation for market transparency, energy statistics, subsidy control and anti-double-counting mechanisms because they can capture all relevant production and injection volumes and then allocate them, where applicable, to specific certificate types and market uses.

Table 2: List of system types applied by countries, including operator list

Country	System type	Operator list
Austria	Type 4: Parallel Systems	IB (E-Control), Biomethane Registry (AGCS), Biofuel Registry (eINa Environmental Agency)
Switzerland	Type 1: GO Issuing Body	IB (Pronovo)
Germany	Type 4: Parallel Systems	Biomethane Registry (dena), Biofuel Registry (Nabisy by BLE)
Denmark	Type 3: Hybrid System	IB and Registry (Energinet)
France	Type 3: Hybrid System	IB and Registry (EEX)
Hungary	Type 1: GO Issuing Body	in start-up
Ireland	in start-up	Renewable Transport Fuel Obligation, RTFO (NORA), GOs, ETS and future Renewable Heat Obligation (GNI)
Italy	Type 4: Parallel Systems	IB and CIC Registry (GSE, Gestore dei Servizi Energetici)
Lithuania	Type 1: GO Issuing Body	IB (Amber Grid)
Netherlands	Type 4: Parallel Systems	IB (VertiCer) HVE in transport (Nea Dutch Emissions Authority)
Norway	None	-
Portugal	Type 1: GO Issuing Body	IB (EEGO, Entidade Emissora de Garantias de Origem)
Serbia	None	-
Sweden	Type 1: GO Issuing Body	Swedish Energy Agency (Energimyndigheten)
Slovenia	None, start-up anticipated	Borzen on behalf of Energy Agency of the Republic of Slovenia (AGEN-RS)
Slovakia	Type 3: Hybrid System	IB and Registry for CoA (SPP Distribucia)

Country	System type	Operator list
Ukraine	Type 1: GO Issuing Body	in a trial mode by State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE)
United Kingdom	Type 4: Parallel Systems	Department for Transport's Low Carbon Fuels Delivery Unit for RTFCs in transport and Green Gas Certification Scheme (GGCS) by REAL for RGGOs.

The comparison of system types shows that different system types are possible, and the most suitable choice depends on national legal frameworks, market maturity and available resources. However, it does suggest that **single-purpose systems are less future-proof than integrated architectures built on a reliable production-data foundation**. The target is never a highly advanced IT-system but rather careful consideration of design criteria to develop a robust, transparent, scalable system that can be expanded coherently as additional certificate, compliance and interoperability requirements emerge.

2.4.5 *Fragmentation increases the need for coordination and measures for prevention of double counting*

Several countries operate more than one relevant system, for example one for Guarantees of Origin and another for biofuel sustainability documentation or transport-quota fulfilment. Such parallel systems are not inherently problematic, but they require strong coordination. The BIOMAPE mapping confirms that where systems remain institutionally and technically separate, there must be:

- clearly defined division of responsibilities;
- formalised data exchange procedures;
- a clear understanding of which certificate or record may be used for which claim;
- effective safeguards against the multiple use of the same biomethane volume.

Unfortunately, the mapping exercise also revealed that none of the systems running in parallel have implemented these safety measures.

The diversity of certificate instruments identified in the mapping (such as CPBs, GGEs, CICs, RTFCs, Biomethannachweise, CoOs, GOs and PoS-based mechanisms) demonstrates that certificate systems must be capable of supporting different compliance logics without compromising market integrity.

2.5 Recommended pathway for national registry development

2.5.1 *Introduction into national registry development*

The analysis in this report suggests that countries establishing or revising national biomethane registries should avoid narrow, single-purpose solutions and instead pursue **phased, modular**

and production-data-centred architecture. The recommended starting point is a registry core that documents biomethane production and injection volumes while providing the basis for certificate lifecycle management and later system expansion.

2.5.2 *Start with a production-data-centred registry core*

A future-ready registry should first establish a reliable national data foundation. This includes the registration of biomethane production facilities, operators, injection points, metering data acquisition, verified production and injection volumes, and, where relevant, core sustainability-related master data.

This production-data core is essential because it enables the registry to document the national biomethane production which can be further used for specific certificate requests. It strengthens market transparency, improves national statistics, supports subsidy and compliance oversight, and creates a robust basis for measures to prevent double counting.

2.5.3 *Add certificate functions according to national priorities*

Building on this data foundation, countries should add certificate modules in line with their policy and market needs. These may include:

- **Guarantees of Origin** for consumer disclosure;
- **Certificates of Origin** for broader renewable gas markets or cross-border trade;
- **Proofs of Sustainability** or interfaces to sustainability systems where relevant;
- **national compliance certificates** linked to quotas, blending obligations, subsidies or other support mechanisms.

These certificate types should be managed in a coordinated system, but they must remain **legally and functionally distinct**. GOs, CoOs, PoS and national compliance certificates serve different purposes and should not be treated as interchangeable. Their relationships, attribute requirements, transfer rules and cancellation logic must be clearly defined to prevent the inappropriate multiple use of the same biomethane volume or its associated attributes.

2.5.4 *Design for interoperability from the outset*

Even where certain interfaces are not yet immediately required, the architecture should be prepared for later interaction with:

- European cross-border certificate schemes;
- the Union Database or UDB-related processes, where applicable;
- national support-scheme and compliance systems;
- dashboards or market transparency tools;
- trading platforms, where justified by market maturity and the legal framework.

Interoperability should therefore be treated as a **core design requirement**, instead of integrating later a technical add-on. This requires harmonised attribute structures, robust certificate identifiers, clearly defined rules for issuance, transfer, and cancellation. Data exchange should be based on clearly specified formats and interfaces (e.g.: XML or JSON or CSV) with the decisive requirement being that data are consistently structured, validated and interpretable across systems.

A related principle is that **one certificate must exist in one active system state at a time**. Particularly in cross-border transfers, transaction logic must ensure that a certificate is no

longer available in the exporting system before it becomes valid in the receiving system. This is essential to prevent double sales, double counting, and double claiming across connected systems.

2.5.5 *Ensure strong governance, auditability and neutrality*

A clear governance framework is most important to ensure transparency and market trust. National registries require transparent rules, clearly defined roles and responsibilities, audit trails for relevant certificate actions, correction procedures, and safeguards against double counting and double claiming.

The registry operator should act as a **neutral system administrator**. It must ensure system integrity and proper execution of registry functions, but it must never participate economically in certificate transactions or create conflicts of interest. Where registries connect to external schemes or EU-level systems, technical interoperability must be complemented by organisational coordination, shared rulebooks and clear responsibility for error handling and dispute resolution.

2.5.6 *Develop toward integrated renewable gas data governance*

Countries do not need to implement every advanced function from the beginning. A phased approach is preferable. However, the initial architecture should allow the registry to evolve over time toward more integrated renewable gas data governance.

Where market development and regulatory complexity justify it, national systems may gradually expand toward a data-centre model or a fully integrated registry architecture. This does not necessarily require one single software system or one single organisation. It does require that certificate systems, sustainability documentation, support-scheme administration and reporting structures can exchange data reliably and apply coherent anti-double-counting controls.

The overall guidance is therefore clear: new and evolving biomethane registries should be built around reliable production data, expanded through clearly differentiated certificate modules, and designed from the outset for interoperability, auditability and future integration. Registry quality should be understood not merely as an administrative matter, but as a precondition for market trust, policy effectiveness, cross-border trade and investment confidence.

3 Policy and Regulatory Framework

3.1 Climate and energy targets in the EU policy context

The European Union provides a broad framework for renewable energy and climate targets to support market development while safeguarding environmental integrity. Figure 4 presents an inverted pyramid of the main EU policy instruments with a focus on the increasing level of detail on Biomethane in the specific framework.

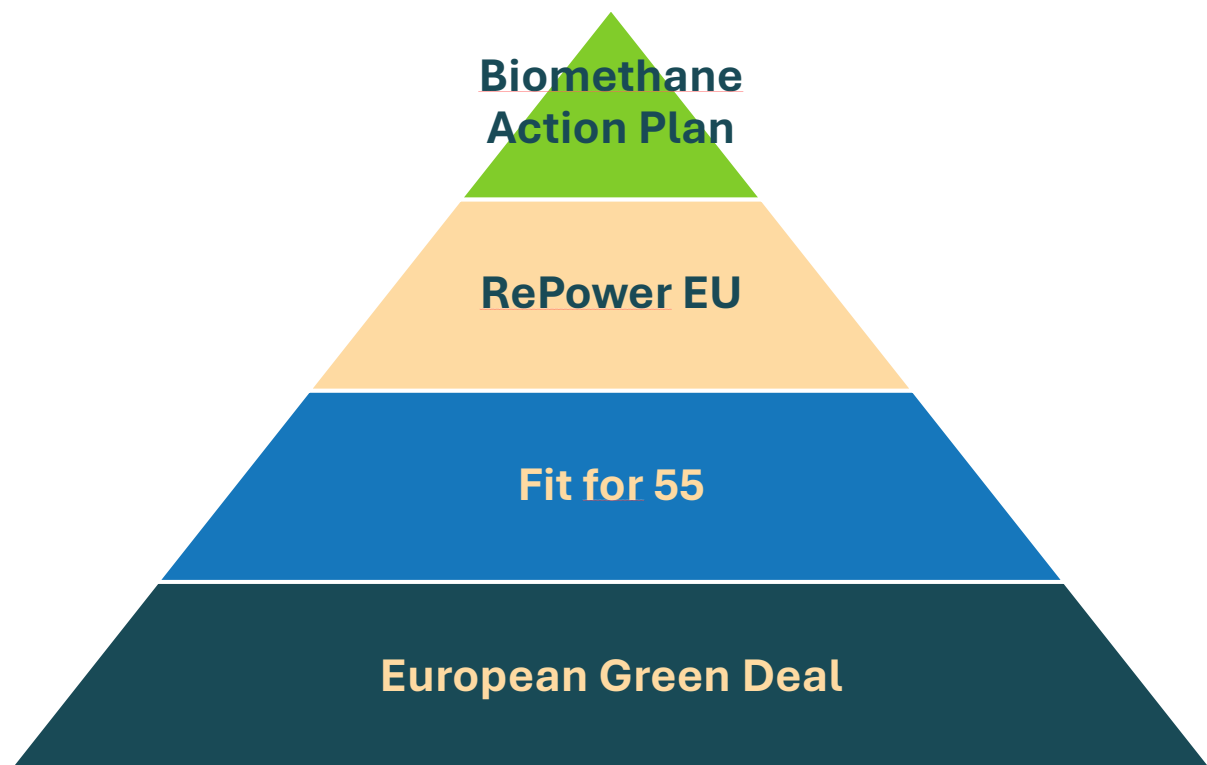


Figure 4: EU policy frameworks targeting the biomethane market in rising level of detail, displayed as an inverted pyramid

At the highest level of the inverted policy pyramid, the EU climate ambition is defined by the objective of climate neutrality by 2050 and at least –55% greenhouse gas emissions by 2030, as set out under the European Green Deal. These objectives are implemented through the Fit for 55 package which translates them into binding legislative measures.

Within this framework, directives and regulations should support realising Europe's biomethane potential and its market ramp up. The most important policy files are listed in Table 3. However, a thorough policy analysis suggests that the demand versus supply targets lead to policy gaps and non-technical market barriers.

Table 3: Overview of EU policy instruments and functions for biomethane market ramp up

Level	Policy Framework	Function
Strategic	Sustainability goals / Green Deal	Vision & long-term targets
Legislative	Fit for 55 / RED	Binding targets & quotas
Strategic-operational	REPowerEU	Supply targets
Implementation	Biomethane Action Plan	Deployment support
Market framework	Gas Package	Infrastructure & trade

The Directive (EU) 2018/2001 (RED II/III) is the central instrument for renewable energy deployment. It establishes a binding target of at least 42.5% renewable energy by 2030 and introduces sector-specific obligations, including binding quotas for RFNBOs e.g. in the transport sector. While biomethane is recognised as a renewable fuel across sectors, there are no dedicated binding targets for biomethane specifically in place.

On the supply side, the REPowerEU Plan sets political ambitions to scale renewable gases, including 35 bcm of biomethane production by 2030 and 20 million tonnes of renewable hydrogen (production and imports). The Biomethane Action Plan supports these objectives through measures addressing investment, feedstock mobilisation, and permitting. However, these targets remain non-binding.

Table 4 provides a consolidated list of political non-binding and legally binding biomethane and hydrogen targets.

The regulatory framework is complemented by the Regulation (EU) 2024/1789, which enables market access, infrastructure integration, and cross-border trade of renewable gases, as well as the Regulation (EU) 2020/852, which defines sustainability criteria based on lifecycle emissions.

Table 4: Consolidated list of EU-level biomethane and hydrogen (or RFNBO) targets

Concerns area:	Target	Type of Target	Policy Framework
Biomethane	35 bcm/year by 2030	Political (non-binding)	REPowerEU / Biomethane Action Plan
Hydrogen (RFNBO)	10 Mt domestic + 10 Mt imports by 2030	Political (non-binding)	REPowerEU
RFNBO (transport)	≥ 1% by 2030	Binding	RED III
Advanced biofuels + RFNBO	≥ 5.5% (transport)	Binding	RED III
Renewables overall	≥ 42.5% (→ 45%)	Binding	RED III
GHG reduction	–55% by 2030	Binding	Fit for 55 / Green Deal
Climate neutrality	Net zero by 2050	Binding (EU Climate Law)	Green Deal

3.2 Market segments influenced by EU policies

Legislation plays a decisive role in framing biomethane markets by defining which uses are mandatory, incentivised, or voluntary, and by setting the conditions under which claims may be made (see Figure 5).

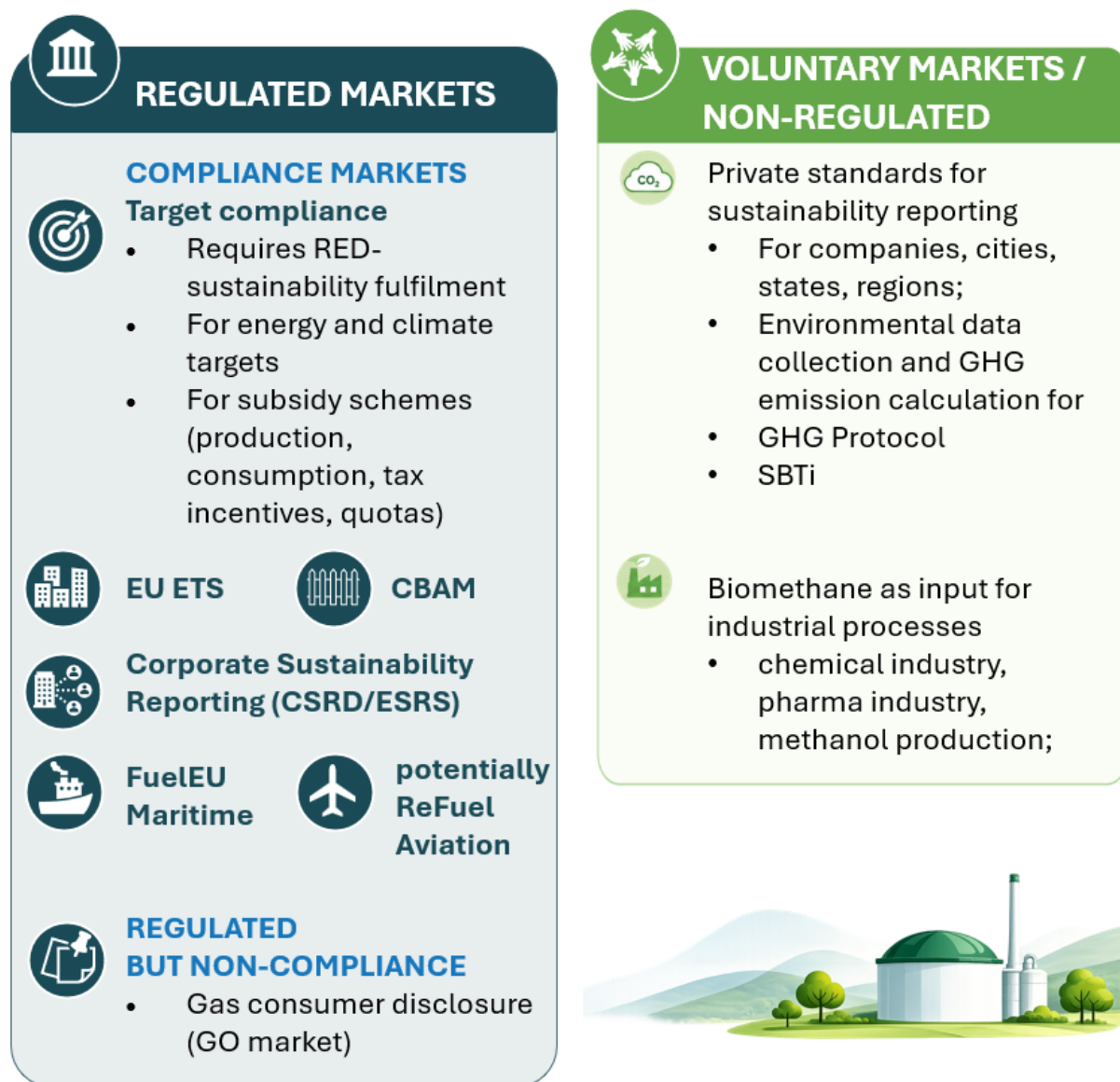


Figure 5: Illustration of different market segments for biomethane

The first category comprises **REGULATED COMPLIANCE MARKETS**, where participation is mandatory for market participants of the respective scope and strict regulatory requirements apply. Compliance is typically associated with monitoring, reporting and verification obligations, as well as enforcement mechanisms defined at European or national level. In these markets, biomethane contributes to the fulfilment of legally defined objectives, including renewable energy targets, greenhouse gas (GHG) emission reduction requirements and sector-specific obligations.

Compliance markets include applications subject to RED sustainability and greenhouse gas emission savings criteria, as well as biomethane volumes benefiting from production- or consumption-based support schemes, such as feed-in tariffs or premiums, tax exemptions or remunerations, supplier quota obligations and GHG-based biofuel quotas. Compliance markets also include the use of biomethane within the EU Emissions Trading System (EU ETS), as well as emerging corporate sustainability reporting obligations under CSRD (Corporate Sustainability Reporting Directive) and ESRS (European Sustainability Reporting Standards), where traceable and verifiable renewable gas attributes are increasingly required. Also, the FuelEU Maritime sector and potentially ReFuel Aviation are subject to compliance as well.

The second category consists of **REGULATED BUT NON-COMPLIANCE MARKETS**, most notably gas consumer disclosure through Guarantees of Origin, where participation is regulated but the use of certificates does not count towards binding renewable energy targets.

Finally, **VOLUNTARY OR NOT YET REGULATED MARKETS** exist alongside these frameworks, including the use of biomethane for environmental data collection and GHG accounting under private standards such as the GHG Protocol or SBTi, as well as biomethane supplied as a renewable feedstock for industrial processes in sectors such as chemicals, pharmaceuticals or methanol production for product related documentation.

3.3 Regulated compliance markets

3.3.1 Renewable Energy Directive (RED)

The Renewable Energy Directive provides the central legal framework for the promotion and accounting of renewable energy within the European Union. It establishes binding targets, defines sustainability and greenhouse gas emission saving criteria, and sets rules for how renewable energy, including biomethane, may be counted towards national and European targets.

RED II (recast; Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources), for the first time, acknowledges biomethane by expanding existing regulatory frameworks to biomethane. The revised Renewable Energy Directive (RED III; Directive (EU) 2018/2001 as amended by Directive (EU) 2023/2413) significantly strengthens and extends the regulatory framework for renewable energy and renewable fuels.

Under the current framework (revised RED), biomethane is recognised as a renewable fuel that may contribute to targets in multiple sectors, including electricity, heating and cooling, and transport. It sets binding targets for renewable energy, including a 10% indicative sub-target for renewable gases in final energy consumption by 2030. Its eligibility depends on compliance with the Directive's sustainability and GHG emission saving criteria, as set out primarily in Articles 29 and 30. *In* Article 31a, the legal basis for the establishment of the Union Database (UDB) which supports the tracing of biofuels was laid (for details see 3.3.5 Union Database (Art 31a RED). RED III explicitly strengthens the role of biomethane and hydrogen in decarbonizing hard-to-abate sectors (e.g., industry, heavy-duty transport) and introduces new provisions for cross-border cooperation (Art. 22) and guarantees of origin (GOs) for gaseous fuels (Art. 19).

3.3.2 Biofuels quota

Biofuel quota systems require fuel suppliers to ensure that a defined share of the energy they place on the market is renewable or achieves specified greenhouse gas (GHG) emission reductions. The current framework is defined under Articles 25–31 of the Renewable Energy Directive (RED III), which establish targets for renewable energy use in transport and set out sustainability and GHG emission saving criteria. The Fuel Quality Directive (Directive 98/70/EC) introduced similar GHG reduction requirements for transport fuels. While still in force, its role has largely been integrated into the RED framework, which now serves as the primary basis for biofuel quota systems.

Under the Renewable Energy Directive (RED III), Member States must ensure that fuel suppliers meet at least one of the following targets in the transport sector by 2030:

- a **minimum 29% share** in transport comes from advanced biofuels (Art. 25(2)) by 2030, with biomethane eligible for double counting if produced from waste/residues (Art. 25(4)); or
- a **minimum 14.5% reduction in greenhouse gas (GHG) intensity** of transport fuels compared to a fossil fuel baseline.

In addition, RED III introduces sub-targets to steer the fuel mix, notably:

- a minimum share of advanced biofuels and renewable fuels of non-biological origin (RFNBOs) (e.g. 5.5% combined, with at least 1% RFNBOs),
- and limits on certain feedstocks (e.g. food and feed-based biofuels).

Compliance is demonstrated through certification under voluntary schemes recognised by the European Commission, which verify adherence to RED requirements. A list of voluntary schemes providing the recognised framework for renewable gases and biomethane is shown in Figure 6. The key certificate type used in this context is the Proof of Sustainability, confirming that a specific quantity of biomethane meets the applicable sustainability and GHG criteria and can be counted towards supplier obligations.

The EU biofuels quota and national implementations are a central driver for the development of sustainability frameworks for biofuels and renewable gases, including biomethane.

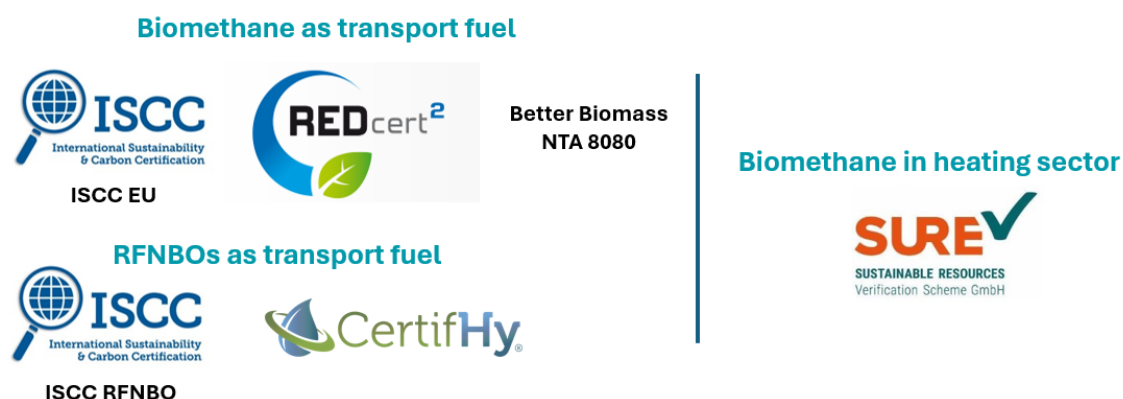


Figure 6: List of voluntary schemes with European Commission recognition which are covering renewable gaseous energy carriers

3.3.3 Mass Balance and Chain of Custody according to RED

For target compliance, the Renewable Energy Directive requires the use of a mass balance system for tracking biofuels, bioliquids and biomass fuels, including biomethane. Under this approach, sustainability characteristics are assigned to consignments of energy carriers and may be mixed, provided that the overall balance of inputs and outputs is maintained. The mass balance system ensures that the total quantity of sustainable material does not exceed the quantity entering the system.

For gaseous fuels, the application of the mass balance system is facilitated by the structure of the European gas infrastructure. The **interconnected European gas grid** is recognised as **one single logistical facility and mass balance system** by the European Commission Implementing Regulation (EU) 2022/996 of 14 June 2022 on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria. This means that if the requirement of the corresponding accounting rules is fulfilled, biomethane injected at one point of the network may be withdrawn at another location while retaining its associated sustainability characteristics.

The mass balancing concept is one of three main criteria to reach sustainability according to the Renewable Gas Directive. The calculation of GHG emission values without its tracking along a whole supply chain and mass balancing within this supply chain is not sufficient for RED sustainability compliance.

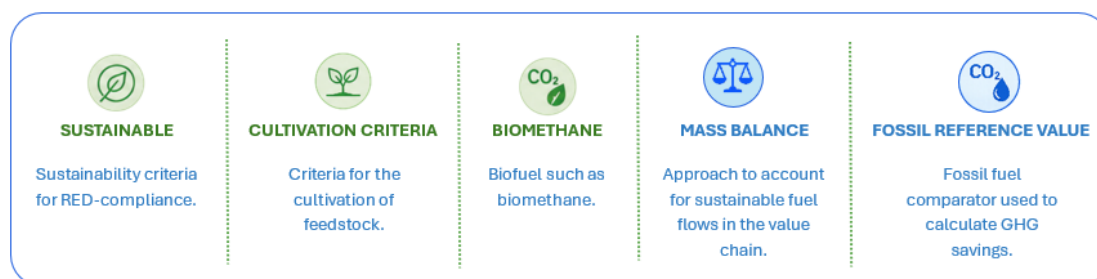


Figure 7: RED-compliant sustainability can be achieved only with mass balancing along the supply chain

3.3.4 Definition Sustainability for RED compliance

For biomethane to be counted towards renewable energy targets or to qualify under compliance schemes, it must meet specific criteria, including:

- **CULTIVATION CRITERIA:**
 - ♦ restrictions on eligible feedstocks, including requirements related to agricultural biomass, waste and residues;
 - ♦ rules on land use, including the protection of high biodiversity value areas and high carbon stock land;
- **MASS BALANCING** of GHG emissions along the whole supply chain (see chapter 3.3.3),
- **MINIMUM GHG EMISSION SAVING** thresholds compared to fossil fuel comparators, calculated according to methodologies defined in the Directive and its annexes.

These criteria apply across all compliance sectors for counting towards renewable energy shares and for meeting GHG reduction obligations. RED III raises the minimum GHG savings

threshold for biofuels to 70% (from 60% in RED II) and introduces dynamic default values for new feedstocks (Annex V).

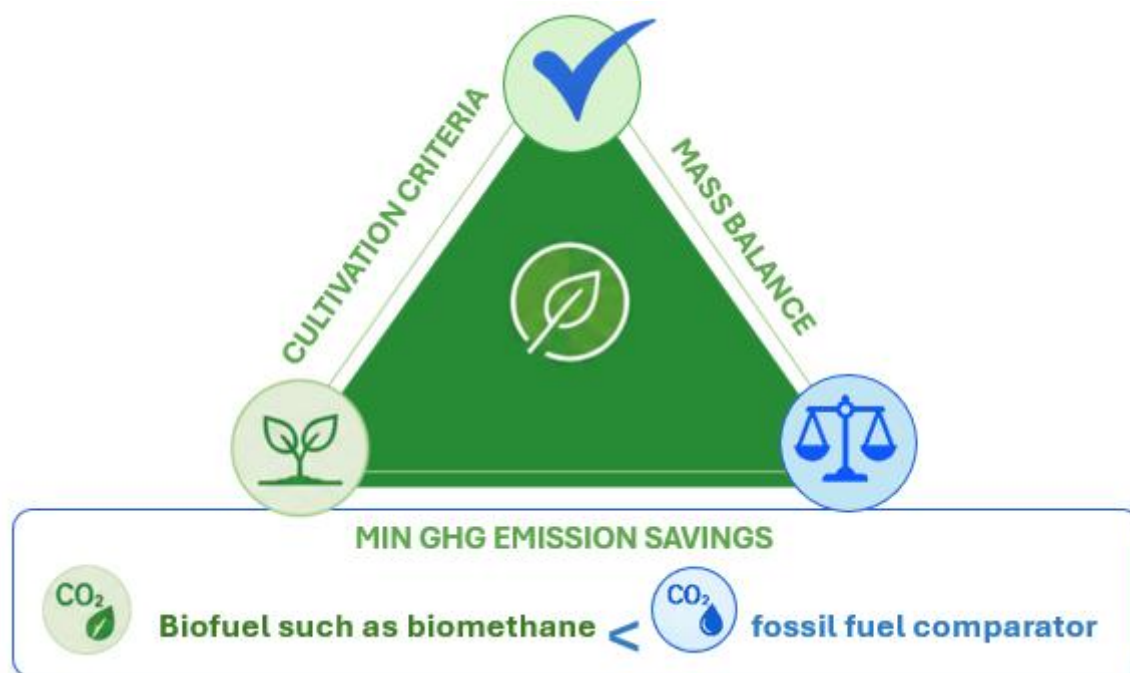


Figure 8: Sustainability criteria for RED compliance are threefold: cultivation criteria, mass balance and minimum greenhouse gas emission savings go hand in hand

3.3.5 Union Database (Art 31a RED)

The Renewable Energy Directive provides, in Article 31a, the legal basis for the establishment of the Union Database (UDB), which supports the tracing of biofuels and biomethane in sectors where compliance with sustainability criteria is required and will thus allow target allocation. The database facilitates the information exchange between economic operators and Member States comprising all EU Member States and with an outlook to integrate UK, Ukraine, Norway and Switzerland without a specific timeline.

The Union Database could become a vehicle to support the implementation of RED requirements and bring harmonisation across Europe, once fully operable. However, its implementation in EU-member states for gaseous energy carriers is not expected before the end of 2026 according to the European Commission (as of May 2026).

3.3.6 Monitoring and Reporting Regulation (for EU-ETS)

The Monitoring and Reporting Regulation (MRR), established under Commission Implementing Regulation (EU) 2018/2066 and Directive 2003/87/EC, outlines the rules for monitoring, reporting, and verifying greenhouse gas (GHG) emissions within the EU Emissions Trading System (EU ETS). It provides detailed requirements for emissions quantification and data documentation, including specific provisions for biomass fuels such as biomethane.

Where biomethane meets the sustainability and GHG-saving criteria of the Renewable Energy Directive (RED), it may be assigned a zero-emission factor ($\text{CO}_2 = 0$) for EU ETS reporting. This recognition of its biogenic carbon origin allows installations using compliant biomethane (RED-

sustainability compliance) to report reduced or zero emissions, thereby influencing the number of emission allowances required for a given reporting period. The MRR is therefore the primary legal route through which biomethane translates into compliance value in the EU's main carbon-pricing instrument.

Guidance Document No. 1 (January 2025) specifies special rules for zero-rated biogas injected into natural gas grids. From 2022, operators may account for biogas purchases as consumed within their installations, even if not physically delivered, by assigning a zero-rated biomass fraction based on energy content and mass balance principles. This approach, reported as tier 3b, requires operators to determine biogas quantities from purchase records and ensure no double counting—typically through a biogas registry system. The 2024 amendment to Article 38(5) MRR provides two formally equivalent evidence routes which are either UDB documentation and cancellation (not yet applicable) or the documentation in a Proof of Sustainability via a recognised voluntary scheme throughout the complete scheme's chain of custody to ensure adherence to RED III mass balance requirements and prevent separate use of guarantees of origin.

The fourth-phase MRR (EU) 2018/2066 has been amended four times: IR (EU) 2020/2085 (RED II alignment), 2022/388, 2023/2122 and 2024/2493 of 23 September 2024 (further biomass / UDB alignment plus ETS2 extension). Article 38(5) requires biofuels, bioliquids and biomass fuels (including biogas and biomethane) to meet sustainability criteria of Article 29(2)–(7) and (10) RED III to count this respective biofuel consignment as zero-rated. Without meeting sustainability requirements and zero-rating, the preliminary emission factor applies.

For renewable fuels of non-biological origin (RFNBO) and recycled carbon fuels (RCF) injected into natural gas grids, the same approach applies, using the UDB or a Member State database to determine zero-rated fractions. However, in cases where hydrogen (H₂) is blended into the grid, EU ETS operators must physically separate the hydrogen from the gas mixture, as stipulated in RED II guidance. Further details on these criteria are provided in Guidance Document No. 3, Section 5.3 ("Biomass issues in the EU ETS").

The ETS2, established under Directive (EU) 2023/959, extends the EU Emissions Trading System to cover fuels used in buildings (heating), road transport, and additional small combustion sectors not included in ETS1, with fuel suppliers designated as the regulated entities. Originally set to begin on 1 January 2027, the compliance date has been deferred to 2028 following the Council's late-2025 general position on the EU Climate Law 2040 package, though monitoring will commence in 2025 and verification in 2026, pending final adoption through trilogue negotiations.

Under Article 38(5) of the MRR, suppliers delivering certified biomethane which have to be previously verified via Proofs of Sustainability (PoS) or the Union Database (UDB), are exempt from surrendering ETS2 allowances, thereby extending the compliance value of biomethane to residential, commercial heating customers, and small industrial consumers below the 20 MW threshold of ETS1.

3.3.7 Carbon Border Adjustment Mechanism (CBAM)

The Carbon Border Adjustment Mechanism (CBAM) is an EU policy instrument established under Regulation (EU) 2023/956, forming part of the broader EU “Fit for 55” package under the European Union climate policy framework.

The Carbon Border Adjustment Mechanism (CBAM) applies a carbon price to imported goods equivalent to the EU ETS cost faced by domestic producers. CBAM is designed to address the risk of carbon leakage, which refers to the relocation of production to countries with less stringent climate policies, leading to an increase in global emissions despite local reductions. It applies a carbon price to certain imported goods.

It currently covers cement, iron and steel, aluminium, fertilisers (ammonia, nitric acid, urea), electricity and hydrogen. Biomethane is not itself a CBAM good. However, biomethane can play a supportive and increasingly strategic role within CBAM-relevant value chains. By substituting fossil fuels in industrial production processes, biomethane can contribute to lowering the embedded emissions of goods subject to CBAM reporting. This can translate into reduced CBAM-related costs for importers or improved competitiveness for EU producers, as lower reported emissions lead to fewer CBAM certificates required. In this way, the use of biomethane and other renewable gases can provide a tangible competitive advantage while supporting compliance with EU climate objectives.

Sustainability requirements of the Renewable Energy Directive apply for CBAM in a similar way as it does for ETS. Under Annex II, point A.2.5(b) of Regulation (EU) 2023/956, emissions from biomass sources, including biogas as defined in Article 2(28) of Directive (EU) 2018/2001, are treated as fossil unless evidence for zero-rating is provided in accordance with point B.3.3. To qualify for zero-rating under B.3.3, the biomass must be used for combustion and comply with the sustainability criteria outlined in Article 29(2)-(7) and (10) of RED III, regardless of its geographical origin. In cases where biogas is co-fed with natural gas, only the mass-balanced, certified fraction is eligible for zero-rating. Point B.3.3(6) further specifies two formally equivalent evidence routes for compliance: either documentation and cancellation via the Union Database (UDB), which is not yet applicable, or documentation through a Proof of Sustainability issued by a recognised voluntary scheme, ensuring adherence to RED III mass balance requirements and preventing the separate use of guarantees of origin throughout the complete chain of custody.

3.3.8 CSRD and ESRS

The Corporate Sustainability Reporting Directive (CSRD, Directive (EU) 2022/2464) establishes a framework for mandatory sustainability reporting by companies operating within the European Union. It is complemented by the European Sustainability Reporting Standards (ESRS, Commission Delegated Regulation (EU) 2023/2772), which define the detailed reporting requirements and disclosure formats to be applied by in-scope entities.

Under this framework, companies are required to disclose information on their environmental impact, including greenhouse gas (GHG) emissions, energy consumption and the use of renewable energy. The ESRS specify that disclosures must be based on reliable, verifiable and comparable data, covering both direct emissions (Scope 1) and indirect emissions (Scope 2 and Scope 3), where relevant.

- **Scope 1:** Direct greenhouse gas emissions from sources owned or controlled by the company, such as on-site fuel combustion or company-operated vehicles.
- **Scope 2:** Indirect greenhouse gas emissions from the consumption of purchased energy, including electricity, heat, steam or cooling.
- **Scope 3:** All other indirect greenhouse gas emissions occurring across the company's value chain, including upstream and downstream activities such as purchased goods, transport, and product use.

The CSRD and ESRS do not establish specific certification mechanisms for biomethane. However, they create a demand for transparent and verifiable data on renewable energy / renewable gas use, which may be supported by existing systems for documenting and tracking biomethane attributes.

3.3.9 Gas market legislation

Regulation (EU) 2024/1789 of the European Parliament and of the Council of 13 June 2024, commonly referred to as the Gas Market Regulation, establishes the legal framework for the internal markets for renewable gas, natural gas and hydrogen. The Regulation is part of a broader legislative effort, together with the accompanying Directive (EU) 2024/1788, to decarbonise Europe's energy systems. It forms an essential component of the Fit-for-55 package. The Gas Market Regulation primarily establishes the technical and regulatory framework within which biomethane may be injected into and transported via existing gas infrastructure, and under which cross-border trading of biomethane, including the associated certificate and registry systems, can take place. The Regulation prioritises the connection of biomethane production facilities to gas transmission and distribution grids. It accelerates the timelines for responding to injection requests and grants regulatory authorities the power to apply tariff discounts for biomethane producers.

Member States, regulatory authorities and system operators are required to ensure that markets for natural gas and by extension renewable gases including biomethane, are operated in accordance with principles of non-discrimination, transparency and fair access. Where a transmission system operator offers the same service to different customers, it must do so under equivalent contractual terms and conditions, either using harmonised transport contracts or a common network code.

The Regulation further ensures fair and transparent access to gas networks, storage and LNG facilities for all market participants, enabling renewable and low-carbon gases to access the market regardless of whether production facilities are connected to distribution or transmission networks.

Transmission system operators are required to cooperate to avoid restrictions to cross-border flows resulting from gas quality differences at interconnection points between Member States. Where such restrictions cannot be avoided, a mechanism is established to monitor and progressively remove them.

Cross-border coordination is further promoted to ensure third-party access to grids and foster competition; harmonised tariffs may be established across Member States.

Gas quality requirements for injection are not yet fully harmonised at European level, resulting in different national technical specifications. The Commission is empowered to adopt implementing acts and network codes to progressively address this fragmentation.

3.4 Regulated but non-compliance market: consumer disclosure

A second market category refers to a **regulated market** of **consumer disclosure frameworks**, in which participation is **governed** under Article 19 of the Renewable Energy Directive, **but the use of certificates does not contribute towards binding renewable energy targets**.

According to Article 19, Member States are required to ensure that Guarantees of Origin are issued for renewable energy upon request of the producer and used exclusively for the purpose of disclosing the renewable origin of energy to final consumers. Recital 55 further clarifies that Guarantees of Origin are intended to support informed consumer choice and transparency in energy markets, while remaining distinct from support schemes and compliance mechanisms, meaning that their use does not contribute towards renewable energy targets or obligations. To proof of the share of renewable energy sources the system of electronic certificates, Guarantees of Origin (GOs), was implemented with the purpose of disclosure of energy origin for suppliers to final consumers. EU Member State target compliance on gross final consumption including sustainability requirements, GHG emission values and a mass balancing mechanism are considered a system different from GOs under the Renewable Energy Directive. The technical and operational framework for Guarantees of Origin is further defined in the **CEN EN 16325 standard**, which establishes requirements for the data content, the issuance, transfer and cancellation of GOs. The standard applies to electricity, gas (including biomethane), heating and cooling, and provides a harmonised basis for the implementation of GO systems across European countries.

3.5 Voluntary markets

3.5.1 Background of voluntary markets

In addition to regulated frameworks, biomethane is also used within voluntary or not yet regulated markets, where no binding legislative requirements govern the use of renewable gas certificates or sustainability attributes. These markets are primarily driven by corporate climate strategies, environmental reporting practices and voluntary commitments to reduce greenhouse gas emissions.

In addition to corporate reporting, biomethane is increasingly used as a renewable feedstock in industrial processes, including in sectors such as chemicals, pharmaceuticals and fuel production. In these applications, the use of biomethane is typically driven by voluntary decarbonisation targets, supply chain requirements or product-specific sustainability claims, rather than by regulatory obligations.

3.5.2 *GHG accounting under private standards: GHGP, SBTi*

A key application in this context is greenhouse gas (GHG) accounting under internationally recognised private standards, such as the Greenhouse Gas Protocol (GHGP) and the Science Based Targets initiative (SBTi). These frameworks provide methodologies for companies, cities and other organisations to quantify and report their emissions, including emissions associated with energy consumption.

Within these frameworks, biomethane may be considered as a renewable energy source contributing to emission reductions, provided that its characteristics are credible, traceable and consistent with the accounting rules applied. The treatment of biomethane depends on the specific methodological approach used, including the distinction between location-based and market-based accounting for energy-related emissions. There is no guidance at the moment, and a revision is taking place of both documents.

As these markets are not harmonised at European level, practices may vary depending on the applicable standards, sectoral requirements and organisational approaches.

3.6 National regulatory frameworks

3.6.1 *Introduction and background*

EU legislation establishes a comprehensive framework for renewable energy development, ranging from legally binding instruments like the European Green Deal and Fit for 55 to non-legally binding initiatives such as REPowerEU and the Biomethane Action Plan. The Renewable Energy Directive (RED III) establishes a common EU framework with binding targets but delegates the specific implementation to Member States. This allows each Member State to adapt the directive's provisions to its national energy infrastructure, market conditions, and policy priorities while ensuring alignment with the overarching EU objectives. Consequently, this results in a patchwork of national approaches, with varying focuses on production-side support, demand-side measures, or indirect tax incentives, which hinders a harmonised market ramp-up across Europe. Non-EU members also show strong interest in aligning closely with these frameworks, particularly to maintain cooperation in climate and energy policies and to remain competitive in energy markets.

3.6.2 *Overview of support mechanisms*

National biomethane policies deploy a range of instruments. Production support typically takes the form of feed-in tariffs, which provide a fixed remuneration per unit of biomethane injected into the grid, or market premiums, which complement the market price received by producers. Demand-side support creates a market pull through quota systems, under which gas or fuel suppliers are required to include a defined share of renewable gas in their portfolio or face financial penalties. Further incentives may include investment support for production facilities and financial contributions to grid connection costs. Tax-related measures may include exemptions or reductions in energy taxes for sustainable renewable gases, whereby biomethane that fulfils defined sustainability criteria becomes eligible for partial or full tax exemptions or tax rebates compared to fossil natural gas. Tax exemptions can provide direct or indirect incentives: a clear tax exemption provides an incentive via its immediate economic

advantage, while a tax rebate, where a previously paid tax can be remunerated when specific conditions are fulfilled, is rather an indirect incentive. Several countries have introduced or are developing CO₂ pricing mechanisms or national emissions trading systems, as part of broader tax reforms aimed at greening the tax system while maintaining international competitiveness. Within these frameworks, the use of biomethane may reduce the carbon cost burden due to its lower or zero-rated emissions factor.

It should be noted that the eligibility of renewable gas for counting towards EU renewable energy and decarbonisation targets is conditional on compliance with the RED III sustainability framework, including verified GHG emission savings and mass balancing along the full supply chain. National support mechanisms are therefore consistently aligned with these requirements. This linkage is not merely a formal regulatory choice, but a logical necessity: without a common compliance basis, nationally supported renewable gas volumes could be claimed for target fulfilment in another Member State, which would undermine both the integrity of national support schemes and the consistency of EU-level target accounting.

3.6.3 Policy trends and market evolution

Results from BIOMAPE's country mapping exercise, based on the BIOMAPE questionnaire responses, supplemented with desk research, analysed 18 European countries, reveal a highly fragmented biomethane policy landscape. The data highlights both disparities and commonalities in support mechanisms. The countries listed in Table 5 include BIOMAPE lead countries (Austria, Ireland, United Kingdom) and focus countries (Hungary, Serbia, Slovenia, Portugal, Ukraine). It also includes additional EU Member States Germany, Denmark, France, Italy, Lithuania, Netherlands, Sweden, Slovakia, and non-EU members Norway and Switzerland to provide a broader European context.

The analysis confirms that biomethane support in Europe remains heterogeneous and often indirect. While direct support mechanisms like FiTs and FiPs have historically driven renewable electricity market integration and uptake, dedicated support for biomethane production remains limited. Only a few countries, such as France or the UK (Green Gas Support Scheme, GGSS), maintain gas-based feed-in tariffs, while Denmark phased out its programme in 2020.

Historically, renewable electricity support schemes served as market drivers for biomethane, with FiTs for power from direct biogas electrification or decentralised biomethane laying the foundation for early biomethane registries (e.g., AGCS in Austria, dena in Germany, Energinet in Germany, Vertogas in the Netherlands which was replaced with VertiCer recently and GGCS in the UK). However, electricity-based support schemes are currently only ongoing until their phase-out which will be in most countries around 2030 or beyond. However, they are not anymore central to biomethane market uptake, as they support renewable electricity rather than biomethane itself. This underscores that support for renewable gases remains structurally weaker than for renewable electricity.

Countries with limited gas grid infrastructure (e.g., Sweden and Norway) focus on transport applications and filling stations rather than grid injection. Non-EU members (e.g., Switzerland, Serbia, Ukraine, partly also Norway and UK) are actively aligning with EU frameworks,

demonstrating the global relevance of EU biomethane policies to form a common European market.

France exemplifies a shift towards hybrid support models through its dual support mechanism, which combines a regulated feed-in tariff (FiT) with a quota-based Certificats de Production de Biogaz (CPB) scheme. This approach creates a predictable demand signal for biomethane, effectively transitioning the market from regulated remuneration toward market-based mechanisms and establishing a robust hybrid support model.

In Germany an example was shown of how primarily demand-side-oriented policy approach may be vulnerable to market turbulence, as evidenced by declining GHG quota prices and fraud cases, which have destabilised the biomethane sector and highlighted the need for more balanced policy frameworks.

Investment support (CAPEX) represents another cornerstone of biomethane market development, with schemes provided or anticipated in 13 of the 18 researched countries (Austria, Switzerland, Hungary, Ireland, Italy, Lithuania, Netherlands, Norway, Portugal, Slovenia, Slovakia, Sweden, and the UK). These subsidies are critical for overcoming the high upfront costs associated with biomethane projects and scaling production capacity. However, their practical implementation is not always as market-friendly as intended. Under EU State aid law, investment aid must demonstrate an "incentive effect", meaning it must induce investments that would not otherwise occur, or would be undertaken later, in a more limited form, or differently without support. Both the CEEAG (Guidelines on State aid for climate, environmental protection and energy 2022) and the CISAF (Clean Industrial Deal State Aid Framework) reinforce this principle: aid applications must normally be submitted before the start of works, as projects already irreversibly underway typically lack the required incentive effect. This practically leaves awarded funds unused in several countries since market participants are still waiting for more stable price signals and more robust trading routes.

Tax incentives have emerged as a key instrument for improving the economic competitiveness of biomethane, with at least 10 of the 18 researched countries implementing or anticipating such measures (Austria, Switzerland, Denmark, France, Ireland, Netherlands, Norway, Slovenia, Sweden, and the UK). The advantage is particularly pronounced given biomethane's low or zero-rated emissions factor, which reduces carbon cost burdens under carbon pricing mechanisms like the EU ETS and national schemes, further enhancing its competitiveness. Tax incentives are intended to bridge the cost gap between biomethane and fossil fuels, with the aim of making renewable gases economically viable. However, in practice, tax incentives are not always actually implemented, with implementation regulations sometimes still outstanding or practical business processes not yet defined. Moreover, the distinction between direct tax reductions and administratively more complex tax rebate systems may be decisive in determining the actual benefit to the market. Additionally, the price range of such incentives varies significantly throughout Europe. Across the analysed countries, the quantifiable tax advantage for biomethane ranges from about 11 to 28 €/MWh. At the lower end, Ireland provides a relief of 11.48 €/MWh for the biogas share of vehicle gas through the carbon

component of Mineral Oil Tax. France offers an avoided natural-gas excise burden of 16.39 €/MWh for eligible biomethane uses. The strongest quantified price signals are found in Norway, where exemption from the CO₂ tax on fossil natural gas corresponds to roughly 25–26 €/MWh, and Sweden, where the carbon-tax advantage is approximately 28 €/MWh. These values are not directly comparable in every detail, since they relate to different tax bases and sectors, but they show that tax policy can create a material biomethane value premium, in some countries reaching a level comparable to a significant share of production-support mechanisms.

The fragmentation of national approaches creates both opportunities and challenges. While non-EU members like Switzerland, the UK, and Ukraine have developed strong domestic frameworks—including tax exemptions, FiTs, and investment support—they face recognition challenges in EU compliance markets. For Ireland, the unique situation of its gas grid being connected to the EU only via the UK (a non-EU member) introduces regulatory uncertainty regarding the eligibility of mass-balanced biomethane transfers for RED targets, potentially affecting cross-border trade and statistical reporting. Cross-border trade and UDB connectivity remain key priorities for these countries to access EU compliance markets and avoid isolation.

Overall, two trends can be identified: firstly, policy frameworks are increasingly shifting toward demand-side and market-based instruments, while maintaining strategic production support where necessary. Secondly, the focus is more often on an emission-based system to reduce GHG emissions instead of a focus on production volumes. This can be seen with the French and Dutch blending obligation and different transport quotas.

The combination of tax incentives, investment aid, and evolving registry systems is creating a more dynamic, but still fragmented, biomethane market across Europe.

Table 5: Comparative overview of national incentives, registry types, and production volumes;
legend: ✓ support scheme operational, ~ support scheme defined but not practically operational, - no such support scheme

Country	FiT (power from gas)	FiT bio-methane	FiP / market premium	Tax exemption	Consumption quota	Blending obligation	Biofuel quota	Investment support	EU ETS	national ETS
Austria	✓ (Renewable Electricity Act)	-	-	~	-	-	~	✓ (Renewable Expansion Act)	~	~
Switzerland	-	✓ (Energy Act)	✓ (Energy Act)	✓ (Mineral Oil Tax Act)	✓	-	-	✓ (Industry Biogas Fund)	-	-
Germany	✓ (Renewable Energy Sources Act)	-	-	-	✓	-	✓ (Federal Immission Control Act)	-	✓ (Greenhouse Gas Emissions Trading Act)	✓ (the Fuel Emissions Trading Act)
Denmark	-	-	✓	✓ (Danish Green Tax Reform)	-	-	✓ (RED III)	-	~	~



Country	FiT (power from gas)	FiT bio-methane	FIP / market premium	Tax exemption	Consumption quota	Blending obligation	Biofuel quota	Investment support	EU ETS	national ETS
France	-	✓ (French Energy Code)	-	✓ (TIRUERT, TICGN)	✓ (French Energy Code)	-	✓ (RED III)	-	~	~
Hungary	✓ (METÁR)	-	-	-	-	-	✓ (RED III)	✓ (Jedlik Ányos Energy Programme)	-	-
Ireland	✓ (REFIT 3 until 2030)	-	-	✓ (Natural Gas Carbon Tax, NGCT, for non-transport gas use and carbon component of Mineral Oil Tax, MOT, for vehicle gas)	✓ (Renewable Heat Obligation, RHO, under development)	-	✓ (Renewable Transport Fuel Obligation, RTFO)	✓ (under development)	✓	n.a.



Country	FiT (power from gas)	FiT bio-methane	FiP / market premium	Tax exemption	Consumption quota	Blending obligation	Biofuel quota	Investment support	EU ETS	national ETS
Italy	-	-	✓ (2022 Ministerial Decree)	-	-	-	✓ (CIC, Emission certificates for Consumption)	✓ (National Recovery and Resilience Plan, 2022 Ministerial Decree)	?	?
Lithuania	-	-	-	-	-	-	✓ (RED III)	✓ (Renewable Energy Law)	?	?
Netherlands	✓ (SDE, Promoting the Dutch Sustainable Energy Transition)	-	-	✓ (Environmental Taxes Act)	✓ (Green Gas Blending Obligation Act)	✓ (Environmental Management Act, start 2027)	✓ (Environmental Management Act)	✓	✓	✓
Norway				✓ (Excise Duties)				✓ (Energy Act)	n.a.	n.a.



Country	FiT (power from gas)	FiT bio-methane	FiP / market premium	Tax exemption	Consumption quota	Blending obligation	Biofuel quota	Investment support	EU ETS	national ETS
Portugal	✓ (Decree-Law 225/2007)	-	-	-	-	-	✓ (RED III)	✓ (cost-sharing mechanism, for grid connection; Decree-Law March 2026)	-	-
Serbia	-	-	-	-	-	-	-	-	-	-
Sweden	-	-	✓ (Förordning 2022:225)	✓ (Lag 1994:1776)	-	-	✓ (RED III)	✓ (Climate Leap under Förordning)	?	?
Slovenia	✓ (Borzen support scheme, ZSROVE Act)	-	-	✓ (Excise Duty Act)	-	-	✓ (RED III)	✓ (Common Agricultural Policy)	?	-
Slovakia	✓ (Act No. 309/2009)	-	-	-	-	-	✓ (RED III)	✓ (Slovak Recovery and Resilience Plan)	✓ (Slovak Ministry of Environment)	-



Country	FiT (power from gas)	FiT bio-methane	FiT / market premium	Tax exemption	Consumption quota	Blending obligation	Biofuel quota	Investment support	EU ETS	national ETS
Ukraine	-	-	-	-	-	-	-	✓	n.a.	~ Ukraine "On the Basic Principles of State Climate Policy" under development
United Kingdom	-	✓ (Green Gas Support Scheme, GGSS)	-	✓ (Green Gas Levy)	-	-	✓ (Renewable Transport Fuel Obligation, RTFO)	✓	n.a.	n.a.



4 Biomethane market dimensions and outlook

The comparison of biomethane production levels and 2030 targets across European countries reveals significant differences in both current market maturity and future ambition as is shown in Table 6 and Figure 9. It should be noted that the underlying data is subject to several limitations. The gas demand figures used in this comparison are based on the most recent available data (primarily from 2024 or 2025), while the biomethane targets are largely derived from National Energy and Climate Plans (NECPs), complemented in some cases by industry estimates or sectoral studies. Gas demand varies and may change by 2030 but for simplification this calculation uses current gas demand data in comparison with 2030 biomethane targets. It is not explicitly mentioned whether the stated targets are legally binding, indicative policy ambitions or market estimations. Therefore, this table is intended to provide a structured overview and comparative insights rather than definitive values, and the figures should be interpreted with appropriate caution.

Table 6: Biomethane production, gas demand and market dimensions: current status and 2030 outlook

Country	Number biomethane plants	current bio-methane production (TWh/year)	current annual gas demand (TWh/year)	2030 target (TWh/year)	current biomethane share vs. gas demand (%)	2030 target: biomethane share vs. current gas demand (%)
Austria	17	0.170	80.00	7.50	0.21	9.38
Switzerland	47	0.380	19.50	2.90	1.95	14.87
Germany	267	11.000	844.00	65.00	1.30	7.70
Denmark	60	7.500	30.00	30.00	25.00	100.00
France	214	11.600	393.00	44.00	2.95	11.20
Hungary	2	0.160	95.00	5.00	0.17	5.26
Ireland	2	0.041	50.00	5.70	0.08	11.40
Italy	115	6.500	610.00	26.00	1.07	4.26
Lithuania	12	0.277	17.00	1.40	1.63	8.24
Netherlands	82	2.500	320.00	20.00	0.78	6.25
Norway	15	0.530	2.50	n.a.	21.20	n.a.
Portugal	3	0.038	60.00	2.50	0.06	4.17
Serbia	0	0.000	29.00	0.37	0.00	1.28
Sweden	71	1.630	10.00	10.00	16.30	100.00
Slovenia	0	0.000	11.00	0.12	0.00	1.09
Slovakia	2	0.060	47.00	5.00	0.13	10.64
Ukraine	6	0.215	210.00	10.00	0.10	4.76
United Kingdom	124	7.500	700.00	8.00	1.07	1.14

Today, the highest shares of biomethane relative to gas demand can be observed in Denmark (approximately 25%), Sweden (around 16%), and Norway (around 21%). However, the Norwegian figure should be interpreted with caution, as it reflects a very small overall gas demand and the absence of a fully developed gas grid, which inflates the relative share.

Looking ahead to 2030, Denmark and Sweden stand out as the only countries targeting near-complete substitution of natural gas with biomethane (around 100%), positioning them as clear system-transformers. A second group of countries—including Austria (80 TWh), Switzerland (19.5 TWh), and Slovakia (47 TWh)—shows strong scale-up ambitions, with projected biomethane shares exceeding 10% of current gas demand. These countries are characterised by low to medium gas demand levels, which facilitates achieving higher relative shares. Germany (844 TWh), France (393 TWh), and the Netherlands (320 TWh), by contrast, fall into a moderate category, with target shares in the range of 5–11%, reflecting incremental but significant growth in systems with explicitly high gas demand.

In contrast, countries such as Portugal, Serbia, and Slovenia remain at an earlier stage, with comparatively low target shares and more limited market development. These countries currently have little to no biomethane production, and the initial integration of biomethane into the gas system represents the primary challenge. This differs from the previously mentioned countries, which can already rely on a more established biomethane market, including existing production capacity, operational experience, and functioning market structures.

The United Kingdom represents a distinct case for two main reasons. First, gas demand figures differ substantially depending on the methodological scope applied: lower estimates of around 319 TWh reflect final consumption, while higher values of approximately 700–730 TWh include total inland demand, notably gas used for electricity generation and energy-sector processes. As gas-fired power generation remains a key component of the UK energy system, this discrepancy significantly affects the calculation of biomethane shares. Second, the assessment of 2030 biomethane levels is not based on a clearly defined binding target but rather derived from long-term ambitions of up to 120 TWh by 2050; assuming a linear growth trajectory implies around 33–34 TWh by 2030, although a more realistic intermediate range is likely 15–25 TWh when accounting for typical infrastructure deployment and market ramp-up dynamics.

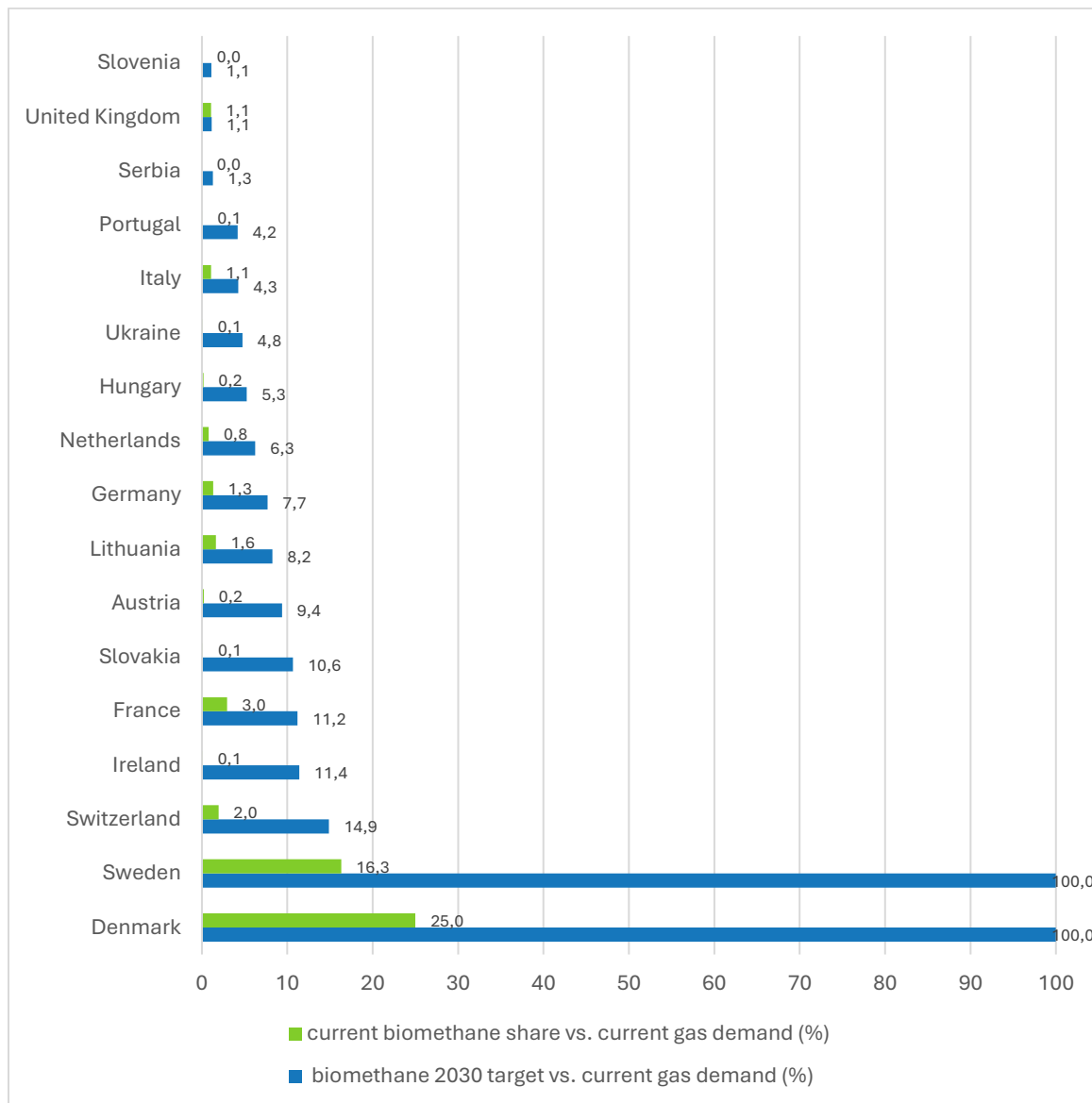


Figure 9: Comparison of biomethane production shares with current gas demand (%) currently and for biomethane 2030 targets with current gas demand by country

5 Renewable Gas Certificates

5.1 Definition of certificates

Certificates in the context of renewable energy, in this context gas, are electronic documents that represent specific attributes of a defined energy carrier, its quantity of energy and in some cases also describe their quality (referring to input biomass material and GHG emission values). A certificate does not represent the physical gas itself, but the intrinsic value of renewable gas, referring to environmental, sustainability, or origin-related attributes. Certificates therefore enable the decoupling of physical flows from attribute tracking, allowing renewable gas to be traded and claimed in parallel of its physical delivery. Certificates serve as standardised instruments to document, transfer, and verify information related to the production, characteristics, and use of renewable energy carriers.

5.2 Certificate use, claims and validity

5.2.1 *Purpose, claims, and use cases of renewable gas certificates*

Certificates enable different types of claims, depending on the regulatory or market context in which they are used, e.g. compliance, regulated or voluntary markets (for details see chapter 2). The primary purpose of certificates is to ensure traceability, transparency, and credibility of renewable energy attributes across complex supply chains, in the BIOMAPE context referring to renewable gas attributes. More generically, the purpose of a certificate is to provide reliability and transparency to market participants, while also ensuring security and trust across the entire market it serves.

In compliance markets, certificates serve as evidence for fulfilling binding obligations such as renewable energy targets or greenhouse gas reduction requirements and are subject to strict rules. In disclosure contexts, they enable energy suppliers to inform consumers about the origin of gas, focusing on transparency rather than compliance. In voluntary markets, certificates support corporate sustainability strategies, including emissions accounting and renewable gas claims under recognised standards to provide transparency. Across all these uses, the credibility of claims depends on robust (registry) systems that ensure consistency, traceability, independence and the avoidance of double counting.

Understanding these use cases is essential for defining registry functionalities and certificate lifecycles.

5.2.2 *Lifetime and validity of a renewable gas certificate*

Certificates are issued based on verified data and follow a defined lifecycle, typically comprising market participant registration, certificate issuance, ownership transfer, and cancellation/retirement. Underlying necessary business processes are described in chapter 6 Business processes for renewable gas registries.

Validity rules differ depending on the underlying policy objective and market application of certificates. In disclosure systems based on Guarantees of Origin under the Renewable Energy Directive, validity typically refers to the total lifetime of a certificate, i.e. a fixed period between production and the final date by which the certificate must be used for disclosure purposes (commonly 12 months after production). In contrast, in compliance markets linked to RED target fulfilment (such as biofuels quota systems or greenhouse gas reduction obligations) validity is usually not defined as a fixed expiry period of the certificate itself, but is instead linked to specific accounting rules, for example restricting the use of certificates or Proof of Sustainability data to volumes produced within a given reporting period (e.g. a calendar year), with clearly defined deadlines for compliance reporting and verification. These differing approaches significantly increase the complexity of registry operation, particularly when multiple certificate types and market applications are managed within one system, as validity rules must be consistently applied and enforced depending on the intended use.

5.3 Content and data of renewable gas certificates

5.3.1 *Unique certificate identifiers*

Certificates must include a unique identifier (in practice mostly referring to certificate ID numbers) to ensure traceability, prevent duplication, and enable consistent tracking across ownership transfers and registry systems. The unique identifier serves as a digital fingerprint for each certificate and is essential for maintaining data integrity throughout the certificate lifecycle.

The identifier is typically generated at the point of issuance and remains associated with the certificate through all subsequent transactions, including transfers, cross-border exchanges, and cancellation/retirement. In interoperable systems, identifiers must remain unique not only within a national registry but across connected systems, requiring harmonised identifier structures or coordination via central schemes.

REGATRACE highlights that robust identifier systems are a key mechanism to prevent double counting and double claiming, particularly in cross-border contexts. The identifier must allow the reconstruction of the full lifecycle of a certificate and should be linked to all relevant attributes, including production data, sustainability characteristics, and transaction history.

5.3.2 *Content, data fields, attributes*

As initially described, renewable gas certificates are electronic documents that represent specific attributes of a defined quantity of energy and in some cases also describe their quality (referring to input biomass material and GHG emission values). Therefore, renewable gas certificates contain a defined set of data fields, comprising attributes which describe the characteristics of the respective energy unit. A data field is a defined element within a certificate that contains a specific piece of information describing the characteristics of the renewable gas.

The consistency and standardisation of these data fields are essential for interoperability between registries and for ensuring the credibility of claims. This list can be provided based on experiences of registry operators in BIOMAPE lead and focus countries and ERGaR as scheme

operator, insights from the circulated questionnaires, and requirements of the CEN 16325 standard. These attributes typically include:

- Mandatory data fields:
 - ◆ production details (location, installation, technology),
 - ◆ energy carrier and volume or quantity,
 - ◆ production date and period,
 - ◆ input material: biomass source in case of biofuels and biomethane, renewable power source in case of RFNBOs,
- Mandatory data fields, in case of compliance claims:
 - ◆ biomass source in case of biofuels and biomethane, renewable power source in case of RFNBOs,
 - ◆ sustainability characteristics,
 - ◆ GHG emission values,
 - ◆ certification scheme and audit information.

Each data field follows a predefined format and structure to ensure consistency and interoperability across systems. Typical field types include

- numerical fields (e.g. energy quantity, GHG values),
- categorical fields (e.g. technology type, feedstock category),
- date fields (e.g. production period, issuance date),
- alphanumeric identifiers (e.g. certificate ID, installation ID), and
- Boolean fields (e.g. compliance status).

The standardisation of field types and formats is essential to enable automated processing, validation, and exchange of certificate data at and between registries and certification systems. Certificates must support auditability, meaning that all relevant data fields and changes over time can be reconstructed and verified by auditors.

5.3.3 Data acquisition and verification

The robustness of certificate systems depends on structured data acquisition and verification processes across all attribute layers. Based on previous research of the REGATRACE project and knowledge gained from the BIOMAPE D2.1 questionnaire on operational practices, this chapter explains how data is collected and validated at different stages of the complex renewable gas value chain, with each attribute layer drawing from specific sources and verification steps and adding an information layer to the renewable gas certificate.

Overall, layers 3 and 4, and in part layer 2, are subject to regular updates and variability across production periods, whereas layer 1 remains largely fixed after initial registration. This distinction between static and dynamic data is essential for designing efficient auditing and data management processes and also reflects the mandatory data for specific certificate types. Across all layers, REGATRACE emphasises the importance of consistent auditing cycles, clear allocation of responsibilities, and integration between registries and certification systems. Certification schemes play a central role in this process by defining audit methodologies, verification rules, and reporting requirements. Clear auditing rules and regular auditing

procedures ensure that data remains accurate, traceable, and verifiable throughout the certificate lifecycle, forming the basis for credible and reliable market operation.

5.4 Certificate attribute layers

5.4.1 Introduction to certificate attribute layers

Based on previous research and data acquisition within REGATRACE and BIOSURF findings, certificate data can be structured into different attribute levels. These are updated to reflect current legal and practical requirements and refined as “attribute layers” for the purpose of this BIOMAPE deliverable. The following chapter provides insights on each of these information layers. Figure 10 illustrates an overview.

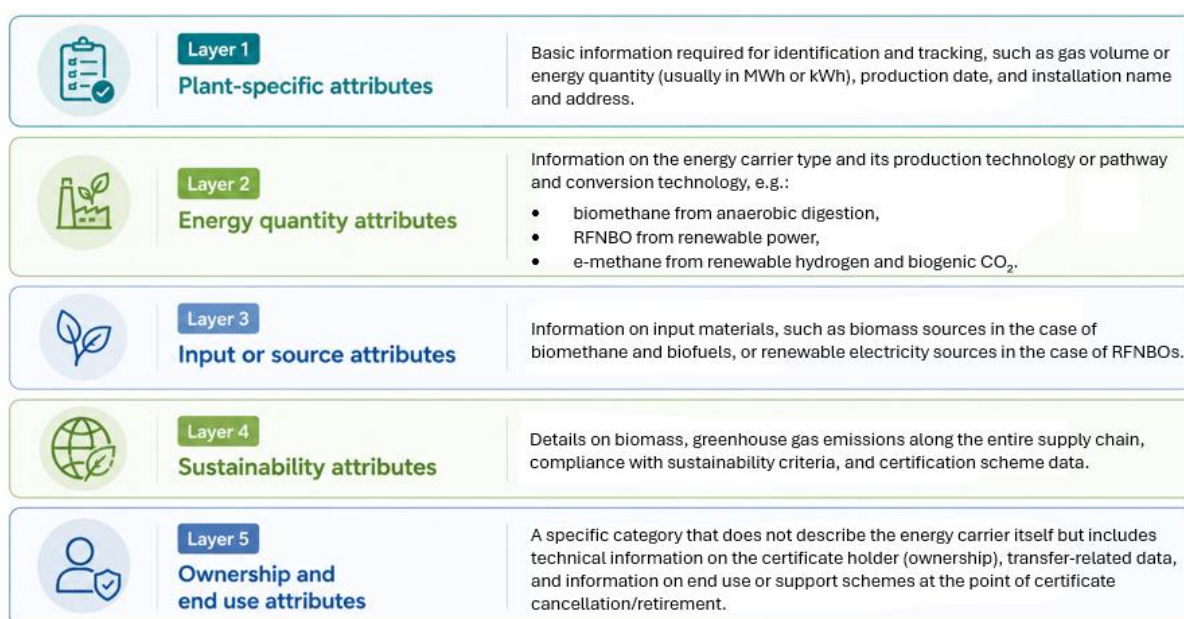


Figure 10: Overview of attribute layers of a renewable gas certificate

5.4.2 Attribute layer 1 – Plant-specific attributes

Basic information required for identification and tracking, such as gas volume or energy quantity (usually in MWh or kWh), production date, and installation name and address.

Plant-specific attributes are primarily established through the initial registration of a production installation, where the plant operator submits relevant technical and permitting documentation, engineering specifications of the production process, plant audit documents, and similar evidence. The collected data typically includes plant identity (name, address, location), commissioning date, metering point information, as well as technical parameters such as capacity, applied technology, production pathway and/or conversion technology (e.g. anaerobic digestion and upgrading). These attributes are generally static. Once validated during registration, they remain unchanged over time, except in cases where the production installation undergoes modifications, such as capacity expansions or technology updates, which must be formally communicated to the registry operator.

5.4.3 *Attribute layer 2 – Energy quantity attributes*

Information on the energy carrier type and its production technology or pathway and conversion technology, e.g. biomethane from anaerobic digestion, RFNBO from renewable power, e-methane from renewable hydrogen and biogenic CO₂.

Energy quantities (usually expressed in MWh or kWh) are typically collected from original metering devices. Data delivery may be performed directly by grid operators, other market roles in the energy market or indirectly by auditors who document and verify meter readings. Metered production data is typically reported regularly such as every month and forms the basis for certificate issuance. In systems where one certificate corresponds to 1 MWh, issuance follows a standardised unit-based approach. In alternative designs, where registries issue production batches instead of fixed units, the size of these batches may vary for each issuing period, depending on production volumes and reporting intervals

5.4.4 *Attribute layer 3 – Input or source attributes*

Information on input materials, such as biomass sources in the case of biomethane and biofuels, or renewable electricity sources in the case of RFNBOs.

Input or source attributes rely on detailed documentation of feedstock inputs or energy sources, typically verified by third-party auditors. For biomethane, this includes biomass type, origin, and supply chain characteristics. Data may be provided by plant operators and subsequently verified through certification schemes applying RED-compliant methodologies or directly submitted by authorised auditors. In all cases, auditors assess whether input materials meet eligibility criteria and are correctly accounted for. These attributes are semi-dynamic in nature, meaning their data may vary between production batches depending on feedstock composition and sourcing.

5.4.5 *Attribute layer 4 – Sustainability attributes*

Details on biomass, greenhouse gas emissions along the entire supply chain, compliance with sustainability criteria, and certification scheme data are summarised under the term “sustainability attributes”.

These attributes are based on data generated through certification under recognised voluntary schemes. These include greenhouse gas emission calculations across the full supply chain, compliance with sustainability criteria and mass balancing requirements, and audit results. The data is verified by accredited auditors and linked to the certificate through scheme documentation, ensuring consistency with RED requirements and enabling recognition across Member States. Similar to input attributes, sustainability data is dynamic and may change between production batches, for example due to variations in biomass input or process efficiency, which directly affect GHG emission values.

5.4.6 *Attribute layer 5 – Ownership and end use attributes*

A specific category that does not describe the energy carrier itself but includes technical information which are generated within the registry system during certificate transactions. These include information on certificate ownership, ownership transfers, and final use, such as cancellation/retirement for compliance, disclosure, or voluntary claims. Additional data on

support schemes or end-use categories may be recorded at the point of cancellation, reflecting how the certificate is ultimately used. These attributes evolve throughout the certificate lifecycle and are therefore inherently dynamic.

5.5 Certificate types (PoS, CoO, GO)

5.5.1 Overview of certificate types (PoS, CoO, GO)

Coming from a diverse policy landscape and segmented market areas (see chapter 2) several certificate types have emerged and received relevance in the context of renewable gases, each serving distinct functions. Figure 11 illustrates an overview and comparison of these certificates. More details are described in the following chapters.

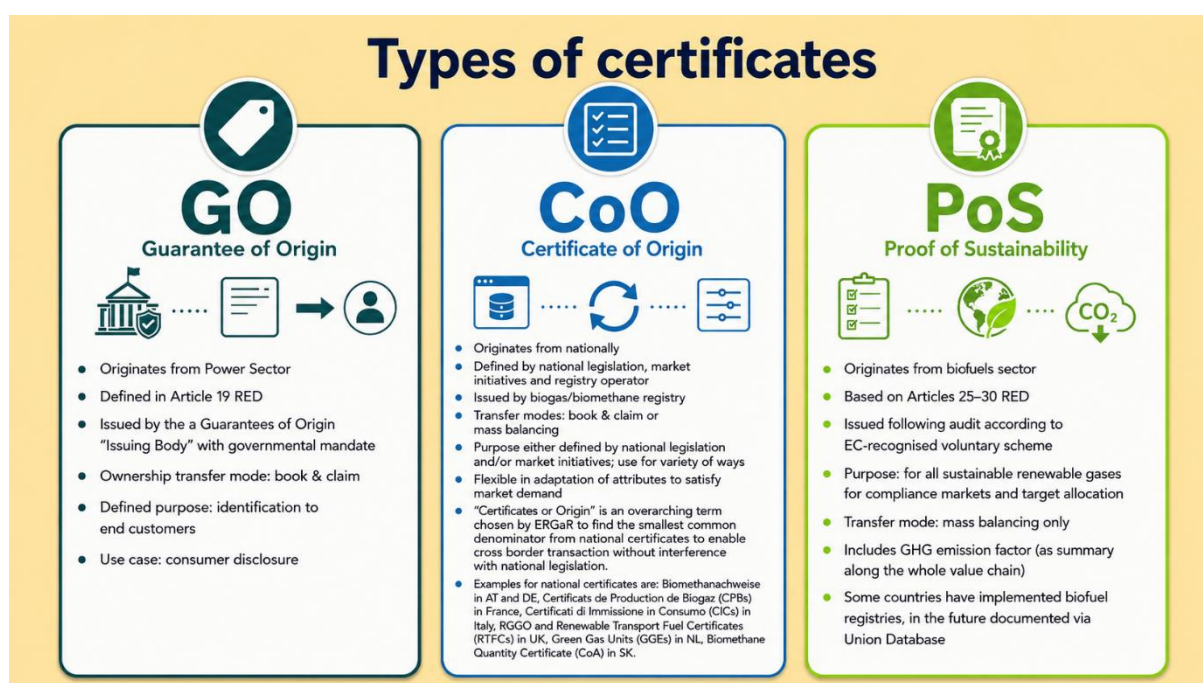


Figure 11: Comparison of different certificate types for renewable gases

5.5.2 Proofs of Sustainability (PoS)

Proofs of Sustainability (PoS) are originally used for compliance with biofuel targets (Fuel Quality Directive and Renewable Energy Directive) and have been expanded (with RED III) to all EU compliance markets. They confirm that a fuel / energy carrier meets defined sustainability and GHG emission saving criteria. These certificates are essential for counting renewable energy towards regulatory targets or quotas on national and EU level.

5.5.3 Certificates of Origin (CoO)

In some Member States, national certificate systems are implemented to serve specific policy objectives, such as ensuring eligibility for subsidies, demonstrating compliance with renewable energy quotas, or supporting voluntary disclosure of renewable gas consumption. These

systems use certificate names in national languages, reflecting the diversity of approaches across Europe.

Some of these national certificate systems predate RED II, such as

- AGCS Biomethannachweise in Austria, operated by AGCS Gas Clearing and Settlement AG since 2012,
- dena Biogasnachweise in Germany, operated by the Deutsches Biogasregister at dena German Energy Agency since 2011,
- the Danish Oprindelsesgarantier, operated by Energinet since 2012,
- the Renewable Gas Guarantees of Origin (RGGOs) issued by the Green Gas Certification Scheme (GGCS) in the UK, operated by REA since 2012,
- or Renewable Transport Fuel Certificates (RTFCs) administered by the UK Department for Transport (DfT) since 2008 (with biomethane eligibility established under the Renewable Transport Fuel Obligation).

Other national certificate systems were introduced recently to support new national schemes, including:

- Certificats de Production de Biogaz (CPBs) in France, operated by EEX (European Energy Exchange) since January 2026,
- Green Gas Units (GGEs) in the Netherlands, operated by the Dutch Emissions Authority (NEa) since 2027 (with the obligation starting in January 2027),
- Certificati di Immissione in Consumo (CICs) in Italy, operated by the GSE (Gestore dei Servizi Energetici) since the early 2010s (with the current framework well-established by 2020).
- Biomethane Quantity Certificate (in Slovakia).

The **EUROPEAN RENEWABLE GAS REGISTRY (ERGAR)** is a non-governmental association that brings together national biomethane registries to facilitate knowledge transfer. ERGaR's vision is to harmonise the European renewable gas market with a clear mission to define a standardised set of core attributes, representing the "lowest common denominator" required across all countries, which forms the basis of its **CERTIFICATE OF ORIGIN (COO) SCHEME**. This way, the scheme enables secure, interoperable, and efficient cross-border trading of biomethane certificates between participating national renewable gas registries. Thanks to this "lowest common denominator" approach, all national registries can participate without interfering with national legislation. The common term for this harmonised attribute set, which encompasses a diverse range of national certificate types, is the **CERTIFICATE OF ORIGIN (COO)**.

5.5.4 Guarantees of Origin (GOs)

Guarantees of Origin (GOs) constitute one specific instrument within the broader landscape of renewable gas certification. They are used primarily for consumer disclosure, providing evidence that a given quantity of gas was produced from renewable sources and enabling energy suppliers to transparently communicate this information to end users.

According to Article 19, Guarantees of Origin are issued „in response to a request from a producer of energy from renewable sources“ meaning that issuance is not necessarily

automatic for all produced renewable energy volumes but may depend on an explicit request by the producer.

GOs are typically issued in standardised units (e.g. 1 MWh). They are commonly used in for consumer information and in some cases for voluntary markets with limited application in regulatory compliance.

The Renewable Energy Directive explicitly distinguishes GOs from compliance instruments. According to Article 19(2), GOs “shall have the sole function of providing evidence to a final customer that a given share or quantity of energy was produced from renewable sources.” Furthermore, the directive clarifies that GOs do not confer a right to benefit from support schemes, nor do they count towards the fulfilment of renewable energy targets, thereby clearly separating disclosure from compliance use.

As a result, GOs do not, by themselves, provide the data infrastructure required for regulatory target accounting, subsidy management, or the prevention of double counting across different market segments as they have been specifically designed for consumer disclosure. There is a specific system type dealing with GO issuing, trading and cancelling, called Issuing Body. Chapter 10.2.2 specifically focusses on Issuing Bodies for Guarantees of Origin (GO-IB) (type 1).

While GOs have long been established in the electricity sector, their extension to renewable gases such as biomethane was only formalised under RED II. Consequently, GO systems for biomethane are still evolving and, compared to electricity markets, remain less mature in terms of implementation experience, harmonisation, and cross-border integration.

5.5.5 *Implications on registry design*

Clear documentation of certificates and tracking rules are particularly relevant where the same unit of energy could be used for multiple claims. Thus, registries must be designed to handle these certificate types, while ensuring clear separation of purposes and claims. Chapter 0 provides insights on different system design options to deliver on this requirement with special focus on the complexity arising from different certificate types, validity options and purposes or use cases.

6 Business processes for renewable gas registries

6.1 Introduction to business processes

The tasks and functions of a renewable gas registry for certificate management require well-structured and efficient business processes. Some of these processes are supported and executed through the registry's IT system, while others rely on administrative procedures carried out by staff members. Depending on market size, complexity, and available resources, registries must determine which processes are best handled manually by experienced personnel, and which can be effectively automated within the IT system.

Registries must support the full lifecycle of certificates in a consistent and secure manner, including the registration and approval of production units, issuance based on verified data, ownership transfer between market participants, and cancellation upon use, while also accommodating different validity rules depending on certificate type and market application. According to REGATRACE, robust lifecycle management—combined with clear rules for data handling, auditing, and system interaction—is essential to ensure traceability, prevent double counting, and maintain trust in renewable gas markets.

6.2 System operation and support processes

6.2.1 *Market participant registration, user authentication and access management*

The registration of market participants is the pre-requisite for the operation of an account-based registry system. The definition of roles and account types is discussed in more detail in chapter 7.3 Accounts and roles .

Most important is the registration of production installations, where plant operators submit technical and regulatory data that is verified before approval. In addition, other market participants such as auditors, traders, and end users should also have to undergo specific registration procedures. This includes the submission of company-related data such as copies of business license, company register excerpt, and annual reports or sustainability reports. Specifically for traders, a gas trading licence or a proof of connection to the gas grid or proof as gas market participant could be relevant. For auditors, certificates of competence for specific market areas and more specifically certification of competence as permitted by recognised voluntary schemes could be requested. Additionally, the implementation of a dedicated know-your-customer (KYC) process may ensure that only trustworthy parties are admitted as market participants, thereby strengthening market trust and credibility.

6.2.2 *Error handling and withdrawal of renewable gas certificates*

Certificate withdrawal refers to the administrative removal of certificates from the market by the registry operator in cases of identified errors, inconsistencies, or the need for corrections. This process is typically governed by clearly defined business processes for error handling and

damage control and must follow specific prerequisites. Registry operators act as neutral system administrators and are not allowed to hold or economically benefit from certificates. While they may withdraw certificates for corrections, this action is fundamentally different from cancellation or retirement. Cancellation/retirement represents the final use of a certificate and serves as proof that the corresponding renewable gas has been claimed for a specific purpose (e.g. compliance, disclosure, or voluntary reporting). Withdrawal, in contrast, is a corrective administrative action and does not represent end use of the physical renewable gas equivalent.

6.2.3 *Reporting and statistical analysis in biomethane registries*

Registry staff generate transparent, accurate, and regulatory-compliant reports and statistical analyses, providing stakeholders with reliable data for market oversight, policy evaluation, and decision-making in accordance with registry architecture and legal requirements.

6.2.4 *System maintenance and updates*

Technical upkeep of the registry platform, including software updates, security patches, and integration with external systems (e.g., Union Database, national databases, or payment gateways), depending on the registry architecture, have to be performed regularly by the registry operator in close collaboration with the IT-system provider.

6.2.5 *Helpdesk and user support*

Providing assistance to market participants for troubleshooting, guidance on processes, and resolving operational issues are regular tasks of registry operators.

6.3 Certificate lifecycle and management processes

6.3.1 *Certificate issuance*

Certificate issuance is based on verified production data, typically derived from metering information provided by grid operators and supported by audit data (for details see chapter 5.3.3 Data acquisition a). Certificates are then allocated to the account of the producer and remain in their ownership until further marketing or use.

6.3.2 *Ownership transfer*

Ownership transfer processes enable the transferability of certificates between account holders within a registry or across registries. These processes must ensure accurate ownership tracking, to keep all relevant information and attributes, and prevent duplication.

6.3.3 *Cancellation / Retirement*

Cancellation or retirement represents the final step in the lifecycle and reflects the use of the certificate for a specific claim. Once cancelled, a certificate can no longer be transferred or reused, thereby ensuring the integrity of claims.

In contrast, withdrawal is a corrective measure performed by the registry operator that does not signify the end use of the physical renewable gas volume.

6.4 Modes of Transfer: Book-and-Claim vs. Mass Balancing

6.4.1 Introduction into modes of transfer

Renewable gas certificate systems rely on different accounting and transfer models to link physical energy flows with corresponding attributes. The two principal approaches are book-and-claim and mass balancing, which differ fundamentally in the chain of custody tracking of attributes as illustrated in Figure 12.

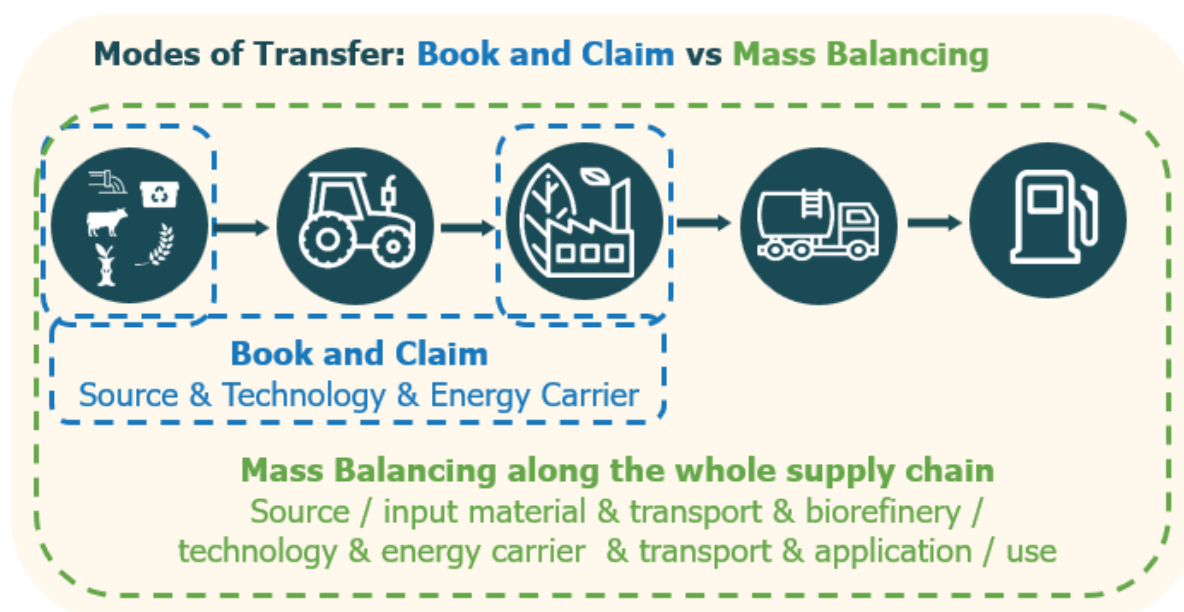


Figure 12: Differences in the modes of transfer, comparing Book and Claim with Mass Balancing

6.4.2 Book-and-Claim (BC)

Book-and-claim is a system in which the physical flow of gas is fully decoupled from the transfer of its renewable and sustainability attributes. Certificates are issued based on verified production and can be transferred independently of the physical gas, allowing market participants to claim renewable gas consumption regardless of their physical supply. This model is typically applied in Guarantees of Origin (GO) systems and voluntary markets, where the primary objective is disclosure and market-based claims. Under the Renewable Energy Directive (RED), GOs are explicitly designed for disclosure purposes and cannot be used for target accounting (e.g. Article 19 RED II / RED III framework), requesting the parallel chain of custody tracking of physical energy delivery and attribute claims.

6.4.3 Mass Balancing (MB)

Mass balancing is a chain-of-custody approach required under the Renewable Energy Directive for compliance markets (Articles 25–31 RED II / RED III). It is a specific accounting method used where physical tracking of biomethane molecules is not suitable. It allows renewable gas inputs and outputs to be balanced within a defined system boundary, the interconnected European

gas grid, ensuring that the quantity of renewable gas claimed does not exceed the quantity produced and injected. According to RED requirements, mass balancing must ensure that sustainability characteristics, including greenhouse gas (GHG) emission savings, are consistently transferred along the supply chain, and that defined validity periods are respected. Mass balancing is essential along the entire supply chain, from production to final use, and is typically closed at the point of end use or certificate cancellation/retirement. Registries must ensure consistent accounting between injected and withdrawn volumes, aligned with sustainability reporting requirements and, where applicable, EU-level systems such as the Union Database. This approach is particularly relevant in compliance markets, where it is a regulatory requirement linked to sustainability criteria and GHG accounting. Registries must ensure consistent accounting between injected and withdrawn volumes, aligned with sustainability reporting requirements and, where applicable, EU-level systems such as the Union Database.

6.4.4 *Differences in modes of transfer*

A key difference between the two approaches lies in the degree of physical linkage: while book-and-claim allows full decoupling of certificates from physical flows, mass balancing maintains a virtual linkage within a defined system boundary, ensuring that inputs and outputs remain quantitatively and temporally consistent. Furthermore, mass balancing is typically mandatory for compliance with RED sustainability criteria, whereas book-and-claim is primarily used for disclosure and voluntary claims.

6.4.5 *Implications on registry design*

Bookkeeping is a fundamental function of renewable gas registries, ensuring that all certificate-related transactions are accurately recorded, traceable and auditable. It provides the accounting framework that can link production, ownership transfer, and final use of renewable gas attributes.

With the implementation of the Union Database, parts of the mass balancing function, particularly supply chain tracking and sustainability data reconciliation, may increasingly be managed at EU level. Nevertheless, national registries remain essential as data providers for specific gas related information such as metered injection and withdrawal information or national specific attribute information. National registry systems ensure the consistency between certificate issuance, ownership transfer, and final use.

6.5 Prevention of double counting and double claiming

The chapters above describing the diverse policy landscape and the different certificate types raise awareness on the risk of double counting and double claiming. **DOUBLE COUNTING** occurs when the same unit of renewable energy is counted more than once towards regulatory targets or obligations. **DOUBLE CLAIMING** refers to situations where multiple actors claim the same environmental attribute, for example when both a producer and a consumer claim the renewable nature of the same gas.

A central function of a national registry for certificate management is the prevention of double counting and double claiming. Cross-border transfers add further complexity, requiring harmonised rules and interoperable systems to ensure that certificates are not duplicated or misused across jurisdictions. Registry operators must implement the suitable business processes, technical and procedural safeguards, cooperation agreements and risk management to ensure that each unit of biomethane is only used once for a specific claim.

Within the previous EU-funded project REGATRACE, several concrete prevention mechanisms were identified:

First, **STRICT CERTIFICATE LIFECYCLE MANAGEMENT** is essential. Each certificate must be uniquely issued for a defined quantity of energy from renewable gas and must be cancelled once it has been used for a claim. Registries must ensure that no certificate can be reused after cancellation and that all transactions are fully traceable.

Second, **MUTUAL EXCLUSIVITY OR LINKING RULES BETWEEN CERTIFICATE TYPES** are required. REGATRACE highlights that where both GOs and PoS exist for the same biomethane volume, clear rules must define whether:

- both certificates can coexist but only one can be used for a claim, or
- the issuance or use of one certificate automatically restricts or cancels the other.

This avoids situations where the same energy is used simultaneously for compliance (e.g. transport quotas, ETS) and disclosure (e.g. GO claims).

Third, **HARMONISED DATA ATTRIBUTES AND CROSS-CHECKS** play a key role. Registries should include sufficient information (e.g. production batch, installation, sustainability status) to allow verification that certificates referring to the same physical volume are not duplicated across systems.

Fourth, **INTER-REGISTRY COOPERATION AND DATA EXCHANGE MECHANISMS** are necessary, particularly for cross-border transfers. In a first step, separated systems have to recognise each other and harmonise their rules or develop common rules as the following principal step. REGATRACE emphasises the importance of common rules and standardised interfaces to ensure that certificates transferred between systems and countries remain unique and are not recreated or double-issued.

Fifth, **INTEGRATION WITH CERTIFICATION SCHEMES AND EXTERNAL SYSTEMS** (such as sustainability certification schemes or the Union Database) supports consistency checks across the supply chain. This helps to ensure that the same batch of biomethane is not certified multiple times under different systems.

Finally, **RISK MANAGEMENT AND AUDITING PROCEDURES** are required. Registries should implement monitoring systems, transaction controls, and audit trails to detect irregularities. REGATRACE also underlines the importance of clearly defined responsibilities between registry operators, issuing bodies, and auditors, as well as procedures for handling errors, reversals, and disputes.

Together, these measures form a comprehensive framework to safeguard the integrity of certificate systems and registry systems and ensure that renewable gas claims remain credible across compliance, disclosure, and voluntary markets.

6.6 Risk Management and Mitigation Strategies

Biomethane registries face multiple risks that can undermine their integrity, security, and compliance with EU regulations. A proactive risk management framework is essential to:

- Ensure regulatory compliance (e.g., RED III, EU ETS, GDPR).
- Maintain stakeholder trust in certificate markets.
- Prevent financial and reputational damage (e.g., from fraud or double counting).

Table 7 identifies key risks and proposes mitigation strategies for registry operators.

Table 7: Key risks and respective mitigation strategies

Risk Category	Specific Risks	Potential Impact	Mitigation Strategies	Responsible Party
Double Counting	Same certificate used in multiple markets	Non-compliance with RED III and EU ETS	Unique certificate IDs, cooperation agreements and data exchange in case of several authorities	Registry Operator(s)
	Parallel use of GOs and PoS for same gas	Loss of market trust	Automated checks for certificate status (issued/transferred/cancelled), and data exchange in case of several authorities	Auditors/ Voluntary Schemes, assisted by Registry Operator(s)
			Mass balance validation (ensure physical and attribute flows match)	Auditors/ Voluntary Schemes, assisted by Registry Operator
Fraud	Fake certificates (e.g., forged data)	Financial losses, legal penalties	Multi-factor authentication (MFA) for user logins, maximum limits (max. kWh) for certificate transfers	Registry Operator, Scheme Operator
	Identity theft (e.g., impersonating a producer)	Reputational damage	KYC (Know Your Customer) checks for all account holders	Registry Operator
	Collusion (e.g., producers and traders)	Market manipulation	Audit trails for all transactions (who, when, what)	Registry Operator, Scheme Operator
Data Breaches	Cyberattacks (e.g., hacking, ransomware)	Loss of sensitive data, system downtime	Encryption (AES-256 for data at rest, TLS 1.3 for data in transit)	IT Team

Risk Category	Specific Risks	Potential Impact	Mitigation Strategies	Responsible Party
	Insider threats (e.g., staff misuse)	Regulatory fines (GDPR)	Role-based access control (least privilege principle)	IT Team
			Regular penetration testing and vulnerability assessments	IT Team
Operational Risks	System downtime	Disruption of certificate trading	Redundancy and backup systems (e.g., on-premises + cloud)	IT Team
	Human error (e.g., manual data entry)	Incorrect certificate issuance	4-eyes-principle, automated data validation (e.g., check for RED III compliance before issuance)	Registry Operator
	Data loss	Loss of audit trails	Automated backups (daily, encrypted, offsite)	IT Team
Legal & Regulatory	Non-compliance with RED III	Ineligibility for EU funding & support	Automated compliance checks (e.g., GHG thresholds, feedstock restrictions)	Legal Team
	Non-compliance with GDPR	Fines up to 4% of global revenue	Data protection impact assessments (DPIAs)	Legal Team
	Non-compliance with EU ETS (MRR)	Invalid zero-rated biomethane claims	Integration with UDB/ERGaR/AIB to ensure data consistency	Registry Operator
Market Risks	Lack of liquidity in certificate markets	Difficulty for producers to sell certificates	Market-making services (e.g., partnerships with trading platforms like CEGH)	Registry Operator
	Price volatility	Unpredictable revenue for producers	Price transparency tools (e.g., publishing market data)	Registry Operator

7 Principles and system design of renewable gas registries for certificate management

7.1 Core principles

Renewable gas registries are digital, online systems that maintain a central database for the issuance, storage, transfer, and cancellation/retirement of certificates representing renewable gas attributes. Market participants are represented as account holders within the system, and ownership of certificates is managed through an account-based structure, ensuring a clear separation of ownership at all times.

Registries serve renewable gas markets by providing transparency, reliability, security, neutrality, auditability, and data integrity. They function as the trusted infrastructure that ensures that certificates are uniquely identifiable, traceable throughout their lifecycle, and used only once for a specific claim.

A key principle of registry design is the prevention of double counting and double claiming, requiring strict control of certificate issuance, transfer, and cancellation. Another core principle is harmonisation, ensuring that certificates follow standardised data structures and attribute definitions, which enables interoperability across different systems and jurisdictions. Registries must also ensure that all data is verifiable and based on validated inputs, allowing for consistent auditing and reliable market operation.

7.2 Governance and organisational aspects

7.2.1 Institutional setup

The institutional setup of renewable gas registry systems typically involves multiple actors with clearly defined roles and responsibilities. Key actors may include ministries, regulators, issuing bodies, registry operators, IT-providers, auditors, and certification bodies. A clear separation of roles is essential to avoid conflicts of interest and to ensure market transparency and trust in the system. In particular, registry operators must act as neutral entities and must not participate in the market as traders or certificate holders. They may be overseen by ministries and regulators. Similarly, auditing and certification functions must remain independent from registry operation and market participation. This separation of powers ensures that no single actor can control multiple critical functions within the system, thereby strengthening accountability, preventing misuse, and supporting the credibility of certificate-based markets.

7.2.2 Contractual framework

Participation in renewable gas registries is governed by contractual arrangements between the registry operator and market participants. These contracts define the rights and obligations of account holders, including rules for registration, certificate handling, data provision, and compliance with applicable standards. They also specify conditions for access to the system, responsibilities for data accuracy, and procedures for dispute resolution. In addition, contractual frameworks typically regulate liability, including limitations of liability for registry

operators, as well as provisions related to system availability and data integrity. In the context of interoperability and scheme participation, additional agreements may be required between registry operators and scheme organisations or platform providers.

Usually a central document, such as the terms and conditions of a registry or the scheme rules governing a European scheme provide the legally binding framework conditions for system operations, while the adherence to such rules is agreed upon via a dedicated participation agreement signed by both parties (registry and market participant or scheme operator and participating registry).

REGATRACE emphasises the importance of clear and harmonised contractual structures to ensure legal certainty, support market participation, and enable cross-border cooperation.

7.2.3 Recognition and auditing of the registry system

The operation of renewable gas registries should be subject to oversight and auditing to ensure reliability, transparency, and compliance with applicable standards. In line with practices observed in European registry systems and REGATRACE recommendations, registry operators are typically subject to internal and external audits covering system integrity, data handling, and operational processes. More details are provided in chapter 8.2.4 Security.

Auditing ensures that registry processes, including certificate issuance, transfer, and cancellation, are carried out in a consistent and verifiable manner, thereby strengthening market trust and enabling mutual recognition between systems.

Recognition may be required when registries participate in European schemes, where compliance with scheme rules, data standards, and governance requirements must be demonstrated (see chapter 9.2.5 Auditing in the context of scheme participation).

7.2.4 Fee structure

Registry systems typically apply a structured fee model to cover operational and administrative costs. Based on practices observed in European registries, fee structures may include one-time registration fees, annual account maintenance fees, and transaction-based fees for certificate issuance, transfer, or cancellation. In some systems, additional fees may apply for specific services, such as data corrections, audits, or access to advanced functionalities.

Fee levels and structures vary between countries and registries, reflecting differences in market maturity, system complexity, and funding models. Some registries aim to minimise barriers to entry by applying relatively low fees, particularly in early market stages, while others operate on a cost-recovery basis with more differentiated pricing structures. REGATRACE highlights that fee systems should be transparent, non-discriminatory, and proportionate, ensuring that they support market development while covering operational costs.

7.3 Accounts and roles

7.3.1 Introduction to account models and role models

Renewable gas registries are structured around an account-based system in which market participants are represented as account holders. REGATRACE highlights that registries should

define a clear role concept in advance of system development, as roles determine how users interact with the system and which functions they are allowed to perform.

The data for each account are gathered during the registration process of market participants. A typical account model allows the registration of companies (representing a legal entity) and personal accounts (representing a natural person). Several personal accounts can be linked to one company account. This way, several staff members of one legal entity can perform their businesses or in case of staff changes, the company's data stay available.

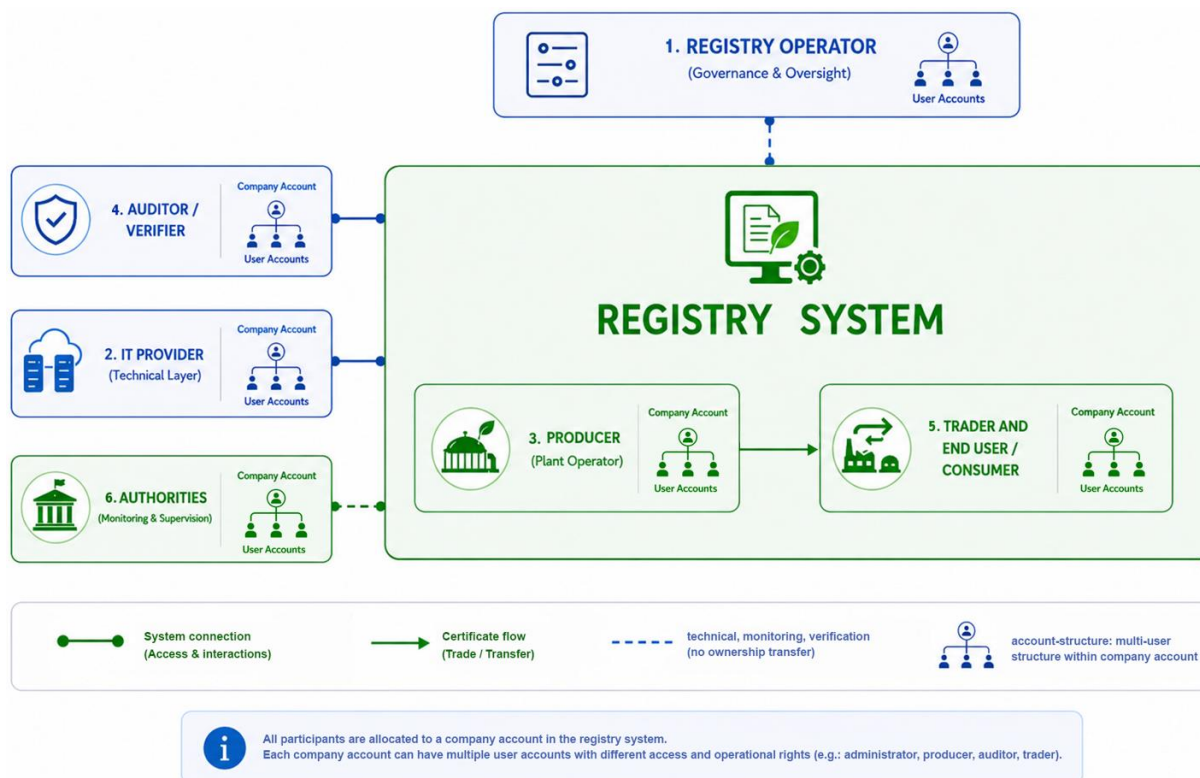


Figure 13: Depiction of the account-based registry system

Registries may allow natural person accounts to hold multiple roles, reflecting the fact that market participants may act in different capacities within the renewable gas value chain. While a company account may be assigned only one role. In addition, registry systems often implement multi-user account structures, where different users within the same organisation are assigned specific permissions (e.g. initiation, approval, or read-only access). This supports internal governance, including the application of the four-eye principle for critical transactions.

Across existing European registries, a consistent set of core roles can be identified: producer (plant operator) and trader. The role of consumers can be stand-alone or a subordinate role of the trader role. A classical registry system developed for all market segments (compliance, regulated and voluntary) also provides additionally the role of auditor (authorised verifier) to reflect the market need of audited data and information, especially in the context of RED-

certified sustainability and GHG emission data to allow biomethane certificates to be used for target compliance.

This clear role-based model is essential to define the rights, responsibilities, and permitted actions within the registry and to ensure secure system operation, clear allocation of responsibilities, to avoid conflicts, prevent misuse and provide transparency.

REGATRACE emphasises that registries should remain flexible to introduce new roles or adjust permissions over time to reflect evolving regulatory requirements, new market actors, or additional use cases. This flexibility is particularly important in the context of emerging renewable gas markets, where new actors (e.g. hydrogen producers, industrial off-takers, authorities for compliance) may require tailored access rights and functionalities.

7.3.2 *Roles: rights and responsibilities*

7.3.2.1 *Producer (plant operator)*

DESCRIPTION: The producer operates the biomethane / renewable gas installation and is responsible for providing production-related data. Certificates are typically issued to the producer's account based on verified injection data.

RIGHTS AND RESPONSIBILITIES: Producers can initiate ownership transfers (and trades) of certificates and may assign auditors to their installations. They also have the right to cancel/retire certificates to signify the end use of the respective renewable gas.

Dependent on the chosen business processes, the auditor is responsible for adding sustainability data or the producer may add such information based on explicitly defined auditing reports.

7.3.2.2 *Auditor / authorised verifier*

DESCRIPTION: Auditors are independent entities responsible for verifying technical, operational, and sustainability-related data. They have to receive permission by a producer to receive access to the producer's account including all their certificates.

RIGHTS AND RESPONSIBILITIES: Their role includes validating input data, confirming biomass, sustainability and GHG emission data and information up to confirming RED-sustainability compliance, and uploading audit reports. Auditors typically have restricted write access limited to verification functions. They represent the only role without any right to execute trades or ownership transfer of certificates. Auditors must not economically benefit from certificates.

7.3.2.3 *Trader*

DESCRIPTION: Traders are market participants who transfer certificates between accounts. They play a key role in market liquidity and optimisation of certificate use across different markets. Trader roles can be taken up by OTC traders, suppliers or their dedicated trading desks. Also, consumers (or end users) could take up the trader role or receive a sub-ordinate role type of the trader.

RIGHTS AND RESPONSIBILITIES: Their rights typically include holding, transferring, and managing certificates within their accounts. They specifically have the right to cancel/retire certificates to signify the end use of the respective renewable gas.

7.3.2.4 *Trader (End user / consumer)*

DESCRIPTION: End users are entities that ultimately use biomethane and may require certificates for compliance, disclosure, or voluntary claims. In some registries, end users do not require a direct account and instead receive proof via traders or suppliers, while in others they may hold accounts to directly cancel certificates.

RIGHTS AND RESPONSIBILITIES: Their rights include holding, transferring, and managing certificates within their accounts. They specifically have the right to cancel/retire certificates to signify the end use of the respective renewable gas.

7.3.2.5 *Authorities and special accounts*

DESCRIPTION: Registries may include dedicated accounts for public authorities, funding agencies, or regulatory bodies. These accounts typically have monitoring or supervisory rights, allowing them to access relevant data for compliance checks, subsidy allocation, or reporting purposes without participating in market transactions.

RIGHTS AND RESPONSIBILITIES: The rights and responsibilities of such specialised accounts must be tailored to specific needs and requests on the respective market they serve. They may include receiving and holding certificates, cancellation/retirement of certificates upon specific use cases such as target allocation or subsidy pay-out.

7.3.2.6 *Registry operator (administrator)*

DESCRIPTION: The registry operator is responsible for the overall management and governance of the registry system, including user registration, account administration, quality assurance, and system maintenance. This role has overarching rights, including the ability to grant access, manage system settings, and ensure compliance with applicable rules. While the operator has overarching administrative rights within the system, it does not participate in market transactions, thereby maintaining neutrality and trust in the system.

RIGHTS AND RESPONSIBILITIES: Registry operators oversee system integrity without engaging in market transactions. Although registry operators theoretically may execute all functions of the registry, they do not have the right to execute ownership transfers (and trades) or audit any certificates. Operators have the right to withdraw certificates upon explicit errors or correction needs and need specific business procedures ready for damage control and in case of error handling. It is a fundamental value of registry systems that the registry operator may not hold or own any certificates and act as market participant. Registry operators may not economically benefit from certificates. Although they can withdraw certificates from the market, this is not equal to a cancellation/retirement of certificates which always represents the end use of the respective physical renewable gas equivalent.

7.3.2.7 *IT provider (system operator / technical service provider)*

DESCRIPTION: In most cases, the technical operation of the registry system is outsourced to a dedicated IT provider, which is separate from the registry operator. The IT provider is

responsible for the development, hosting, maintenance, and technical functioning of the system.

RIGHTS AND RESPONSIBILITIES: From a technical perspective, the IT provider may have access to all system functionalities; however, any execution of critical actions (e.g. data corrections, system interventions, or configuration changes) may only be carried out upon authorised request and instruction by the registry operator. This separation ensures clear governance, maintains control with the operator, and reduces risks related to unauthorised system manipulation.

8 Functional and non-functional requirements of a renewable gas registry

8.1 Functional requirements of a renewable gas registry

8.1.1 *Introduction to functional requirements*

Renewable gas registries must provide the full functionality required to manage certificates across different market segments, including compliance markets, regulated disclosure systems, and voluntary markets. This requires the ability to accommodate different rules and data requirements depending on the intended use of certificates.

Core functions of renewable gas registries for certificate management have to cover the business processes as described in chapters 6.2 and 6.3. These include the registration of production units, issuance of certificates based on verified data, transfer between account holders, and cancellation upon use. The current chapter addresses these functions behind those business processes.

Auditability is another core requirement. Registries must maintain comprehensive audit trails recording all relevant actions, including data inputs, certificate lifecycle events, and user interactions. These audit trails must allow the reconstruction and verification of all transactions and support auditing by competent authorities or third parties.

Throughout all these processes registries must ensure traceability of certificates and provide reporting functionalities to support compliance, disclosure, and voluntary claims.

8.1.2 *Administrative and master data functions*

Standard functions comprise the basic administrative and operational functionalities required for continuous registry operation administered and executed by the registry back office. These functions include the registration and approval of market participants and production units, which fall under master data management, user and role administration.

Master data management is the process of collecting, storing, and maintaining the core information—referred to as master data—that defines the key entities and attributes within a renewable gas registry. Master data include essential, consistent, and shared reference data about all registered participants (such as producers, traders, and consumers), as well as production units and facilities. Master data are referred to as attributes of layer 1 (see also 5.4.2 Attribute layer 1 – Plant-specific attributes), encompassing critical attributes like production capacity, sustainability certification, technical specifications, ownership details, geographic location, and compliance status. Master data management provides a reliable foundation for all account opening and user management, certificate-related processes, including issuance, transfer, and cancellation.

8.1.3 Back Office Processes (Certificate Creation, Auditing)

Back-office-processes include the creation of certificates based on verified production data, as well as ongoing auditing to ensure data integrity and compliance. Registries must validate that production data meets sustainability and greenhouse gas criteria before issuing certificates. Auditing processes involve regular checks and balances to prevent fraud, double counting, or non-compliance with regulatory frameworks.

8.1.4 Certificate lifecycle management functions

8.1.4.1 Introduction on lifecycle management functions

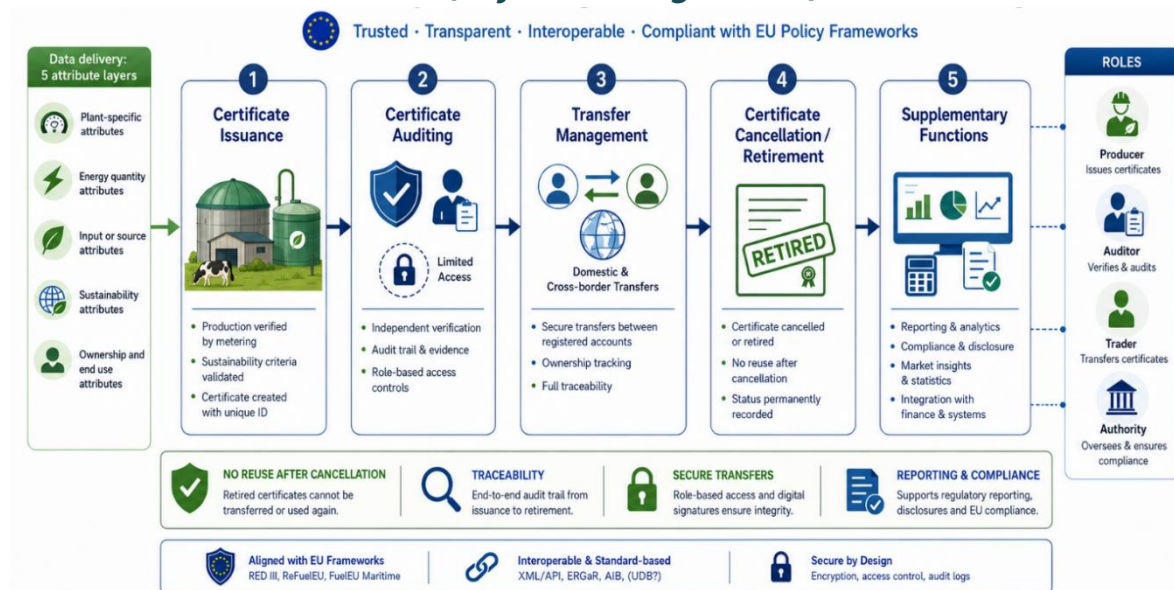


Figure 14: Certificate lifecycle management in renewable gas registries

8.1.4.2 Certificate Issuance

To issue certificates, registries must first receive verified production data, typically based on metering readings from production facilities. Different levels of automation are possible depending on the data volume a registry has to manage and on the available resources. In practical terms, the registry must provide an interface capable of receiving metered injection quantities and, where applicable, related sustainability or audit data from external sources. Such incoming data may be transmitted through predefined exchange formats such as XML, CSV or comparable structured files, or through direct system-to-system interfaces (APIs) with metering, balancing or upstream data management systems.

8.1.4.3 Certificate Auditing

To allow certificates for compliance target allocation, registries must provide dedicated functionalities to support certificate auditing and the controlled involvement of external auditors without compromising ownership integrity or data confidentiality. Auditors require role-specific access rights allowing them to review plant data, production batches,

sustainability documentation, and certificate information only for those installations or certificates for which they have been authorised by the producer. Auditor access must therefore be limited, traceable, and auditors may never hold or transfer certificates themselves.

Registries must support changing auditor assignments over time, as producers may switch auditors in line with periodic certification requirements of recognised voluntary schemes. Flexible user-role management and full logging of auditor validations and confirmations are therefore essential to ensure traceability of which auditor verified which production data for certificate issuance.

8.1.4.4 *Certificate Cancellation / Retirement*

Cancellation or Retirement marks the final use of a certificate, such as for compliance or disclosure, and must be recorded to prevent reuse. The registry system must ensure that any cancelled/retired certificate is taken out of the market (to prevent reuse) but at the same time, no data should be deleted. All cancelled/retired certificates have to stay available for statistics and reporting.

8.1.5 *Transfer Management*

Transfer management functions govern all ownership changes of certificates between account holders, both within the registry and across system boundaries. This includes bilateral transfers between domestic market participants, and interfaces for transfers to external national authorities, connected partner registries, or European cooperation schemes. ERGaR outlines the technical and organisational prerequisites for secure cross-border exchanges, including harmonised data formats and verification steps.

Transfer management must ensure that only eligible certificates are transferred, that all ownership changes are fully documented, and that exports or imports are processed according to harmonised business procedures.

8.1.6 *Supplementary market and reporting functions*

In addition to standard certificate handling, registries often require specific supplementary functions depending on the respective market applications. These may include invoicing and fee management, reporting functionalities for competent authorities and market participants, mass balancing and bookkeeping support, generation of cancellation confirmations, and interfaces for data delivery to subsidy administrators or compliance authorities.

Particularly in multifunctional registry systems, such functions ensure that the registry provides a reliable basis for regulatory reporting, sustainability accounting, and financial settlement.

8.2 *Technical (non-functional) requirements of a renewable gas registry*

8.2.1 *Introduction to technical requirements*

National biomethane registries require robust IT systems that ensure secure, reliable, and auditable operations. Such infrastructure is the key for developing biomethane markets. This

chapter provides insights into fundamental system requirements, architecture and extensibility, standard user procedures and performance requirements.

8.2.2 *Secure data management and user authentication*

At a minimum, registry systems must support secure user authentication and role-based access control, ensuring that only authorised users can access and perform specific actions.

User management must reflect the different roles of market participants, including producers, traders, auditors, and competent authorities where applicable. Each role must be associated with clearly defined permissions, ensuring that actions such as certificate issuance, transfer, or cancellation can only be performed by authorised entities.

Registries must ensure the implementation of a structured data environment, including unique certificate identifiers, consistent data handling, and full traceability of all certificate-related actions. All transactions and data modifications must be recorded to allow reconstruction of the certificate lifecycle.

8.2.3 *System Architecture*

The architecture of a biomethane registry system must reflect the structural complexity of the market it serves. A well-defined data model forms the foundation for the core entities: production units, certificates, accounts, and transactions, capturing relationships inherent to the renewable gas markets. Certificates are linked to production data and their associated attributes; transactions record the transfer of ownership between accounts throughout the full certificate lifecycle.

A fundamental architectural distinction exists between static and dynamic data. Static data, referring to plant specific attributes (layer 1 see chapter 5.4.2) including plant identity, location, and production technology, is established during the registration process and remains unchanged over time. Dynamic data, such as attributes of layers 2, 3 and 4 (see chapters 5.4.3, 5.4.4, 5.4.5) such as production volumes, feedstock composition, and greenhouse gas emission values, vary across production periods and are associated with specific batches. This distinction directly informs the attribute layer design and must be reflected consistently throughout the system.

At the structural level, a modular architecture is recommended, with clear separation between data storage, application logic, and external interfaces. Modularity supports maintainability and scalability and enables flexible deployment to meet evolving external requirements, including regulatory changes or integration with European-level systems such as the Union Database, without requiring to reshape the entire system. This design principle also constitutes a prerequisite for interoperability across national registry systems operating within a common European framework.

8.2.4 *Security*

Biomethane registries operate essential infrastructure for the energy transition, handling and storing sensitive data such as personal and company data of the registered market participants, production volumes, ownership records, and sustainability attributes while facilitating ownership transactions and compliance reporting. To ensure the integrity, security, and

resilience of these systems, a multi-layered approach is essential, encompassing technical, organisational, and legal measures.

This includes the use of encryption for data transmission and storage, secure communication protocols, and protection against unauthorised access or cyber threats. Authentication and authorisation mechanisms must be robust and aligned with best practices.

Registries are required to review and implement all relevant national and EU regulations to fulfil ensure and maintain compliance with applicable data protection standards, particularly regarding the handling of personal and commercially sensitive data. Table 8 provides a list of relevant frameworks.

Compliance with the General Data Protection Regulation (Regulation (EU) 2016/679, GDPR) is mandatory for biomethane registries, as they process personal data of account holders. Registries should review the implementation of data encryption (AES-256) and pseudonymisation, while ensuring data subjects can exercise their rights, including access and erasure requests. In addition, a Data Protection Officer (DPO) must be appointed for large-scale data processing.

Key EU regulations include the Directive (EU) 2022/2555 on measures for a high common level of cybersecurity across the Union (NIS2), which mandates incident reporting, risk management, and supply chain security for critical entities.

The Regulation (EU) 2022/2554 on digital operational resilience for the financial sector (DORA) further imposes requirements for ICT risk management, business continuity, and incident reporting on systems involved in financial transactions such as trading.

Technical safeguards are fundamental to mitigating cyber threats, data breaches, and fraud. Role-Based Access Control (RBAC) with Multi-Factor Authentication (MFA) ensures that users have the minimum necessary permissions, while Intrusion Detection/Prevention Systems (IDS/IPS) and DDoS protection (e.g., via cloud-based scrubbing services) safeguard against external attacks.

Regular penetration testing and vulnerability assessments, as well as compliance with ISO/IEC 27001:2022 for Information Security Management Systems (ISMS), provide a structured framework for continuous improvement.

Organisational measures further strengthen security by addressing human and procedural risks. A well-defined Information Security Policy (ISP) should outline roles, responsibilities, and acceptable use of registry systems, complemented by mandatory cybersecurity training and phishing simulations for staff and users. An Incident Response Plan (IRP) must detail steps for detection, containment, eradication, recovery, and lessons learned, with 24/7 monitoring and automated alerts for suspicious activities. Third-party risk management is equally critical, requiring vendor assessments and contractual safeguards, such as the right to audit and data breach notification clauses. For advanced resilience, registries may explore blockchain for immutability, Zero Trust Architecture, and AI-based anomaly detection to enhance security and trust in cross-border certificate trading.

Table 8: Relevant standards and frameworks for Biomethane Registry security

Standards & Frameworks	Relevance	Key Requirements
ISO 27001	Core standard for Information Security Management Systems (ISMS).	Risk assessments, access control, incident management, continuous improvement.
ISO 27017	Cloud security best practices.	Secure cloud configurations, data encryption, access logging.
ISO 22301	Business continuity management.	Disaster recovery plans, redundancy, backup systems.
NIS2	EU-wide cybersecurity for critical infrastructure.	Incident reporting, risk management, supply chain security.
GDPR	Data protection for personal data.	Encryption, pseudonymization, right to erasure, DPO appointment.
DORA	Operational resilience for financial entities.	ICT risk management, penetration testing, business continuity.

8.2.5 Technical requirements on interoperability and interfaces

Interfaces technically support secure data transmission and enable automated data delivery from metering systems for Attribute layer 2 – Energy quantity attributes (see chapter 5.4.3). This provides basis for certificate issuance, as described in chapter 8.1.4.2.

Additionally, interoperability with other national or European systems is primarily achieved through the adoption of established data communication standards in the gas sector, such as Edig@s or other European message formats, ensuring consistent data semantics, syntax and exchange logic across systems. Standardised interfaces built on these formats, support secure data synchronisation and exchange, mutual authentication of communicating systems, and validation of exchanged data.

Exchange of valid data relies on standardised data formats (e.g. JSON, XML or CSV), harmonised attribute lists and exchange protocols to ensure data compatibility enabling consistent transfer, interpretation and use across systems. This is a prerequisite for cross-border transfers: integration with European schemes, and interaction with EU-level systems such as the Union Database.

REGATRACE emphasises that interoperability is not only a technical issue but relies on harmonised data structures, communication protocols, and transaction logic. Registries must therefore ensure compatibility with external systems from the outset to avoid complex adaptations at a later stage.

8.2.6 Level of automation and system controls

Process automation is essential to ensure efficiency, scalability, and reliability. It contributes to interoperability with other systems and reporting obligations. On the one hand, routine processes such as Certificate lifecycle management **functions** (see chapter 8.1.4) should be automated wherever possible. Automation reduces the risk of human error and enables timely

processing of large volumes of transactions. Such automation approaches must be based on predefined rules and validated data inputs.

On the other hand, for small markets with a low number of market participants and limited transactions, less financial resources and less experienced operators, an initial system design including manual or semi-automated processes may be appropriate and can support capacity building and gradual market development.

Regardless of the level of automation, robust control mechanisms must be implemented such as validation checks for data completeness and correctness, verification of eligibility criteria before certificate transfers, and monitoring of unusual transaction patterns. Systems should also include alert mechanisms to notify operators or users of potential issues, such as expiring certificates or inconsistencies in reported data.

The appropriate level of automation should be adapted to the maturity of the market. While full automation is not an objective in itself for the establishment of a renewable gas registry for certificate management, a certain degree of harmonisation and automation is necessary to ensure interoperability and support market integration. Application programming interfaces (APIs) are commonly used to enable automated data exchange, reducing manual intervention and improving efficiency.

8.2.7 *Extensibility and scalability*

System architecture design of data models enables extensibility without requiring fundamental system redesign. In practice, **EXTENSIBILITY** means the integration of additional attributes, the adaptation of data field types for attributes, the extension of enumeration lists (content of dropdown lists) or the addition of certificate types. This is particularly relevant in view of evolving regulatory frameworks and the increasing relevance of other renewable gas types, such as hydrogen or RFNBOs.

SCALABILITY refers to the registry system's capability of increasing numbers of market participants, certificates, and transactions over time. This includes the ability to process higher data volumes, support more frequent data exchanges, and maintain system performance under growing demand.

Research findings of the REGATRACE project suggest that modular system architecture is best suited for both extensibility and scalability as it allows for individual update or adoption of individual components. More details and system architecture are discussed in chapter 0.

8.2.8 *Availability, performance and environments*

Registry systems must ensure high availability and reliability, as they represent core infrastructure for renewable gas markets. Systems must be designed to minimise downtime and ensure continuous operation, even under increasing system load.

This includes the implementation of backup systems, redundancy mechanisms, and disaster recovery procedures.

In this context, a distinction is typically made between a **PRODUCTION SYSTEM** (live system used for real transactions and certificate management) and a **TEST SYSTEM** (a separate environment used for development, testing, and validation of new functionalities or updates). Test systems allow operators to simulate system changes, verify interoperability with external systems, and test recovery procedures without affecting live operations. This separation is essential to ensure

safe implementation of updates or bug fixes and reliable recovery of system functionality in case of technical failures.

Performance requirements must ensure that transactions can be processed within reasonable timeframes, even during periods of high activity. REGATRACE highlights the importance of system resilience, including the ability to maintain operations in case of technical failures and to restore system functionality within defined recovery time objectives.

8.2.9 Maintenance, operations and IT governance

Ongoing maintenance and support are essential to ensure the long-term functionality and reliability of registry systems. This includes regular support, system monitoring, system updates, bug fixing, incident handling, and reporting as well as adaptation to changing regulatory requirements.

Registries must establish clear processes for system maintenance, including responsibilities for technical operation, incident management, and user support. This may involve in-house teams or external service providers, depending on the chosen implementation architecture (see chapter 0). Clear governance structures must ensure that responsibilities between registry operators and IT providers are well defined, particularly in cases where system operation is outsourced.

In addition, user support functions must be provided to assist market participants in using the system, resolving issues, and understanding regulatory requirements

From an IT governance perspective, registries should also implement structured release management processes, ensuring that system updates are tested, documented, and deployed in a controlled manner. This includes the provision of dedicated test environments, allowing market participants to validate upcoming changes prior to deployment and to provide structured feedback before updates take effect in the production system. Monitoring tools should be used to track system performance, detect anomalies, and support proactive system management.

8.2.10 Operational logging (operator monitoring and control)

Registry systems should include a comprehensive operational logging that enables the registry operator to monitor, review, and verify all relevant system activities. All actions performed within the registry, including user activities, certificate lifecycle events (issuance, transfer, cancellation), data modifications, and system-level interventions must be recorded in the logs. The operational log must ensure full traceability of all processes, allowing the reconstruction of events at any point in time. This is essential for auditing purposes, error analysis, and the investigation of potential irregularities. Logs should include time stamps, user identification, action type, and affected data elements.

Access to the operational log should be restricted to authorised personnel of the registry operator, ensuring data confidentiality while enabling effective system oversight. In addition, the system should support filtering, search, and reporting functionalities, allowing operators to efficiently analyse system behaviour and identify anomalies.

The operational logging is closely linked to broader audit trail requirements and supports compliance with regulatory obligations, as well as the overall integrity and credibility of the registry.

8.2.11 User Experience (UX) and graphical user interface (GUI)

A good user experience is essential for the effective operation of registry systems, as well as for providing valuable market services. The graphical user interface (GUI) must be designed to allow intuitive navigation, clear presentation of information, and efficient execution of tasks.

Users must be able to easily access relevant information, including certificate holdings, transaction history, and account status. Key processes such as certificate transfer or cancellation should be straightforward. All business processes should be documented in user manuals with guidance, step-by-step instructions and screenshots. This documentation can be made publicly available on the registry's website or exclusively to market participants via a shared space within the website or the registry system.

A well-designed user interface reduces the risk of user errors, increases efficiency, and supports broader participation in the market, particularly for new or less experienced users.

8.2.12 Use of Web 3 and Blockchain Technology for registries

Currently, registries utilise Web2 infrastructure. However, emerging Web3 technologies and the tokenisation of real-world assets on public blockchains can make a strong use case in the future.

Regulatory clarity regarding the Markets in Crypto-Assets (MiCA) regulation in the EU has transitioned from a preparation phase to full enforcement.

Emerging privacy-focused zero-knowledge (ZK) blockchains promise key industrial compliance features, such as selective disclosure, programmable privacy, tamper-evident audits, and interoperability. These features are critical for regulatory compliance, as they enable verifiable transactions without exposing sensitive user data.

Many of these capabilities are essential for an integrated and secure renewable gas market.

Blockchain technology can be used at different levels: from simply anchoring cryptographic signatures on public chains to prove the immutability of records in Web2 databases, to full on-chain functionality for registry operations, such as recording production data, issuing certificates, or transferring asset ownership.

In addition to well-established decentralised public blockchains, there is also the option of using permissioned blockchains, such as enterprise-grade Hyperledger Fabric. In such a setting, each registry acts as an identity provider and as a peer for transaction endorsement and validation.

9 Aspects on interoperability of registry systems

9.1 Introduction

Interoperability is a central requirement for the effective functioning of renewable gas certificate systems, particularly in the context of an emerging European biomethane / renewable gas market.

Registries must be able to exchange data with external systems, including certification schemes, other national registries, and EU-level databases. Interoperability is relevant across multiple system levels. At national level, registry systems may need to interact with Guarantee of Origin issuing bodies, biofuel registries, hydrogen registries, or national emissions trading system databases. At European level, interaction with common schemes such as the ERGaR Certificate of Origin scheme, the AIB EECS framework, and the Union Database is required.

The importance of interoperability lies in its role in preventing double counting and double claiming, while enabling market harmonisation and efficient cross-border trade and achieving the higher goal of biomethane for compliance target allocation. To achieve this, interoperability must be addressed across several dimensions, including organisational and administrative structures, functional system requirements, IT interfaces, and contractual arrangements between participating entities.

9.2 Requirements for scheme participation

9.2.1 *Cross-border ownership transfers*

Cross-border ownership transfers of renewable gas certificates are a key enabler of a European market and require clearly defined rules, aligned systems, and mutual recognition between participating systems/registries.

Several preconditions must be fulfilled for cross-border ownership transfers to function properly. These include the use of harmonised certificate attributes, alignment of sustainability status and eligibility criteria, and consistent rules for certificate validity and cancellation.

Harmonisation platforms as operated by European schemes (ERGaR CoO scheme and AIB EECS framework) play an important role in facilitating cross-border ownership transfers.

In this model, national registries connect to a central platform via an interface. This enables the use of harmonised rules, standardised attributes, and consistent business processes across all participants. It significantly reduces long-term operational costs and minimises risks associated with fragmented system landscapes. Research of the REGATRACE project indicates that this approach represents the preferred and future-proof solution for cross-border interoperability, compared to bilateral agreements.

9.2.2 *Organisational requirements for scheme participation*

Participation in a European certificate scheme requires the establishment of clear organisational structures and alignment with common rules. Usually, these rules are developed in a cooperative process between engaged national registries or in case of well-established schemes, the scheme operator will provide draft or updated rules that have to be agreed on

by all engaged registries. Such harmonised rules are summarised in a rulebook which describe the scheme rules (e.g. ERGaR CoO Scheme Rules or AIB EECS Rules). Registries have to ensure consistency with the requirements of the respective scheme rules to ensure compatibility between all participating systems/registries.

In addition, registries must implement standardised data exchange formats and define clear roles and responsibilities for all actors involved. This includes the registry operator, issuing bodies, auditors, and the central scheme operator. Each actor must have clearly defined tasks in the processes of data provision, verification, certificate issuance, and transfer.

Contractual arrangements are a key component of scheme participation. National organisations must enter into formal agreements with the central scheme, defining rights and obligations, operational procedures, and liability provisions. These agreements ensure legal certainty and provide the basis for coordinated operation across different jurisdictions.

Financial aspects also play a role, as cross-border transactions may involve fees or cost-sharing mechanisms that must be agreed upon between participating parties (see also chapter 7.2.4 Fee structure).

The REGATRACE project developed templates for scheme rules, scheme agreements, and national rule books (registry terms and conditions), which may significantly reduce implementation time and legal uncertainty for newly established registries to navigate the process of becoming a scheme participant.

9.2.3 *Business processes for cross-border transactions*

Cross-border certificate ownership transfers require not only technical connectivity but also harmonised business processes. These include transfer validation and confirmation procedures, synchronised handling of certificate status changes, and clearly defined cancellation/retirement logic. In addition, processes for error handling and emergency situations must be established to address discrepancies or system failures. National registries must integrate these harmonised processes into their internal procedures while maintaining the flexibility to address purely national requirements.

Cross-border certificate ownership transfers are commonly called an export/import-process, while the business processes behind reflect several steps on the exporting as well as importing registry sides. The export/import process as such, is an information and data transfer which allows the retirement/cancellation of one energy amount in the production market while documenting the corresponding energy amount in the consumption market. In this way, the export/import process ensures that the certificate and related attributes exist in only one system (market) at any given time.

The export represents, in fact, a cancellation/retirement process of the certificate in the production market/country which implies that the respective biomethane consignment (and its related energy amount, renewable and sustainable value) have been taken out of the producing's registry's market.

Then, an information and data transfer happens between the exporting and importing registry, based on standardised business processes and data models.

The import is processed by the importing registry based on the information and data received of the respective cancelled/retired certificate. Following, a new certificate is issued based on the transferred biomethane consignment (and its related energy amount, renewable and sustainable value).

9.2.4 *Technical requirements for scheme participation*

Participation in a European scheme requires registries to fulfil a set of technical requirements ensuring interoperability, data integrity, and secure operation. Registries must implement standardised data formats and harmonised attribute lists as defined by the scheme rulebook, allowing certificate data to be consistently interpreted across participating systems.

A central requirement is the implementation of interfaces enabling automated data exchange with the scheme or central platform. These interfaces must support secure communication protocols, and synchronisation of certificate status across systems. A decision has to be made on the acceptable duration of business processes, depending on the number of manual steps involved, this can be from several working days to near-real-time processing of transactions. Measures have to be taken that certificates are not duplicated and that ownership changes are consistently reflected.

High standards of data security and system availability are essential. This includes authentication and authorisation mechanisms, protection against unauthorised access, and the ability to maintain system performance under increasing transaction volumes.

Registries must further ensure the use of unique certificate identifiers that remain valid across systems, enabling traceability throughout the entire lifecycle, including cross-border transfers. In addition, systems must support validation mechanisms that check compliance with scheme rules before transactions are executed.

9.2.5 *Auditing in the context of scheme participation*

In the context of participation in European schemes, auditing requirements are more formalised and harmonised. Scheme operators of cross-border ownership certificate transfer systems, define specific technical, organisational, and procedural criteria that participating registries must fulfil. This includes compliance with a common rulebook, implementation of standardised data formats, and adherence to defined business processes.

An initial audit should be performed before admission of a new registry. Follow, regular audits and compliance checks ensure that national registries correctly implement these requirements and maintain compatibility with the overall scheme. A central auditing by the scheme operator or an independent third party commissioned by the operator is conceivable as well as mutual auditing of participating registries.

REGATRACE highlights that such auditing frameworks are essential to ensure mutual trust, prevent inconsistencies, and enable reliable cross-border certificate transfers.

9.3 Requirements for connection to EU-systems (Union Database)

Interaction with EU-level systems, in particular the Union Database, adds an additional layer of complexity. The Union Database aims at tracking the proof of sustainability of renewable fuels

and their sustainability characteristics along the supply chain, particularly for compliance with Renewable Energy Directive requirements.

Renewable Gas Registries for Certificate Management are generally well-equipped to act as data deliverer to the Union Database, considering they receive, store and process production and injection data (energy quantities) as well as biomass and sustainability information (for details see chapter 5.3.3).

To align these data structures and business processes with the data structures and reporting requirements of the Union Database compatibility of data models, as well as clearly defined interfaces for data exchange is required. A key requirement will be the consistency between certificate data and physical supply chain data recorded in the Union Database. Registries should be equipped to ensure that issued certificates correspond to verified and reported volumes and that no discrepancies arise between parallel tracking systems. In addition, registries may support synchronisation of mass balance information where applicable, ensuring that the accounting of renewable gas remains consistent across both systems.

Finally, organisational coordination between registry operators, certification schemes, and competent authorities is required to ensure proper alignment of reporting obligations and verification processes.

It should be noted that the implementation of the Union Database, particularly for gaseous energy carriers, has been postponed several times. As of the time of writing, no fully functional UDB module for gaseous energy carriers (biomethane) is available, and key design decisions regarding data models, access protocols, as well as the interaction between national systems and the UDB remain under development.

Considering these uncertainties, national registries cannot be designed with UDB connectivity as a prerequisite for operation. Instead, a registry-led approach is recommended, in which national systems are developed with full standalone functionality and UDB interfaces are incorporated as modular, activatable components. This ensures continuity of national certificate management functions regardless of the pace of EU-level system development, while preserving the capacity for seamless integration once the Union Database reaches operational maturity.

9.4 Requirements for connection to a dashboard (bid/ask-platform without ownership transfer)

9.4.1 *Background on dashboard functions without ownership transfer*

Dashboards (or bid/ask platforms) without ownership transfer serve as market facilitation tools that provide transparency on supply and demand without directly executing certificate transactions. Certificates remain within the registry system, and any subsequent transaction must be executed within the registry or via a connected scheme. These platforms allow market participants to publish offers and requests for certificates, thereby improving price transparency and market liquidity.

The former REGATRACE project provides deeper insights in REGATRACE D2.6 *Report on design study and technical specification for dashboard and trading platform*. Five different dashboard systems were analysed via desk research and structured interviews (see REGATRACE D2.6, chapter 6). Four of those five platforms were specifically designed to handle biomethane. The one dashboard platform which has been established for power certificate system specifically, still has solid market integration, while all biomethane related platforms were closed since the REGATRACE report was published. Later, a new platform, specifically designed for biomethane and renewable gases was established by CEGH Central European Gas Hub which is called CEGH Green Gas Platform¹. It is well known in Europe and recognises several established national biomethane registries and different certificate types. The platform allows a registration for market parties only if they can prove that they are active registry account holders. Following, the platform explicitly allows the posing of bid and ask offers and enables easier match making and strongly contributes to market transparency.

Still, most biomethane deals today have bilateral and OTC (over the counter) character and the matchmaking or trading possibilities still encounter a rather illiquid market.

9.4.2 Organisational requirements for dashboard

The dashboard acts rather as an informational layer than a transactional system. A registry system could also provide an integrated dashboard function to allow registered market participants to offer their bids and asks to other registered account holders.

A direct connection to a registry is not an absolute requirement for the function but is also possible and requires clearly defined roles and responsibilities between the registry operator and the dashboard platform provider. Agreements must define how data is shared, which information is displayed, and how confidentiality and data protection are ensured.

Market participants must consent to the publication of relevant data, such as available certificate volumes or indicative prices. Governance rules must ensure that information provided on the platform is accurate and does not lead to misleading market signals.

9.4.3 Business processes for dashboard

As dashboards do not perform ownership transfers, they have their own, stand-alone type of business processes to provide bid and ask offering. Once a transaction is agreed between market participants, the actual transfer must be executed through the registry or via a scheme-based process. Those business processes related to ownership transfer and tracking, remain within the registry environment. However, if a dashboard is aligned with registry processes and market models, it may provide the most user-friendly version to market participants by ensuring that displayed information reflects actual certificate structure and availability.

9.4.4 Technical requirements for dashboard

In case a dashboard is a stand-alone version, the technical requirements do not have to be synchronised with registries. However, aligning data models, such as attribute lists, can be a user-friendly market service.

¹ <https://www.cegh.at/en/greengas/>

In case a dashboard and registry are connected, the technical perspective requires the implementation of interfaces that allow the controlled data synchronisation, e.g. only market participants with sufficient biomethane certificates (energy amounts) available on their registry account may publish a bid offer or only those market participants with sufficient sustainability certification may publish a bid or ask offer. While the dashboard functions are prevented from executing any unintended interaction that could affect certificate ownership or registry operations. These interfaces must ensure that only relevant and authorised data is shared, while maintaining data integrity and security. The separation between informational and transactional functions must be strictly maintained at system level.

9.5 Requirements for connection to trading platform (bid/ask-platform with ownership transfer)

9.5.1 *Background on functions of a trading platform with ownership transfer*

Trading platforms with ownership transfer enable the execution of transactions directly within or in connection with registry systems. These platforms allow market participants to buy and sell certificates, with ownership changes executed as part of the trading process.

Such platforms increase market efficiency and liquidity but require a high level of integration with registry systems to ensure that transactions are executed securely and in compliance with applicable rules.

The former REGATRACE project provides deeper insights in report D2.6 *Report on design study and technical specification for dashboard and trading platform*. There was no and there is to date no trading platform with ownership transfer available for biomethane or renewable gas certificates. Comparable systems are not specific for renewable energy but can be found at gas stock exchanges (ICE, EEX, CEGH, etc.) or power stock exchanges (EEX, EPEX, EXAA, etc).

9.5.2 *Organisational requirements for a trading platform with ownership transfer*

The operation of trading platforms with ownership transfer requires a clearly defined organisational structure that involves

- the registry operator (for certificate management and ownership transfer),
- the trading platform provider (for bid/ask offers and information to registry operator to execute ownership transfer), and
- participating market actors.

Each of these three roles carries distinct responsibilities, but their processes, data flows, and accountabilities must mesh seamlessly. Ownership transfers will only be executed reliably if all three sides perform interlocked business processes and have to fulfil all regulatory

requirements. This requires clearly defined organisational arrangements covering roles, responsibilities, data exchange, and liability between the three parties.

Certificate transactions executed via a trading platform have direct effect on the account balances or registries and the ownership of certificates. Thus, responsibilities for transaction initiation, execution and confirmation have to be clearly defined and contractually agreed. These contractual arrangements should also regulate dispute management, liability in cases of failed transactions, technical errors, delayed settlements, or incorrect data processing.

Beyond the contractual layer, robust governance structures are required to ensure that all transactions executed via the platform remain fully aligned with the applicable registry and market rules. This includes secure participant authentication, the enforcement compliance rules and any cancellation and transfer restrictions. Special attention has to be paid to prevent misuse, double-claim or market manipulation.

If the trading platform also facilitates cross-border transactions or transfers under a European cooperation scheme, additional coordination with the respective scheme operator becomes necessary to ensure consistency with harmonised transfer procedures and timing requirements.

9.5.3 *Business processes for a trading platform with ownership transfer*

Trading platforms must be fully aligned with registry business processes to ensure that ownership transfers are executed in alignment. This includes validation of certificate eligibility, confirmation of transaction details, and synchronised updating of registry accounts.

For cross-border transactions, the platform must ensure compatibility with scheme-based processes, including export and import procedures between registries. This requires coordination with scheme rules and timing of transactions to avoid inconsistencies.

Error handling and reconciliation processes are particularly important in this context, as failed or incomplete transactions may have financial and regulatory implications.

9.5.4 *Technical requirements for a trading platform with ownership transfer*

The integration of trading platforms requires robust technical interfaces that allow secure and automated execution of transactions. In the best case, such interfaces should support synchronous validation, confirmation, and settlement of trades, ensuring that ownership changes are immediately reflected in the registry. However, most renewable gas registries for certificate management today are not fully automated and are operated including some manual steps in business processes.

Systems must implement strong authentication and authorisation mechanisms, ensuring that only authorised users can initiate transactions. In addition, audit trails must record all actions to enable traceability and verification.

Interoperability with other systems, including schemes and EU-level databases, should also be ensured where relevant. The technical design should therefore support both transactional efficiency and regulatory compliance.

9.6 Technical requirements on interfaces for interoperability

The level of automation should be discussed be suited to different operational needs considering market volume and liquidity, number of transactions and financial resources, as described in chapter 8.2.6 Level of automation.

If a high automation level is required or chosen to technically support interoperability, registry systems must implement technical interfaces that enable communication with external systems (other registries, certification schemes, European platforms, and the Union Database). These interfaces are typically realised through application programming interfaces (APIs), which allow for easier, fast, automated and secure data exchange between systems.

A key prerequisite for interoperability is the use of standardised data formats and harmonised attribute lists. Data is commonly exchanged in structured formats such as XML or JSON, whereby other formats such as CSV may also be used for simpler data exchanges or manual processing workflows.

REGATRACE highlights that harmonisation ensures consistent data interpretation and that standardisation is a key prerequisite for efficient cross-border transactions and system integration.

Interfaces may support different modes of data exchange, each suited to different operational needs. In real-time communication, data is exchanged immediately and the system responds without delay. This is particularly relevant for certificate transfers, where prompt confirmation is required. In batch-based communication, data is collected over a defined period and transmitted at scheduled intervals, which is common for periodic reporting or large-scale data submissions.

A further distinction concerns the direction of data flow. In a server-driven model, the registry system actively pushes information to connected parties as soon as a relevant event occurs, for example notifying a market participant of a completed certificate transfer without requiring any action on their part. In a client-driven model, the connected party actively requests, or pulls, data from the registry at defined intervals or on demand. Both models have their place depending on the use case: event-based notifications are typically better suited to a push approach, while data retrieval for reporting purposes may follow a pull pattern.

Regardless of the communication mode or data flow direction, all interfaces require robust validation, authentication, and error handling mechanisms to ensure data integrity and system stability.

10 Registry architecture options

10.1 Practical IT development options for registries

Countries establishing national biomethane registries can choose between different implementation approaches, depending on their technical capabilities, human and financial resources, and strategic objectives.

One option is the development of an in-house system, which allows full control over system design and functionality. However, this approach requires significant technical expertise and resources, as well as ongoing maintenance and development capacity. The risks on conflict of interest have to be analysed in such specific cases.

Alternatively, registries may rely on outsourced solutions provided by specialised IT service providers. This can reduce development time and costs, while leveraging existing expertise and proven system architectures. However, it requires clear contractual arrangements and governance to ensure compliance with regulatory requirements.

A third option is the use of shared systems or services (SaaS – Software as a Service), which may be particularly relevant in the context of European harmonisation efforts. Such approaches can reduce costs and facilitate interoperability but may limit flexibility in addressing specific national requirements.

Independent of the chosen approach, multi-phase implementation is recommended. This may include the use of test systems, pilot phases, and gradual onboarding of market participants. Such an approach allows for the identification and resolution of technical and operational issues before full-scale deployment, thereby reducing risks and increasing system reliability.

10.2 7 identified main system administration types

10.2.1 Introduction

Based on REGATRACE knowledge on registry set-up and system design, in combination with the unique data acquisition via the BIOMAPE questionnaire on currently existing and under-development systems in Europe, this report could develop a system typology for renewable gas registries for certificate management that has never before been described in Europe with such detail, precision, and practical background information. Consequently, BIOMAPE can categorise renewable gas certificate systems in Europe into seven administration types, reflecting different policy objectives, market designs, and levels of system integration. A detailed overview is shown in Table 9.

Issuing Bodies for Guarantees of Origin (Type 1) and Biofuel Registries or Databases (Type 2) address clearly defined regulatory functions, namely consumer disclosure through Guarantees of Origin and RED compliance through Proofs of Sustainability. Hybrid Systems (Type 3) and Parallel Systems (Type 4) reflect the growing need to serve multiple certificate types, market segments, and legal requirements at the same time. However, such fragmented structures also increase the risk of double claiming and double counting.

To provide solutions, this report presents three additional system types with the goal to provide a comprehensive data collection and overview. No such system types are applied in Europe at this point to mitigate risks of double counting. However, BIOMAPE will support and advise target countries over the project lifetime and may help the introduction of such systems in Europe.

Production Databases (Type 5) or Data Centers (Type 6) are important complementary system elements which can be applied when already existing infrastructures need to be connected and data harmonised. These system types can mitigate double-counting risks by establishing central data management, improving cross-system validation, and creating a more consistent basis for target allocation and regulatory oversight. The more advanced architectures, namely Data Centers (Type 6) and Fully Integrated Registry Systems (Type 7), respond to the increasing complexity of fragmented national landscapes. A Data Center (Type 6) can improve coordination across existing registries by harmonising data, reducing interfaces, preventing double counting, and supporting target allocation without abolishing established systems. Fully Integrated Registry Systems (Type 7) go one step further by combining all major functions within a single infrastructure, offering the highest level of transparency and efficiency, but also requiring the greatest degree of governance, technical coordination, and institutional alignment.

This chapter provides a description of these 7 system types, relating them to their primary purpose, manageable certificate types, tracking methods among others. They are reviewed concerning their ability to handle complex data sets and their advantages and limitations are discussed.

The analysis on which country can be associated with which system type precedes this chapter and can be found in chapter 2.4.4 the National registry landscapes can be classified into recurring system types which is part of the section on Key Findings and Registry Design Implications under chapter 2.

Table 9: Overview and comparison of 7 types of system setups according to BIOMAPE

Criterion	Type 1 GO Issuing Body (GO-IB)	Type 2 Biofuel Registry / Database	Type 3 Hybrid System	Type 4 Parallel Systems	Type 5 Production Database	Type 6 Data Center	Type 7 Fully Integrated System
Primary Purpose	GO issuance, transfer, cancellation	Compliance (RED sustainability & GHG)	Compliance, disclosure & voluntary markets	Sector-specific functions in separate systems	Comprehensive production tracking	Harmonise parallel registries; prevent double counting; central reporting & target allocation	All functions in one integrated system
Certificate Types	GO	PoS	GO, PoS, CoO and others	GO / CoO / PoS in separate systems	None (data only)	GO, PoS, CoO and other data from connected registries	GO, PoS, CoO and others
Scope of Volumes	Only volumes for which GOs are requested	Volumes relevant for compliance	Multiple market segments and use cases	Different systems for different market areas and functions	All renewable gas production and injection	Volumes documented across multiple connected registries	All production, certificates and market uses
Tracking Method	Book-and-claim (decoupled)	Mass balancing (along supply chain)	Book-and-claim (GO) + Mass Balancing (PoS)	Varies (BoC for GO, MB for PoS)	Physical data recording (from grid operators)	Cross-registry validation + data harmonisation	Book-and-claim + Mass balancing
Regulatory Link	Art 19 RED; not eligible for RED target compliance	Directly linked to RED compliance	Supports compliance and disclosure	Different authorities and frameworks	Provides data for multiple authorities	Supports RED compliance, UDB interaction & national oversight	Supports all compliance, disclosure & market needs



Criterion	Type 1 GO Issuing Body (GO-IB)	Type 2 Biofuel Registry / Database	Type 3 Hybrid System	Type 4 Parallel Systems	Type 5 Production Database	Type 6 Data Center	Type 7 Fully Integrated System
System Integration	Often national; linked to EU disclosure schemes	Future connection to Union Database	National systems; links to EU schemes possible	Limited interoperability between systems	Native data; interfaces with authorities	High; one interface per registry to the central Data Center	High; interfaces with all relevant national & EU systems
Data Complexity	Low (basic attributes)	High (feedstock, GHG, controls, tracking, etc.)	Medium to high	Varies by system	High (production, operators, certification data)	High; harmonised data models, attributes & validation rules	Very high (all data types in one system)
Typical Advantages	Simple, low- cost, easy to implement	Regulatory compliance, robust sustainability tracking	Flexible, multi- purpose, future-ready	Flexibility per sector, sectoral autonomy	Complete data foundation, cost-efficient data collection	Fewer interfaces; preserves registry autonomy; better transparency	Full transparency, efficiency, no duplication, future-proof
Key Limitations	Limited to disclosure, no compliance use	Compliance with transport targets, possible for blending obligations, quotas, ETS	Requires strict separation and governance	Fragmentation, manual alignment, inefficiencies	No certificate management, not a trading system	Strong governance needed; complex harmonisation & dispute resolution	High complexity, cost, needs strong coordination



10.2.2 Issuing Bodies for Guarantees of Origin (GO-IB) (type 1)

GO-based systems are primarily designed for disclosure purposes and follow the model established under Article 19 of the Renewable Energy Directive (RED II / RED III). Details on GOs are described in chapter 5.5.4.

The design of an Issuing Body system reflects the function of GOs as disclosure instruments, rather than mandatory tracking tools for regulatory compliance. These systems are based on the book-and-claim principle, allowing full decoupling of physical gas flows from certificate ownership. GO Issuing Bodies are designed to foster trade via the book and claim mode (see chapter 6.4.2). Since GOs are a separate certificate system from target compliance, Issuing Bodies mostly do not provide any mass balancing functions which are in contrast with book and claim modes. To cover target accounting under RED, a parallel system is needed for compliance purposes, typically based on Proofs of Sustainability (PoS) and mass balancing requirements. Consequently, GO systems do not represent comprehensive tracking systems for renewable gas production but document the share of production for which certificates are requested and issued. While they fulfil important registry-like functions—such as GO issuance, transfer, and cancellation—they only partially cover the objectives of a full registry system for certificate management, as they do not ensure complete accounting of all renewable gas volumes within a market. To fulfil the full range of policy objectives effective design of GO issuing bodies (Type 1) should implement interfaces alongside Proofs of Sustainability and nationally defined certificates or evaluate the integration with a production registry (type 5) or a data center (type 6).

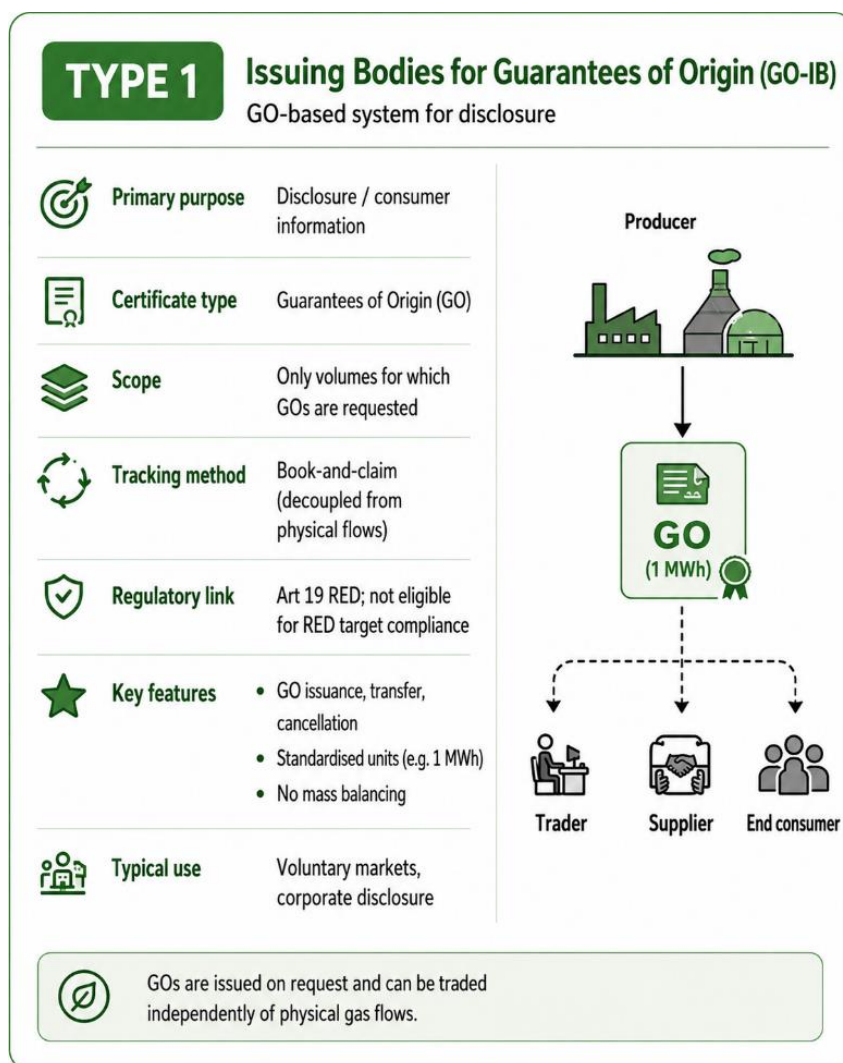


Figure 15: System design type 1: Issuing Bodies for Guarantees of Origin (GO-IB)

10.2.3 Biofuel registries or databases (type 2)

Biofuel registries are designed to support compliance with Renewable Energy Directive targets, originally and particularly for liquid sustainable biofuels in the transport sector. These systems are centred around the documentation and management of Proofs of Sustainability (PoS), which confirm that renewable fuels meet the sustainability and greenhouse gas (GHG) emission saving criteria defined in Articles 25–31 of the RED framework. They are closely linked to mass balancing requirements, ensuring that sustainability characteristics and GHG emission savings are tracked along the supply chain. They typically rely on detailed input data, certification schemes, and auditing processes, and could in the future interact directly with the Union Database.

The level of detail and regulatory control is significantly higher than in GO-based systems.

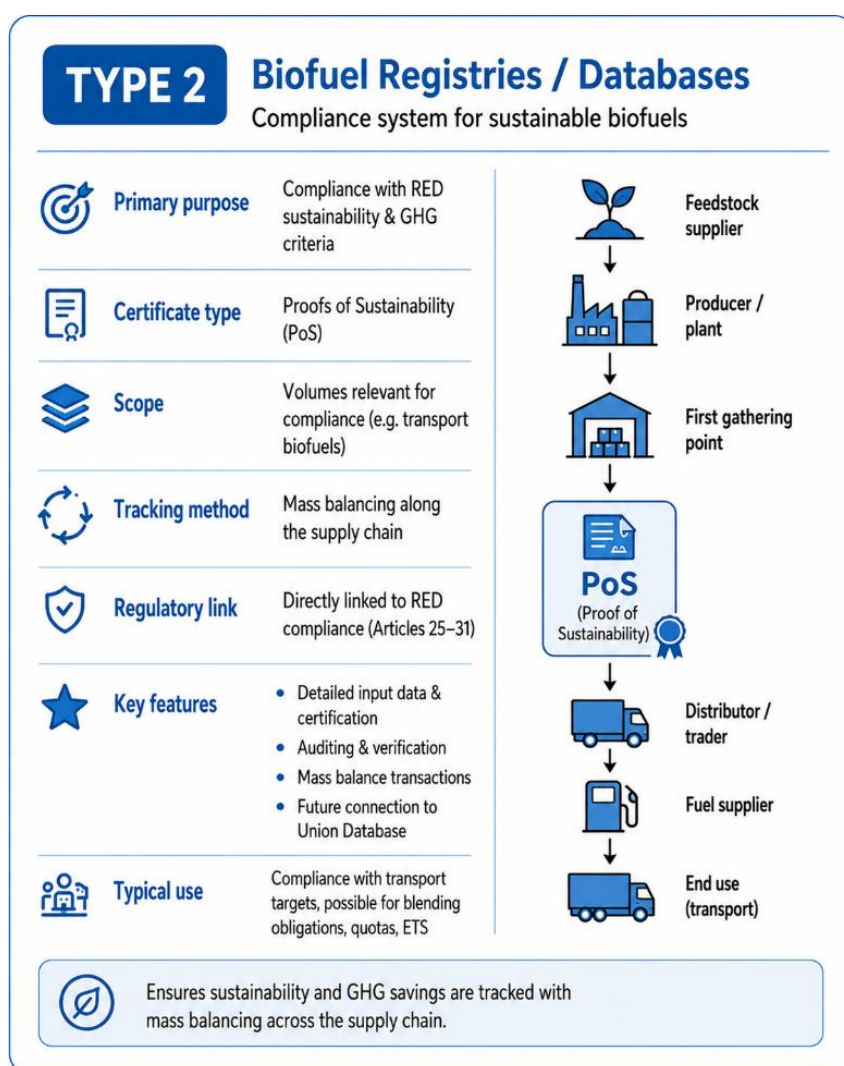


Figure 16: System design type 2: Biofuel registries or databases

10.2.4 Hybrid systems (type 3)

Hybrid systems combine elements of both GO-based and biofuel registry approaches. They can handle multiple certificate types and support different market segments, including compliance, disclosure, and voluntary markets. Hybrid systems must ensure strict separation between different certificate uses while allowing shared infrastructure and data models. This approach is increasingly relevant in countries seeking to integrate biomethane, RFNBOs, and other renewable gases within a single registry framework.

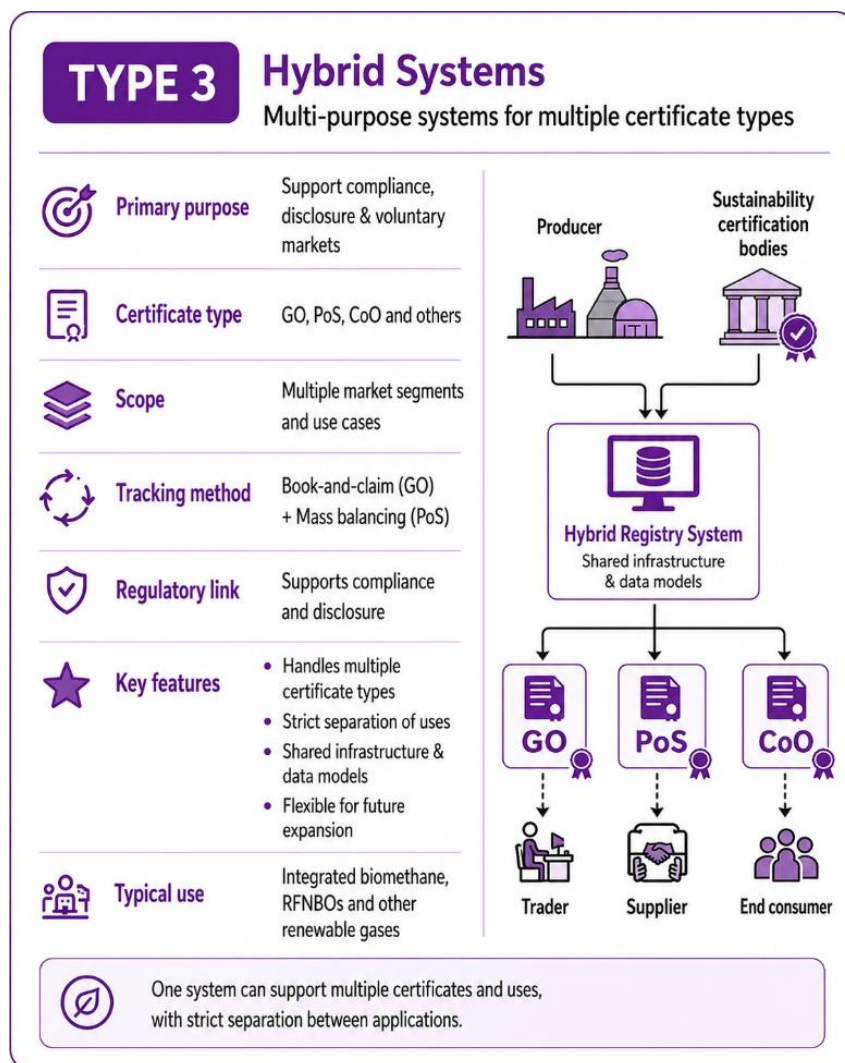


Figure 17: System design type 3: Hybrid systems

10.2.5 Parallel systems (type 4)

Parallel systems refer to national registry landscapes in which multiple independent systems coexist, each serving a specific regulatory or market function, without being fully integrated into a single platform. These typically include separate infrastructures for Guarantees of Origin

(GO), biomethane certificate registries (e.g. CoO), and biofuel registries for transport compliance.

Such systems operate in parallel rather than within a unified architecture, often under different competent authorities and based on distinct regulatory frameworks. While they are often functionally complementary, they are not structurally integrated. As a result, data management, certification rules, data flows, and tracking methodologies may differ across systems, requiring additional coordination to avoid inconsistencies or double counting. This leads to fragmented data flows across systems, limited automatic information exchange on Guarantees of Origin (GO) and Proof of Sustainability (PoS), and increased administrative complexity for market participants. Evidence from countries such as Austria and Germany shows that multiple registries coexist with limited interoperability, requiring manual or procedural alignment between systems. At the same time, parallel systems provide a certain degree of flexibility, allowing each registry to evolve according to sector-specific regulatory requirements. However, they also highlight a key structural limitation: the absence of a centralised and harmonised data infrastructure capable of integrating all relevant functions within a single system.

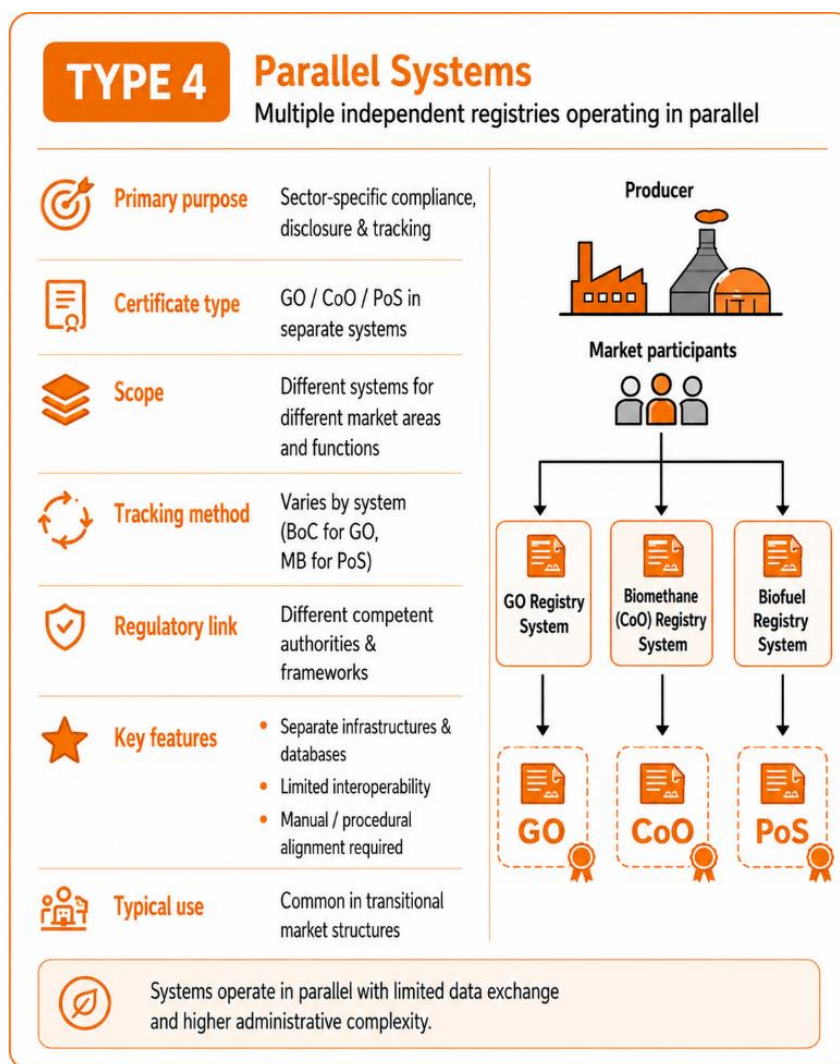


Figure 18: System design type 4: Parallel systems

10.2.6 Production database (type 5)

Production databases represent a foundational system focusing on the comprehensive documentation of renewable gas production and grid injection volumes. In such systems, all production plants are registered, including detailed information on plant characteristics, production technologies, and sustainability certification status.

The primary function of a production registry is to ensure complete and transparent accounting of all renewable gas volumes within a national system, independent of whether certificates are issued for specific market applications. They fulfil a vital role as they combine all business processes for data acquisition including the recording of injection data, typically provided by grid operators, the registration of market participants, the management of master data of operators and market participants and the integration of sustainability-related information from certification schemes and auditors. This helps to reduce costs and efforts for registration or connection for all network operators. To give a practical example: Germany has about 700 gas network operators and to connect all to UDB would be inefficient.

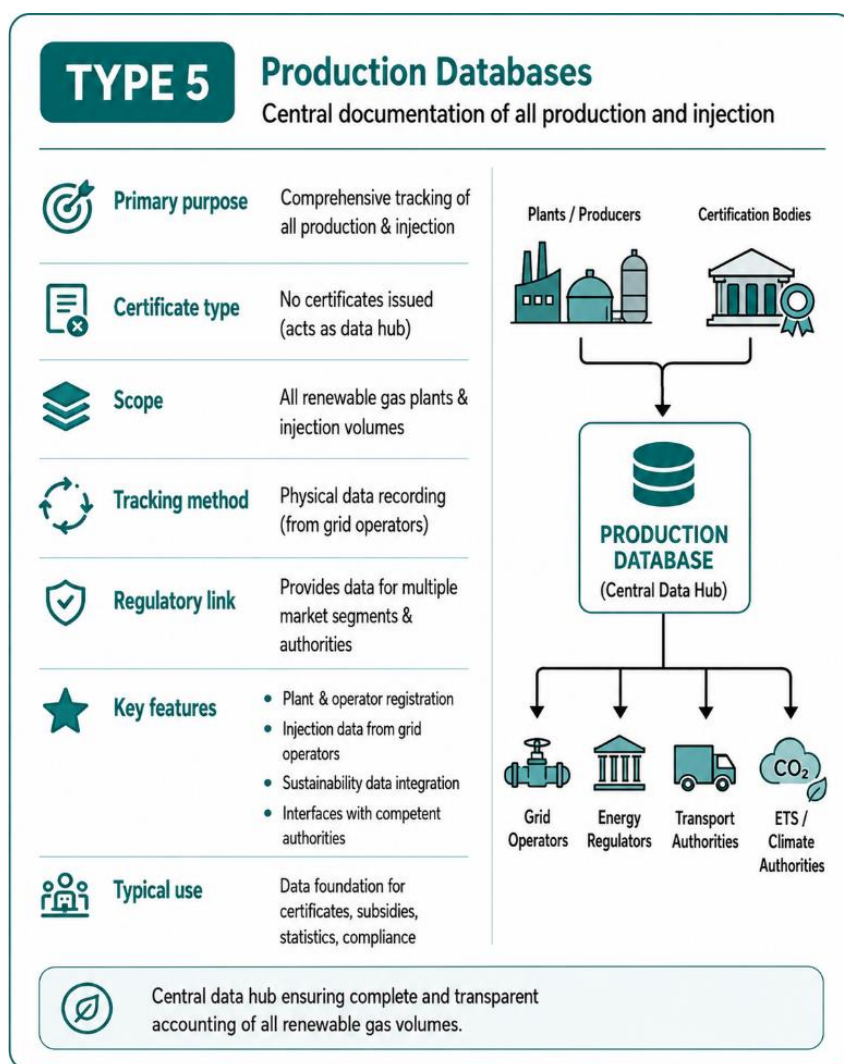


Figure 19: System design type 5: Production databases

Production registries should be designed to establish interfaces and cooperation agreements with competent authorities responsible for different market segments, such as energy regulators, transport authorities, or emissions trading authorities. While production registries do not necessarily manage certificate trading themselves, they provide the essential data basis for certificate management of the lifecycle downstream, including GO schemes and biofuel

registries and most importantly they gather and manage the necessary database for allocation towards target compliance. In this way, they may serve as a central data hub supporting multiple regulatory and reporting obligations.

The absence of dedicated production registries across European markets represents a critical structural gap. Without comprehensive tracking of all produced and grid injected biomethane volumes, national authorities lack the data foundation required for reliable energy statistics, effective subsidy control, and robust anti-double-counting mechanisms.

10.2.7 Data center (type 6)

The Data Center Registry model represents a centralized approach to harmonizing parallel registry systems, addressing the challenges of fragmentation while preserving the autonomy of existing registries. Unlike the Production Registry (Type 5), which serves as a single starting point for certificate issuance and distribution, the Data Center model operates in reverse: it aggregates data from multiple parallel registries (e.g., national or sector-specific systems) to ensure no double counting or double claiming occurs. This setup allows naturally developed parallel systems to continue operating independently while delegating the critical tasks of data validation, harmonization, and target allocation to the central Data Center.

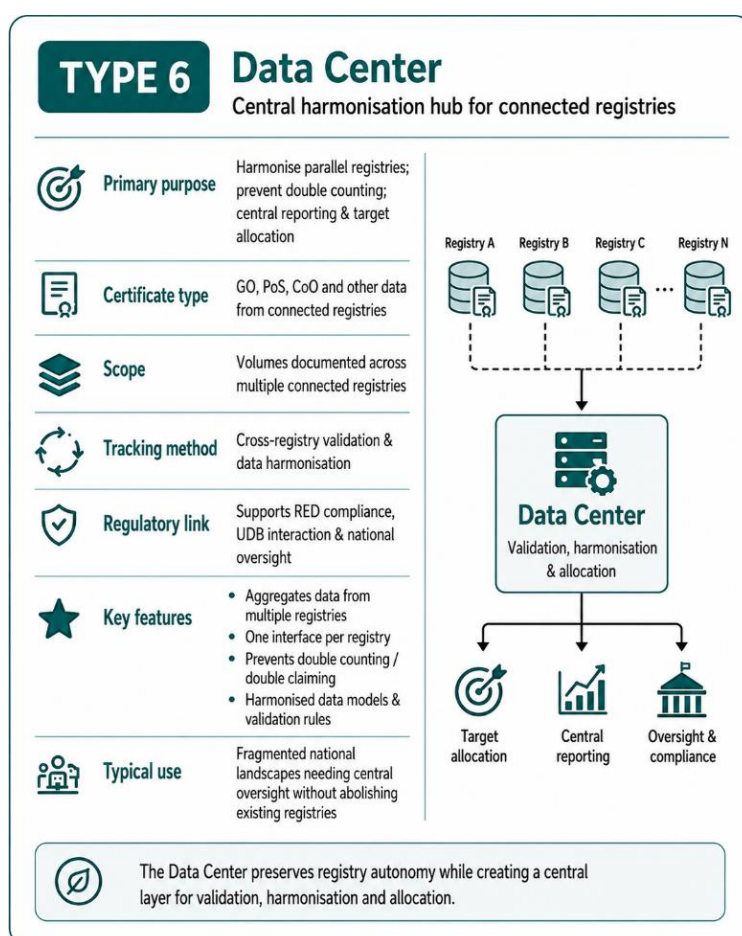


Figure 20: System design type 6: Data center

The primary advantage of this model is its efficiency in reducing interfaces. Parallel registries only need to establish one connection to the Data Center rather than multiple bilateral connections with each other. This simplifies technical integration and reduces the administrative burden on individual registries. The Data Center assumes responsibility for cross-registry validation, ensuring that certificates issued in one system are not reused in another, and that national or EU-level targets (e.g., RED III biomethane quotas) are accurately tracked and allocated. However, this model also presents significant challenges, particularly in harmonising data formats, attributes, and validation rules across diverse registries. The Data Center must develop robust harmonization protocols to align disparate systems, which may require standardized data models (e.g., similar to ERGaR's CoO scheme) and automated validation tools to detect and prevent inconsistencies.

This approach is particularly suitable for Member States with historically fragmented registry landscapes, as it allows for gradual convergence without requiring immediate consolidation. By centralizing reporting and target allocation, the Data Center also provides greater transparency and oversight for national authorities, ensuring compliance with EU frameworks such as RED III and the Union Database (UDB). However, its success depends on strong governance and clear agreements between the Data Center and connected registries to define data standards, validation rules, and dispute resolution mechanisms.

10.2.8 Fully integrated registry systems (type 7)

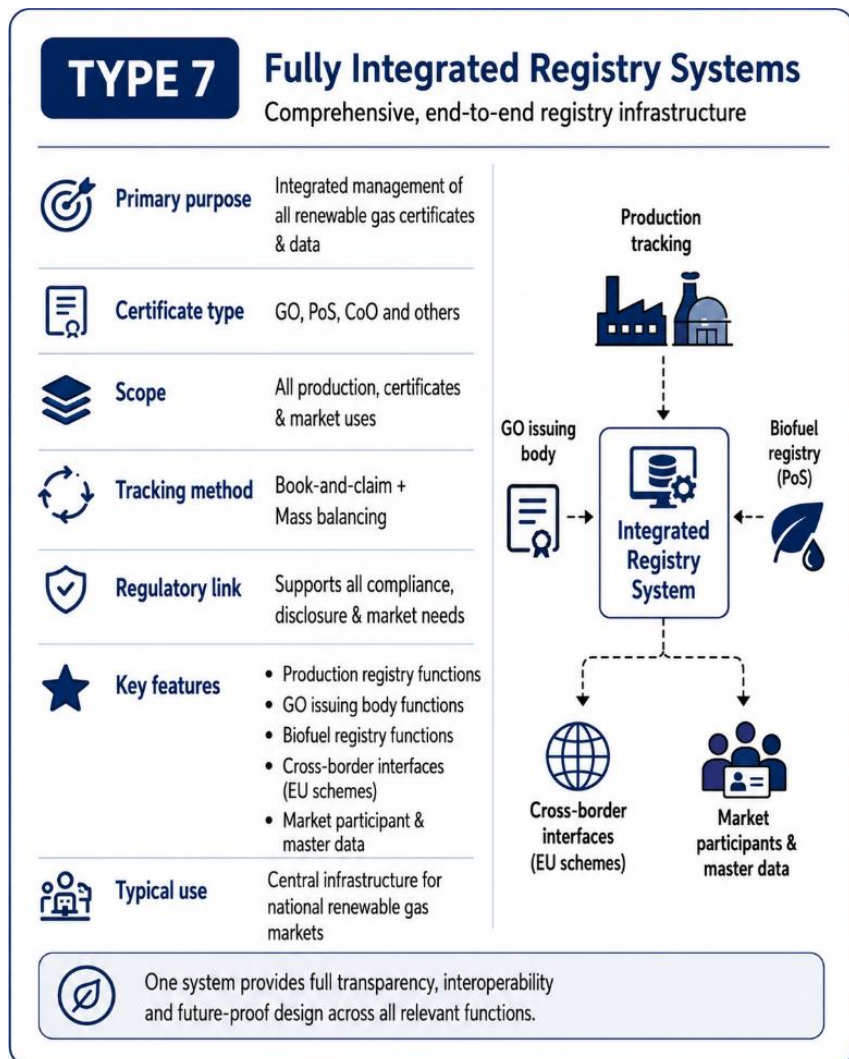
Fully integrated registry systems represent the most comprehensive system architecture, combining master data management, market participant registration, certificate management, sustainability tracking, mass balancing, and potentially market facilitation functions within a single system. These registries aim to serve as central infrastructure for all renewable gas-related data and ownership transfers at national level. They may include interfaces one or both European cross-border schemes.

A wholesome registry typically integrates:

- Production registry functions, documenting all production and injection volumes,
- GO issuing body functions, enabling disclosure-based certificate systems,
- Biofuel registry functions, managing Proofs of Sustainability and compliance tracking,
- Cross-border interfaces, enabling import and export of certificates via connection to European schemes.

By covering all nationally relevant market segments within one system, wholesome registries ensure full transparency and consistency across different certificate types and uses. They enable efficient data management, reduce duplication of systems, and facilitate interoperability with European-level platforms. At the same time, such systems require a high level of organisational, technical, and regulatory coordination, as they must accommodate different rules, data requirements, and market actors within a unified framework.

Figure 21: System design type 7: Fully integrated registry system



11 Country mapping of biomethane registries and support systems

11.1 Introduction and background

The country mapping exercise is a core component of BIOMAPE's Work Package 2 and these updated guidelines (D2.1) for establishing national biomethane registries for certificate management. This chapter provides a deep dive into 18 analysed European countries, including BIOMAPE focus and lead countries. To support comparability across national contexts, each country profile follows the same structure and presents:

- main policy instruments,
- market dimension,
- certificate and registry systems,
- main challenges,
- recommendations.

Particular attention is given to the interaction between certificate and registry systems and national support schemes, quotas, blending obligations, and ETS-related requirements. The mapping therefore helps identify different documentation requirements for biomethane across national support schemes and compliance programmes and assesses how these differences affect the design and implementation of national registries.

A dedicated assessment of the interaction with the Union Database is not yet possible due to the still evolving implementation context. From a policy perspective, however, the country mapping captures the approaches currently emerging in different Member States, including a waiting position, treatment of the Union Database as a parallel compliance system or reference system, and active preparation of national legislation for the implementation of Article 31a RED III.

The information gathered in the subsections on main challenges and recommendations represents a snapshot at the time of report publication in May 2026. At the same time, the mapping provides an important evidence base for BIOMAPE's continued work with the Focus countries within Work Package 2.

11.2 AT: Austria (BIOMAPE lead country)

11.2.1 Main Policy Instrument

Austria's market uptake between 2011 and 2019 was supported by the Green Electricity Act (Ökostromgesetz, ÖSG 2011) which allowed a FiT for renewable power from decentralised, grid-bound biomethane. It was the basis for the set-up of the AGCS Biomethan Register Austria in 2012.

Austria has implemented Article 19 of RED III for Guarantees of Origin (GOs).

The country operates under the Renewable Energy Expansion Act (EAG 2021) which provides investment incentives. Due to a lack of production/consumption support, the investment

incentives have not been harvested and only one call for tender was performed although the EAG asks for annual tendering.

The sector awaits a Renewable Gases Act (Erneuerbare Gase Gesetz). A former version pointing towards a consumption quota did not pass the parliament, while a market premium model is now under discussion.

11.2.2 Market Dimensions

The kick-off and relevant growth of the Austrian biomethane market happened between 2011 and 2019 based on the Green Electricity Act (Ökostromgesetz, ÖSG 2011) thanks to its renewable power FiT. Biomethane production and associated injection volumes in Austria increased steadily between 2011 and 2018. The highest injection volume of approximately 170 GWh was achieved in 2018. In 2019, injection volumes declined and reached around 150 GWh, comparable to 2017 levels. Since 2020, injection volumes have remained at similar levels. The annual Austrian gas consumption of around 90 TWh (average 2011-2021) contrasts with the annual biomethane injection into the public grid of around 146 GWh (average 2016-2021), which can cover approximately 0.2% of the annual Austrian gas demand. About 20% of this production volume is used in the electricity sector thanks to the renewable power FiT. In the years 2022-2025, the annual Austrian gas demand ranged between 70-85 TWh. In 2025, the total biomethane injection of 168 GWh was documented from 17 operational biomethane plants.

The report Renewable Gas in Austria 2040 was commissioned and published by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK; legislative period of the Austrian Federal Government: 2020–2024) to assess the future role of renewable gases within Austria's decarbonisation strategy and climate neutrality objectives. The study evaluates future gas demand scenarios and the technical potential for domestic renewable gas production up to 2040. Its main finding is that Austria could achieve a realisable renewable gas potential of approximately 20.3 TWh per year by 2040, with around half originating from biomethane produced via anaerobic digestion and the remainder from biomass gasification (<https://www.bmwet.gv.at/Services/Publikationen/publikationen-energie/erneuerbares-gas-2040.html>).

Austrian biomethane targets evolved considerably during this legislative period: the 2020 government programme initially referred to a target of around 5 TWh of renewable gas by 2030, while subsequent policy discussions and the draft Renewable Gas Act (Erneuerbare-Gase-Gesetz, EGG – not passed) increased this ambition to 7.5 TWh by 2030. In parallel, the Renewable Expansion Act (Erneuerbaren-Ausbau-Gesetz, EAG 2021) established the broader objective of achieving climate neutrality by 2040 and promoting renewable electricity and gas production, although without setting a dedicated biomethane volume target. Overall, the report concludes that Austria's long-term renewable gas potential substantially exceeds the short-term policy targets, but that significant investment, infrastructure expansion and regulatory support will be required to realize this scale-up.

In 2025, 166 GWh biomethane were produced and injected into the grid. This number excludes one off-grid biomethane production plant and the biomethane volumes used in fueling stations directly (not injected into the grid). It also excludes other renewable gas types. According to estimates by the Austrian Biogas Association, planned biomethane plants with a

capacity of approximately 3.5 TWh are ready for construction, awaiting clear policy guidelines and a supportive registry landscape and simplified certificate systems.

11.2.3 Certificate and Registry Systems

In Austria the registry landscape is complex due to natural growth out of different sector regulations. The country has a long-standing Feed-in Tariff (FiT) for electricity from biomethane and is expanding its registry functions to accommodate multiple certificate types and enhance interoperability.

The AGCS Gas Clearing and Settlement is the national registry operator since 2012, issuing and managing certificates for biomethane injected into the grid. Austria's registry is fully integrated with the ERGaR Certificate of Origin Scheme. It also has a cooperation agreement since 2017 with the eINa biofuel database operated by the Environmental Agency (Umweltbundesamt, UBA) which track records Proofs of Sustainability (PoS) and the substitution obligation of transport fuel suppliers. The PoS registry has a cooperation with the German pendant Nabisy and enables cross-border transactions.

A third system was established with the issuing body by E-Control which has set up a system for Guarantees of Origin (GoO) and is fully integrated with the AIB hub for cross-border transactions of renewable gas GOs.

Austria operates **Parallel Systems (Type 4)**. However, § 81(4)-(6) EAG assigns responsibilities to E-Control to ensure data exchange with other relevant institutions, including the operators of the Biomethane Registry and PoS database. Without harmonised data exchange between these entities, the same biomethane volumes could be double claimed and double counted. By requiring data alignment, cross-checking, and consistency between physical, certificate, and sustainability data, §81 EAG establishes the necessary coordination framework to effectively prevent such double claiming. § 81 EAG provides the legal basis for cross-system data harmonisation in Austria, which is essential to prevent double claiming of biomethane across disclosure and compliance schemes.

11.2.4 Main Challenges

While Austria has a long-standing experience in the biomethane market on national as well as European level, the biomethane production amounts and the number of production plants remain low. The country has lost its former pioneering position to other countries with quick market uptake. Still, the knowledge, technology and infrastructure are available and can be easily reused for a market ramp-up. Expert estimations in the market explain that around 2 TWh of biomethane potential could be reached immediately, with all technical and organisational preparations finalised at hundreds of existing biogas plants ready for a switch to biomethane production and a many future plants which have not started construction. However, the policy support for biomethane in Austria is very unstable. Spanning over three different governments, the sector is fighting to receive an updated support system. Without stable production-side or demand-side support schemes, the transition will not just be challenging but could force many operators to close their currently operational plants.

The ambitious policy targets of reaching around 10% of the current gas demand seem unrealistic to reach within a few years left to 2030, however, stakeholders and market participants seem to be ready to deliver.

Another main challenge is the presented by the fragmented registry landscape created by three parallel systems with no automated interfaces and only limited operational data exchange. This creates confusion, especially since there is a very good policy foundation in the Renewable Expansion Act (with paragraph § 81 EAG) providing the legal basis for cross-system data harmonisation in Austria. However, this has not been implemented. At least, there is a cooperation agreement on information and data exchange between the national registry and the PoS database which had been in place many years before the Renewable Expansion Act came into force. This lack of data harmonisation and grow of parallel systems and business processes creates additional administrative burden for existing market participants as well as high non-technical barriers for new market entries.

11.2.5 Recommendation

Austria lacks a strong and clear policy framework as basis for a stable biomethane market. While existing registry systems are advanced in their technological set-up and interoperability for cross-border transactions, the lack of harmonisation and interoperability on national level hinders easily administerable business cases and market entrance of new parties.

Austria could implement a production registry (Type 5) to align reduce and harmonise administrative tasks over all existing registries and provide a central interface to the Union Database. Another option to ease the administration of naturally grown parallel systems would be a data centre (Type 6), combining and harmonising all existing data and thus enabling clear and simple reporting methods to allow target allocation of biomethane in Austria.

11.3 CH: Switzerland

11.3.1 Main Policy Instrument

Switzerland's biomethane policy framework is independently developed outside the EU's RED III, relying instead on national legislation - primarily the Energy Act (Energiegesetz, EnG) and Energy Ordinance (Energieverordnung, EnV) - under the oversight of the Swiss Federal Office of Energy (SFOE/BFE). The Swiss Federal Office for the Environment (FOEN) is also involved in renewable-fuel oversight.

Support for biogas and biomethane is provided primarily through the Swiss Gas Industry Biogas Fund (Biogasfonds, BGF), financed by contributions from gas suppliers, which provides investment contributions for the production and gas grid injection of renewable gas. Federal support under the Energy Act includes 20-year feed-in tariffs (up to 26.5 ct/kWh) for biogenic gas injected into the grid, with operators able to choose between fixed tariffs or floating market premiums. Additional incentives, such as bonuses for limited co-substrate use ($\leq 20\%$) and Contracts for Difference introduced in 2025, further align support with market conditions.

Biomethane uptake is encouraged through tax exemptions for transport use under the Mineral Oil Tax Act (Mineralölsteuergesetz) and CO₂ tax exemptions for imported bio-LNG under the CO₂ Act and Ordinance (CO₂-Gesetz und CO₂-Verordnung). These tax incentives apply, provided sustainability criteria are met. Sustainability for transport fuels is verified through recognised certification schemes under Swiss climate policy.

11.3.2 Market Dimensions

Domestic biomethane production in Switzerland is approximately 450–500 GWh/year, mainly from agricultural and waste-based biogas plants; of this, around 350–400 GWh/year is upgraded to biomethane quality and injected into the gas grid. In 2024, Switzerland had 47 biomethane plants (up from 15 in 2011).

Switzerland additionally imports significant volumes of biomethane certificates from European production. The total amount of biomethane marketed to Swiss gas consumers (domestic production plus imports) is estimated at approximately 1.5–2.0 TWh/year.

Switzerland's annual natural gas demand amounted to approximately 19.5 TWh in 2024, according to transport and delivery data published by Swissgas and Transitgas. The Swiss Gas Industry Association (VSG) has committed to defossilising the gas grid, starting from ~350 GWh in 2024, targeting 15% (2.9 TWh) renewable gas by 2030, 50% (9.75 TWh) by 2040, and 100% (19.5 TWh) by 2050.

11.3.3 Certificate and Registry Systems

The Swiss biomethane registry was historically operated by the Swiss Gas Industry Association (VSG, Verband der Schweizerischen Gasindustrie, today branded as Gazenergie) and functioned primarily as an industry-operated clearing platform for documenting biomethane quantities and transfers within the Swiss gas sector. Unlike modern systems described in this report, the VSG registry was comparatively simple and focused mainly on tracking energy volumes rather than detailed energy and sustainability attributes. Despite not being legally bound by EU legislation or the strict sustainability certification requirements applicable within the European Union, Switzerland nevertheless decided to establish a formal guarantees-of-origin issuing body (Type 1) for renewable gas operated by Pronovo AG.

Pronovo is a wholly owned subsidiary of the Swiss transmission system operator for electricity, Swissgrid, and functions as an independent execution agency operating several national support and tracking systems for renewable electricity and renewable gases. Pronovo received the federal mandate to implement and operate the new national guarantees-of-origin system following regulatory decisions adopted by the Swiss Federal Council on 20 November 2024. The relevant ordinances entered into force on 1 January 2025, which also marked the official replacement of the former VSG renewable gas clearing office by the new Swiss guarantees-of-origin system.

There is no national biofuel registry for PoS of liquid biofuels.

Distinctions between compliance and voluntary uses, regulated and domestic claims, and cross-border versus national transfers are implemented through a combination of national legislation (Energy Act and Energy Ordinance) and the Pronovo registry rules for issuance, transfer and cancellation of renewable-gas certificates.

There is no national tracking system for hydrogen (though regulation is under development) and no national tracking system for bio-CO₂.

The Swiss GO registry interacts with European market structures through European cross-border schemes. Pronovo was the first Issuing Body or registry to be connected to both, the ERGaR Certificate of Origin Scheme and the AIB EECS rules for gas.

11.3.4 Main Challenges

Switzerland's biomethane sector faces significant scaling challenges, with domestic production at ~350–400 GWh/year, far below the 2030 target of 2.9 TWh (requiring a ~743% increase in six years) but lacking any direct production support or demand pull. Biomethane in Switzerland is used primarily in voluntary green-gas markets rather than in mandatory compliance schemes. Cross-border interaction with EU compliance markets is asymmetric: Swiss imports of sustainable EU biomethane certificates are common, but Swiss biomethane is rarely able to access EU compliance pathways.

The registry system, though advanced with Pronovo's GO issuing body (Type 1), lacks a dedicated Proof of Sustainability (PoS) database for gaseous fuels.

Since Switzerland is not an EU Member State, it is rather interested in international law and tries to identify international recognition pathways. Internationally Transferred Mitigation Outcomes (ITMOs) are verified emission reductions or removals transferred between countries under Article 6.2 of the Paris Agreement and used toward national climate targets, subject to corresponding adjustments to prevent double counting. In the biomethane context, ITMOs could in principle provide an additional pathway for the international recognition of greenhouse-gas reductions beyond ordinary renewable gas certificates or Guarantees of Origin. VSG identifies it as a hurdle in their response to the BIOMAPE questionnaire that such ITMO transfers in the biomethane sector are not yet operational and remain untested.

11.3.5 Recommendation

VSG recommends further harmonisation between renewable-energy policy, climate policy and ETS frameworks at European level, to ensure that biomethane can contribute effectively to decarbonisation targets across heating, industry and transport.

Implementing suitable policy measures to drive domestic demand, and harmonising Swiss energy, climate, and ETS frameworks with EU systems would unlock biomethane's full potential in compliance markets.

Extending the current registry framework with some dedicated sustainability layer to provide sufficient tracking for energy and climate targets and to allow for smooth integration with neighbouring and EU-biomethane markets, would help enhance the Swiss biomethane market to higher efficiency.

11.4 DE: Germany

11.4.1 Main Policy Instrument

The main policy instrument in Germany has been and continues to be the Renewable Energy Sources Act (Erneuerbaren Energie Gesetz, EEG), which promotes renewable electricity from biomethane through a market premium system. In this system, operators sell power and receive a top-up, with funding levels determined through competitive auctions. Priority grid access and 20-year support provide investment security. Biomethane must meet a wide range of criteria, depending on the current version of the EEG. However, there is no direct biomethane production support, no investment support, and no tax incentive for biomethane production.

Consumption support is available in the heating sector for the heating sector regarding buildings and the transport sector as per Articles 25-31 of RED III. The Building Energy Act (Gebäudeenergiegesetz, GEG) allows biomethane to be counted toward renewable energy requirements in buildings (heating sector). Additionally, the Greenhouse Gas Reduction Quota in transport (THG quota) incentivises biomethane use in transport through tradable emission reduction credits, enshrined in the Federal Immission Control Act (Bundes-Immissionsschutzgesetz, BImSchG).

Article 19 of RED III is not implemented, and there is no clear timeline for establishing a GO issuing body as it was postponed several times. The Herkunftsnachweisregistergesetz (HkNRG, GO-Issuing Body-Act) mandates the Environmental Agency (Umweltbundesamt, UBA) to establish a GO-Issuing Body (Type 1).

Biomethane is practically accepted in both the EU-ETS and the national ETS in Germany. The EU ETS is regulated by the Greenhouse Gas Emissions Trading Act (Treibhausgas-Emissionshandelsgesetz, TEHG) and the associated Emissions Trading Regulation (Emissionshandelsverordnung, EHV 2030). The national ETS is regulated via the Fuel Emissions Trading Act (Brennstoffemissionshandelsgesetz, BEHG).

Policy Outlook: A green gas quota is under discussion, which would mandate shares of renewable gases in the gas grid to support the market.

11.4.2 Market Dimensions

Germany has the most mature biomethane market in Europe, supported by a long-established regulatory framework and a well-developed certification infrastructure through the dena Biogasregister, in operation since February 2011. The dena Biogasregister serves as the national standard for documenting biomethane quantities and qualities injected into the natural gas grid and is widely used for compliance with the Renewable Energy Sources Act (EEG), the Buildings Energy Act (GEG), and the EU ETS. The dena registry reports that around 80% of domestic biomethane volumes are documented through the system, underlining its central role in the German biomethane market.

Germany's annual natural gas demand amounted to approximately **844 TWh in 2024**, according to the Federal Network Agency (Bundesnetzagentur, BNetzA). Industrial consumers accounted for around 61% of total gas consumption, while households and commercial consumers represented about 39%.

Even a mature market as in Germany had to undergo significant market uncertainties. Since 2023, the German biomethane sector has experienced considerable turbulence due to declining greenhouse gas quota prices, fraud cases related to biodiesel and upstream emission reduction (UER) projects, and the insolvency of major biomethane trading companies. According to market data, approximately 11,000 GWh of biomethane from 267 plants were injected into the German gas grid in 2024, while domestic consumption amounted to around 10,364 GWh. Injection volumes further increased to approximately 12,300 GWh in 2025, reflecting continued market growth driven by demand from the heating, transport, and industrial sectors.

Germany aims at around 65 TWh of annual biomethane production as of 2030 according to data found in the NECP.

Germany's biomethane market is increasingly driven by decarbonisation requirements in the heating, transport and industrial sectors. Gradual transition towards more sustainable feedstocks can be observed with the steady increase of manure and waste-based substrates, gradual transition towards more sustainable feedstocks.

The market is characterised by comparatively high regulatory maturity, cross-border certificate trading, and strong integration into European renewable gas certification systems. Germany is the biggest importer of biomethane in Europe and has established a market pull for the entire continent.

11.4.3 *Certificate and Registry Systems*

In Germany, the GHG reduction quota of the transport sector (Treibhausgasminderungsquote) requires fuel distributors to reduce the greenhouse gas intensity of their fuel portfolio, with biomethane eligible as a qualifying renewable fuel. The system relies on Proofs of Sustainability (PoS) issued under recognised voluntary schemes as the primary compliance instrument, tracked through the national database Nabisy operated by the Federal Institute for Agriculture and Food (BLE). Nabisy is in cooperation with the Austrian eINa system for compliance with transport targets.

The dena Biogasregister is Germany's national registry for biomethane Certificates of Origin (CoOs) is operational since February 2011 and ever since widely used for compliance with the Renewable Energy Sources Act (EEG), the Buildings Energy Act (GEG), and the EU ETS. It is fully integrated with the ERGaR Certificate of Origin Scheme.

Additionally, Germany has not agreed on a deadline for establishing a GO issuing body which should be operated by the German Environmental Agency (Umweltbundesamt, UBA), reflecting ongoing discussions and regulatory adjustments.

11.4.4 *Main Challenges*

While Germany has the most mature biomethane market, it had gotten destabilised by fraud cases related to biodiesel and upstream emission reduction (UER) projects.

Austria and Germany alike have both very mature certificate and registry systems for Certificates of Origin for national markets and biofuel databases for Art 25-30 RED II compliance. However, these are parallel systems (Type 4), with unnecessary administrative burden for market participants and unharmonised business procedures. German registry operates have not established any business processes or cooperation agreements for data alignment, cross-checking.

While the GO issuing body (Type 1) has already been established in Austria as a third system, Germany is looking toward the same future with three parallel systems but has not yet agreed on a deadline for actually establishing a GO issuing body.

11.4.5 *Recommendation*

Germany should provide details on the establishment of a GO registry to reduce unclarities. At the same time, Germany should enhance the interoperability of its existing registry systems to facilitate harmonisation across business cases. To fill the gap of harmonisation, the implementation of a Type 5 production registry is recommended. To address interoperability

challenges, establishing a Type 6 data center would provide a centralised solution for streamlining data exchange and coordination across systems.

11.5 DK: Denmark

11.5.1 *Main Policy Instrument*

Denmark's biomethane sector is driven by a comprehensive and ambitious policy framework that combines national climate legislation with EU-aligned directives. The cornerstone of this framework is the Danish Climate Act (Klimaloven, 2020), which legally binds Denmark to reduce greenhouse gas (GHG) emissions by 70% by 2030 (compared to 1990) and achieve climate neutrality by 2050. To support these targets, Denmark has implemented a green gas strategy that prioritises the phase-out of fossil natural gas and the scaling up of renewable gases, particularly biomethane. A key policy instrument is the mandate for 100% green gas in the national grid by 2030–2035, which requires all gas consumed in Denmark to be renewable, primarily biomethane or green hydrogen. Additionally, the Danish Green Tax Reform (2022) introduced tax exemptions for biomethane used in transport and heating, further incentivizing its adoption.

11.5.2 *Market Dimensions*

The Danish market is characterised by strong policy support, extensive use of certificates, and growing exports of biomethane certificates, particularly for use in the transport sector. Over the past decade, Denmark has established itself as a European leader in biomethane production and utilization, driven by ambitious climate targets and supportive policy frameworks.

Comparing the country's gas demand of around 30–32 TWh with the nation's biomethane production of 7.5 TWh by 2024, roughly one-quarter to nearly 40% of the country's gas demand could already be covered by domestic biomethane. Denmark has become a leading example of renewable gas integration, with several days in 2024 during which biogas and biomethane production exceeded the country's natural gas consumption. Although the system is transitioning rapidly toward renewable gas supply with targets of 100% biomethane by 2030, Denmark sells the created renewable value as a main exporting country for biomethane certificates. Denmark is a frontrunner in biomethane export, creating a market push in Europe. It is home to around 70 large biomethane producers that inject into the gas grid, operating over 58 biomethane plants and more than 95% of biomethane injected into the gas grid. This infrastructure supports both domestic consumption and export, primarily to Germany and Sweden, where favourable pricing and tax incentives exist.

11.5.3 *Certificate and Registry Systems*

The Danish transmission system operator Energinet operates a comprehensive registry system for biomethane and plays a central role in cross-border certificate trade through the ERGaR Certificate of Origin Scheme. Initially, the registry focused on ensuring compliance with national renewable energy targets and facilitating the integration of biomethane into the Danish gas grid.

In 2017, Energinet entered into a bilateral agreement with the Deutsche Energie-Agentur (dena), the German biomethane registry. This bilateral agreement was replaced by the participation in the ERGaR Certificate of Origin scheme in 2021.

Energinet received the mandate to be the Guarantees of Origin (GO) issuing body (Type 1) through the Danish Energy Agency (DEA), enshrined in the Danish Climate Act (Klimaloven, 2020). Recently, Energinet announced plans to connect to the AIB hub in the coming months. Denmark operates a hybrid system (type 3) where Energinet as registry operator facilitates the certificate management which acts as basis to enable access to national support schemes and also transport quota compliance, with Guarantees of Origin (GOs) fulfil the newest task of Art 19 RED III.

11.5.4 Main Challenges

Danish biomethane may have received production support domestically and then generated additional value when certificates were exported into foreign demand-side or compliance markets in the past. The resulting concern is statistical allocation, double claiming, and target attribution. The export of biomethane certificates to markets with consumption support may have led to a discrepancy in national statistics between exporting and importing countries.

A clarification would require enhanced coordination and data sharing between Denmark and the importing countries, involving Eurostat and its SHARES tool to ensure accurate reporting and prevent double counting. Eurostat, the statistical office of the European Union, plays a crucial role in harmonising statistical data across EU member states. The SHARES tool, developed by Eurostat, is specifically designed to facilitate the exchange of statistical data related to renewable energy, including biomethane. This tool enables member states to share and validate data, ensuring that statistical reporting is consistent and accurate.

11.5.5 Recommendation

Denmark should further clarify and, where necessary, harmonise the statistical allocation, certificate retirement, and cross-border reporting of exported biomethane attributes, in coordination with importing countries and relevant EU reporting tools.

Leveraging Eurostat's SHARES tool can significantly enhance the coordination and data sharing between Denmark and the importing countries, ensuring accurate reporting and preventing double counting. In May 2026 (the publication date of this report) an informal meeting was held between Eurostat representatives, national registry operators and European scheme operators ERGaR and AIB to address this issue and take first steps on clarified statistical data.

11.6 FR: France

11.6.1 Main Policy Instrument

France has established a comprehensive regulatory framework to promote the production and use of biomethane. The cornerstone of this framework is the French Climate and Energy Law, which mandates a significant reduction in greenhouse gas (GHG) emissions and promotes the use of renewable energy sources. This law is aligned with the European Union's renewable energy directives, including the Renewable Energy Directive (RED II/RED III), which sets

sustainability criteria for biofuels and biomethane. France has implemented Art 19 RED III and mandated per ministerial decree EEX to maintain a GO issuing body (Type 1) which has been operational since June 2025. With the CARBURE platform currently being developed for sustainability reporting purposes, France intends to integrate the national database with the UDB, with operations expected to commence in 2027.

France's biomethane support framework is based on a dual mechanism combining a regulated feed-in tariff (FiT) system with the newer quota-based Certificats de Production de Biogaz (CPB) scheme. Both were introduced within the French Energy Code but via different implementing decrees at different times.

The FiT provides financial incentives to support biomethane production and injection, including subsidies for biogas upgrading administered by the French Agency for Environment and Energy Management (ADEME). Requirements for producers to reach specific sustainability and production criteria and conditions under which biomethane injected into the natural gas grid must be purchased at regulated prices by designated counterparties are regulated per a decree.

Alongside the FiT mechanism, France introduced the Biogas Production Certificate (Certificats de Production de Biogaz, CPB) system under the French Energy Code as part of the implementation of the Climate and Resilience Law. Unlike the feed-in tariff, the CPB mechanism is quota-based and market-oriented. It obliges natural gas suppliers to cancel/retire a minimum number of CPBs corresponding to mandated renewable gas incorporation targets. Suppliers can either procure certificates from biomethane producers or produce biomethane themselves. The targets for CPB restitution are set at 0.8 TWh in 2026, 3.1 TWh in 2027, and 6.5 TWh in 2028, creating a predictable demand signal for unsubsidised biomethane production. The obligation increases progressively between 2026 and 2028 and is backed by a penalty of €100 per missing certificate, creating a strong economic incentive for biomethane procurement.

The interaction between the two systems is key to understanding the evolution of the French biomethane market. Historically, the sector was mainly driven by feed-in tariffs (FiTs), which provided stable revenues through regulated gas purchase obligations. The CPB system now introduces a complementary market-based mechanism that gradually shifts part of the support burden from the state to gas suppliers and market participants. In practice, CPBs create additional revenue opportunities for biomethane producers beyond FiT support and are expected to gain importance as renewable gas obligations expand. The coexistence of FiTs and CPBs therefore represents a transition towards a hybrid support model combining regulated remuneration with quota obligations and certificate trading.

Additionally, France has implemented a tax incentive system for biomethane used in transport via the TIRUERT (Taxe Incitative Relative à l'Utilisation d'Énergie Renouvelable dans les Transports) and heating sector via the TICGN (Taxe intérieure de consommation sur le gaz naturel), further encouraging its adoption with economic benefits. The tax incentives are part of a broader strategy to promote the use of renewable gases and reduce the carbon footprint of the transport and heating sectors.

11.6.2 Market Dimensions

France has developed one of the largest and fastest-growing biomethane markets in Europe and has reached the position of the second-largest biomethane market in the EU, driven by strong state support and feed-in tariffs directly for biomethane. The rapid expansion is evident in the number of injection sites: by the end of 2024, 731 biomethane facilities were connected to the French gas network (628 to the distribution grid and 103 to the transport grid), up from around 214 installations in 2020. In 2024, France's total biomethane production capacity reached 13.9 TWh, with annual injections of approximately 11.6 TWh, representing a 27% year-on-year increase compared to 2023, accounting for roughly 3.2% of the country's primary natural gas consumption. ATEE Club Biogaz reports 15.5 TWh of biomethane injected in 2025, alongside 776 GWh of electricity generated from biogas (582 MW of installed capacity). France's annual natural gas demand was approximately 393 TWh in 2024 (climate-corrected final consumption), according to the official French energy statistics published by the French Ministry for Ecological Transition (SDES – Service des données et études statistiques). In its contribution to the BIOMAPE questionnaire, the French association ATEE Club Biogaz identifies formal recognition of biomethane in the GHG Protocol, alongside the gradual ramp-up of the CPB blending obligation as main drivers for biomethane demand in France.

11.6.3 Certificate and Registry Systems

Historically, the French biomethane guarantees of origin (GO) registry was operated by GRDF following a ministerial decree adopted in December 2012, which appointed GRDF (2012-2023) as the body responsible for creating and managing the national biomethane GO registry for injected biomethane. Under the implementation of the Renewable Energy Directive (RED II) and the expansion of renewable gas certification requirements, the French Ministry for Energy transferred the registry mandate to European Energy Exchange (EEX) after a public tender process. EEX was formally appointed as issuing body for the French biomethane certificate systems by ministerial decree of 4 August 2023, with the new registry framework which became operational from October 2023 and the new CPB registry launched in June 2025.

The French Biogas Production Certificate system (Certificats de Production de Biogaz, CPB) establishes a parallel certificate instrument alongside existing GOs and Proofs of Sustainability, with distinct regulatory objectives and trading rules.

Today, EEX operates both the French biomethane GO registry and the new "Certificats de Production de Biogaz" (CPB) scheme on behalf of the French state. A hybrid system (Type 3) was deliberately chosen for clear separation of RED-conform GOs from national CPBs for compliance purposes. The hybrid system accesses one master database but GOs and CPB cannot coexist for the same quantity of biomethane since they do not mix in the system but are separated in two different application databases. Market participants log into the hybrid system via one login but have a button to switch between the application databases and can always only perform within one database / within one market, either GO market or national compliance market (via CPBs).

11.6.4 Main Challenges

In its contribution to the BIOMAPE questionnaire, the French association ATEE Club Biogaz identifies the fragmentation between the GO market and the CPB market as a structural risk to the integrity of French biomethane statistics.

In its April 2026 infringements package, the European Commission opened an infringement procedure against France by letter of formal notice INFR(2026)4002, finding the national biomethane production-certificate scheme (BPC / CPB obligation) incompatible with the free movement of goods under Articles 34–36 TFEU. In the current version, suppliers would have to either produce biomethane themselves or buy certificates from producers located in mainland France, while biomethane produced in other Member States would not be recognised for traceability under the French scheme. The Commission additionally finds France in breach of the Single Market Transparency Directive (EU) 2015/1535 since the scheme and its national implementing measures were not notified at draft stage. France has two months from the letter of formal notice to respond, after which the Commission may proceed to a reasoned opinion. For more details, see the Commission press notice at ec.europa.eu/commission/presscorner/detail/en/inf_26_720 and the DG Energy summary at energy.ec.europa.eu/news/april-infringements-package-key-decisions-energy-2026-04-29_en.

11.6.5 Recommendation

Accelerating the full operationalisation of the CARBURE platform and its alignment with the UDB by 2027 will be critical to streamline sustainability reporting and enable seamless cross-border certificate transfers.

To mitigate double support risks, it is important to clarify the interaction between FiTs and CPBs. Interestingly, the French operator EEX has decided against a wholesome system (type 7) and has deliberately chosen a hybrid system (type 3) which does fragment the certificate types but keeps all production and consumption volume within one operator's system.

Additionally, strengthening coordination between EEX, ADEME, and network operators (e.g., GRDF), e.g. via a data center (Type 6) which centralises data management and reduces administrative complexity, could enhance registry and market efficiency and prevent fragmentation between GO and CPB markets.

11.7 HU: Hungary (BIOMAPE focus country)

11.7.1 Main Policy Instrument

The Hungarian government has been gradually aligning with European renewable gas certification and guarantees of origin frameworks.

Hungary has implemented Article 19 of RED III through Government Decree 215/2024 (VII. 29), which regulates the issuance and management of renewable gas Guarantees of Origin under Act XL of 2008 on Natural Gas Supply, aligning with EU Renewable Energy Directive requirements (In Hungarian: A megújuló gázok származásának igazolásáról szóló 215/2024. (VII. 29.) Kormányrendelet).

Financial incentives in Hungary primarily consist of investment subsidies for biogas and biomethane projects as well as renewable electricity support under the METÁR framework established by Government Decree No. 299/2017 (X.17.) which is administered by the Hungarian Energy and Public Utility Regulatory Authority (MEKH).

Recent funding rounds under the Jedlik Ányos Energy Programme additionally support biogas upgrading and biomethane production investments. In September 2025, €100 million was allocated for investment subsidies, with applications open from 27 October 2025 to 27 January 2026 (up to 45% non-returnable support); results remain unpublished as of March 2026. These mechanisms are administered by the National Energy Agency (<https://.nffku.hu>).

Despite full participation in the EU ETS, no practical biomethane allocations to the system have yet been executed.

Although Hungary fully participates in the EU Emissions Trading System (EU ETS), and the EU ETS is implemented at national level through Hungarian law, no practical business cases to allocate biomethane amounts towards the ETS was executed.

11.7.2 *Market Dimensions*

Hungary's biomethane market is still at a comparatively early stage of development. While Hungary has a well-established natural gas infrastructure and significant agricultural potential for biogas production, biomethane upgrading and grid injection have so far remained limited. There are two biomethane plants operating in the country, with a combined biomethane production of 160 GWh in 2024.

11.7.3 *Certificate and Registry Systems*

Hungary operates a Type 1 GO Issuing Body. The Hungarian Energy and Public Utility Regulatory Authority (MEKH) is since 2026 responsible for the GO issuing body operation.

A GO may only contain information on PoS if the account holder informs MEKH about the issuance of PoS regarding the gas concerned. (After this, the GO and the PoS cannot be sold separately).

The registration system is still very new (2026 start) or still in early operational rollout and information such as registry rulebook, user manual, detailed fee structure, clear onboarding guidance for market participants are not yet publicly accessible.

Since May 2026 (the publication date of this report), MEKH has become a full member of the AIB Gas Scheme Group with the goal to facilitate cross-border transactions.

11.7.4 *Main Challenges*

Hungary's biomethane market is at an early stage of development compared to leading European markets. Hungary's biomethane sector faces structural challenges despite its strong agricultural potential. Limited upgrading capacity, grid integration bottlenecks, low natural gas prices and insufficient financial incentives hinder market competitiveness. However, Hungary is gradually aligning with European renewable gas certification frameworks and participating in the EU Emissions Trading System.

Even a small mandatory blending commitment or binding quota for natural gas suppliers-backed by penalties could drive domestic uptake, given Hungary's annual gas consumption of

around 95 TWh (data for 2025). Without such measures, developers must rely on stable export markets with efficient administrative frameworks.

11.7.5 Recommendation

Hungary's market is emerging but constrained by policy and infrastructure gaps.

Hungary should accelerate the development of a modular, production-data-centred registry architecture that can evolve toward a more integrated Type 7 model as market functions expand. Aligning with ERGaR and AIB Schemes to practically enable export of and unlock the untapped biomethane potential, and introducing binding national targets (e.g., for transport/heating) could unlock growth.

11.8 IE: Ireland (BIOMAPE lead country)

11.8.1 Main Policy Instrument

Ireland's biomethane policy is anchored in the National Biomethane Strategy (2024) and a 2030 production target of 5.7 TWh of biomethane, equivalent to roughly 10% of current national gas demand. Two demand-side instruments are central to delivering this target.

The first is the Renewable Transport Fuel Obligation (RTFO), operated by the National Oil Reserves Agency (NORA), under which biomethane is already an eligible compliance fuel through Renewable Transport Fuel Certificates (RTFCs). Earlier introduced via the National Oil Reserves Agency Act 2007 and under the current framework updated in the European Union (Renewable Transport Fuel Obligation) Regulations 2025 (S.I. No. 664 of 2025).

The second, and the more strategically important for grid-injected biomethane, is the Renewable Heat Obligation (RHO). The Draft Renewable Heat Obligation Bill 2025 is currently in advanced drafting but does subject to redesign. The RHO would oblige large suppliers of fossil heating fuels (i.e.; natural gas, LPG, mineral oils and solid fuels) to source a growing share of their supply from renewable heating fuels. In contrast to earlier discussions of direct support instruments such as feed-in tariffs or production subsidies, the planned Renewable Heat Obligation would create demand for biomethane by placing the compliance obligation on fossil heating fuel suppliers, with the resulting costs ultimately passed through to gas consumers rather than financed directly through the state budget. The draft scheme envisages an initial obligation rate of 1.5% in the first (half-)year, rising to 3% in the second year, with higher rates after a year-three review and operation of the scheme to 2045. The draft Bill was notified to the European Commission on 23 December 2025 under Directive (EU) 2015/1535 (TRIS). On 29 March 2026, the European Commission issued a Detailed Opinion raising concerns that a proposed multiplier for domestically produced biomethane could constitute a restriction under Article 34 TFEU. The standstill period was extended to 29 June 2026, and adjustments to the support mechanism are expected, while the overall scheme is still anticipated to proceed.

In parallel, the Irish government has signalled a complementary biomethane capital grant of via the 2024 Biomethane Capital Grant Scheme. For the next phase, the National Biomethane Programme is listed in the NDP Sectoral Capital Plan 2026–2030 with an indicative allocation of €100–200 million.

Ireland has also established a framework for renewable gas Guarantees of Origin, with Gas Networks Ireland appointed as issuing body (S.I. 350/2022) and the Commission for Regulation of Utilities acting as supervisory authority. A revised supervisory framework published in March 2026 further clarifies issuance, cancellation, and cross-border transfers, and outlines the transition from an interim system (simplified database) to a fully digital national registry system. Ireland applies a domestic carbon tax to fossil fuels outside the EU ETS. This includes the Natural Gas Carbon Tax (NGCT) for non-transport gas use and the carbon component of Mineral Oil Tax (MOT) for vehicle gas. Biomethane receives a clear tax advantage in the transport sector, as the carbon component of MOT is fully relieved for the biogas share of qualifying vehicle gas.

For biomethane eligibility under ETS in Ireland, the Irish EPA guidance explicitly refers to biogas/biomethane fed into a national grid under Article 39(3) and (4) of the Monitoring and Reporting Regulation, of course, only if the fuel complies with the relevant RED sustainability and greenhouse-gas-saving criteria and this is demonstrated through an EU-recognised voluntary certification scheme or equivalent accepted evidence. Gas Networks Ireland has published dedicated guidance for ETS operators on how to update their monitoring plans when procuring biomethane, indicating that biomethane is already considered a practical defossilisation option, not merely a theoretical eligibility pathway.

11.8.2 Market Dimensions

Ireland's biomethane sector is still small in absolute terms but is expected to scale rapidly over the second half of the decade thanks to broad support within gas industry and policy makers. Two plants are currently injecting into the gas grid, with industry estimates pointing to ten to twelve injecting producers within the next two to three years and a sector-wide pipeline of projects backed by significant private investment, including the €80 million Stream BioEnergy plant in Cork (commissioning targeted 2027, 80 GWh/yr expected output) and several other large-scale anaerobic-digestion projects.

According to the Sustainable Energy Authority of Ireland (SEAI) natural gas statistics and annual demand data published by Gas Networks Ireland, with an annual demand of 50-55 TWh, gas remains one of Ireland's most important energy carriers, particularly for electricity generation (40% power from gas), heating and industry.

When the second biomethane plant started operation in 2022, it pushed the annual biomethane production from 5 to 61 GWh. The common aim of 5.7 TWh of biomethane per year by 2030 was manifested in the 2024 Climate Action Plan. Reaching this goal would increase the biomethane share within total gas demand from currently 0.12% to 11.4% in 2030 (assuming an annual gas demand of 50 TWh).

Ireland imports the majority of its primary energy. The single physical entry point for pipeline gas is the Moffat Interconnection Point via the United Kingdom. Physical biomethane imports or exports will therefore necessarily transit through UK pipelines. Mass balancing of energy amounts from biomethane might be at risk because of this single connection. Read more under main challenges.

11.8.3 Certificate and Registry Systems

Ireland has introduced a Renewable Heat Obligation and is preparing a renewable gas blending mandate as the principal demand instruments for biomethane.

Gas Networks Ireland (GNI) was appointed Issuing Body in July 2022, with the Commission for Regulation of Utilities (CRU) as Supervisory Authority. The country currently operates two complementary but separate certificate systems: NORA runs the RTFC scheme under the RTFO for transport, while GNI has been operating a custom-built Excel-based pilot registry for renewable gas since 2019. This voluntary pilot registry by GNI has already demonstrated practical market functionality because it enabled regular biomethane imports from Germany, supported the use of biomethane as a renewable transport fuel, and facilitated claims by EU ETS companies. The pilot supports two distinct national certificate concepts in parallel. Certificates of Origin (CoO) on a book-and-claim basis and Proofs of Origin (PoO) on a mass-balance basis. Indefinite biomethane storability in the grid for mass-balancing and allocation to a later cancellation date are special features of the registry. The custom-built simplified system showed showing how a registry can help unlock market value even before a fully mandated national system is in place.

While the pilot has been sufficient as a market-seeding instrument, it is not suitable for the scale and audit depth needed from 2027 onwards. Ireland is preparing to tender an efficient IT-based registry system for full operation in 2027, with Guarantees of Origin under Article 19 RED III integrated alongside the national certificate scheme to ensure simultaneous compliance with EU and Irish requirements.

11.8.4 Main Challenges

A key structural issue arises from gas transit via the United Kingdom. As outlined in chapter 3.3.3 on mass balance and chain of custody under the Renewable Energy Directive, the application of the mass balance system for gaseous fuels relies on the recognition of the European gas grid as a single interconnected logistical system, as reflected in Implementing Regulation (EU) 2022/996. However, Ireland's only physical connection to this interconnected system runs via the United Kingdom via the Moffat interconnection point. Since the UK is no longer an EU Member State, biomethane cross-border delivered and tracked in mass balancing mode may potentially be affected. In its TRIS feedback on the Renewable Heat Obligation (RHO), the European Commission indicated that biomethane transported via UK infrastructure may not be eligible for counting towards Ireland's RED targets. This creates regulatory uncertainty regarding the continued recognition of Ireland's connection to the EU gas grid for mass balance purposes. If applied strictly, this interpretation could call into question the eligibility of historical biomethane imports from Germany via the Nabisy system since 2020. As a result, existing practices for cross-border biomethane trade could face increased administrative and financial burdens, potentially placing Irish market participants, particularly domestic producers, at a structural disadvantage. The discussions with the European Commission on this matter were ongoing at the time of writing.

A second major challenge relates to the redesign of the Renewable Heat Obligation. The European Commission's rejection of the proposed national production multiplier (Detailed Opinion of 29 March 2026) represents a significant setback for project economics. Without the 1.5 multiplier, domestically produced biomethane, currently estimated at production costs of

€120–220/MWh, must compete directly with significantly lower-cost imports. A redesign of the support mechanism is therefore expected, potentially including alternative instruments such as enhanced capital support or a buy-out mechanism similar to those used in transport schemes. Until such adjustments are made, and the scheme progresses beyond the extended standstill period ending on 29 June 2026, investment certainty for early-stage anaerobic digestion projects remains limited.

Ireland faces a number of structural challenges, which the development of a robust renewable gas registry is expected to help address. A further implementation challenge lies in the timing and technical specification of Ireland's new registry infrastructure. Although GNI was appointed as Issuing Body for renewable gas GOs in 2022, the supervisory framework was only finalised in March 2026. A newly tendered IT system is expected to be fully operational before Q1 of 2027. Ireland will require some specific registry features to tackle domestic challenges such as suitable data exchange with NORA on Renewable Transport Fuel Certificates (RTFCs), overcoming risks of the Irish gas grid being singled-out with the help of a transparent and robust mass balancing function, enabling connection to European schemes for European market integration and overcoming unresolved key interface requirements with the Union Database. All of this should be achieved while ensuring data integrity and security, providing efficient and user-friendly administrative processes for market participants, and supporting the effective uptake and scaling of the biomethane market in Ireland.

11.8.5 Recommendation

Ireland should prioritise three closely linked policy actions. First, it should seek urgent legal and operational clarification at EU level on the eligibility of mass-balanced biomethane transfers via the United Kingdom. Second, the Renewable Heat Obligation should be redesigned swiftly in a way that preserves investment certainty for domestic biomethane production while remaining compatible with EU internal market rules. If the domestic production multiplier is removed, Ireland should compensate through trade-neutral instruments that strengthen project bankability, such as a well-targeted capital grant programme, a sufficiently ambitious and predictable RHO trajectory, and potentially a carefully calibrated buy-out or alternative compliance mechanism. Third, Ireland should clearly define the interaction between the RHO, the RTFO/RTFC system, Guarantees of Origin, national renewable gas certificates, and ETS-related claims. As the country is moving toward a multi-purpose biomethane market, a clear allocation of certificate functions and claims will be essential to avoid overlaps, reduce uncertainty for market participants, and support a coherent scale-up of the sector.

These policy priorities should be reflected in the design of Ireland's future registry infrastructure, which will need to support a fragmented but increasingly interdependent certificate landscape.

Ireland can be understood operating a Parallel Systems model (Type 4), but it should be complemented by either a Production registry (Type 5) or a Data Center functionality (Type 6). Since the GNI renewable gas registry and the NORA RTFC system will continue to operate independently, an early solution for data consolidation and exchange is recommended. Thus, a centralised data-validation and coordination layer would be highly valuable to ensure robust information exchange between systems, prevent double claiming and double counting, support consistent target allocation, and strengthen the transparency of mass-balanced

biomethane flows, especially in light of Ireland's specific cross-border trade uncertainties via the UK.

11.9 IT: Italy

11.9.1 Main Policy Instrument

Italy's biomethane policy is driven by two complementary instruments: a transport-fuel compliance scheme based on Emission certificates for Consumption (IT: Certificati di Immissione in Consumo, CIC), and an investment-led incentive programme financed through the National Recovery and Resilience Plan (Piano Nazionale di Ripresa e Resilienza, PNRR). The CIC scheme transposes the RED transport-quota obligation: fuel suppliers must surrender certificates corresponding to their share of advanced renewable fuels, with one CIC issued per 5 Gigacalories (equals roughly 5.81 MWh) of advanced biomethane for transport use (reference/penalty ceiling is around 375€/CIC). The CIC system has historically been the single most important driver of biomethane economics in Italy and has effectively guaranteed market offtake for compliant producers. In practice biomethane has been the main contributor to fulfil the 75% advanced-biofuel quota.

The PNRR biomethane measure, regulated by the 2022 Ministerial Decree, mobilises approximately €1.9 billion in capital grants (40% of eligible investment) combined with a 15-year operational support scheme (premium/tariff-based) for selected advanced-biomethane plants. Five competitive tender rounds were run between January 2023 and January 2025, awarding approximately 253,000 m³_{standard}/h of injection capacity in addition to organic municipal waste projects. Eligibility is restricted to advanced waste / residue feedstocks, with a minimum 65% GHG saving for transport use (80% for other uses) and mandatory Leak Detection and Repair (LDAR) provisions.

11.9.2 Market Dimensions

Italy is, together with France, one of the two fastest growing biomethane markets in Europe. In 2024, there were 115 operational plants producing approximately 6.5 TWh of biomethane. The IEA Renewables 2025 report identified Italy as one of the five countries (with Germany, France, Denmark and the Netherlands) that collectively account for 93% of EU biomethane production. National 2030 ambition is in the order of 5.7 bcm/year of biomethane. Italy is also one of the leading bio-LNG producing countries in Europe.

11.9.3 Certificate and Registry Systems

In Italy, the biofuel obligation system is administered through Certificati di Immissione in Consumo (CIC), issued by the GSE (Gestore dei Servizi Energetici) to entities that supply sustainable biofuels, including biomethane, into the national distribution system. Each CIC attests to the supply of a defined quantity of energy (10 Gcal/11,62 MWh for conventional biofuels, 5 Gcal/5,81 MWh for advanced biofuels), and certificates are tradeable on a dedicated market organised by the GME (Gestore dei Mercati Energetici). Advanced biomethane from waste and residue feedstocks benefits from double counting under the CIC framework, making it a particularly valuable compliance instrument in the Italian transport sector.

Italy formally complies with Article 19 RED by assigning GSE as the GO issuing body for gas, but the system is less developed and less market-relevant than the CIC market. GSE is a member of AIB but not yet fully connected to the hub for cross-border transactions.

Although Italy operates a (Type 4) parallel system landscape without automatic reconciliation between GO issuance and CIC generation within a unified system, our research shows that consistency is ensured through procedural safeguards, including rules to prevent double counting, such as restricting the simultaneous use of the same biomethane volume for both disclosure and compliance purposes without appropriate cancellation. This coordination relies heavily on input data consistency and sustainability documentation (PoS). Producers must declare the intended end-use pathway (e.g. transport vs. disclosure), and GSE cross-checks this with sustainability certificates, injection data, and contractual flows.

11.9.4 Main Challenges

Italy's principal challenge is the strong concentration of its biomethane support around the transport sector. With the CIC quota delivering most of the revenue and the PNRR measure prioritising transport-eligible projects, biomethane has been steered toward fuel applications rather than toward heat or industrial decarbonisation.

In Italy, the Gestore dei Servizi Energetici (GSE) is responsible for both Guarantees of Origin (GO) and Certificati di Immissione in Consumo (CIC), but these are administered through two distinct registry systems rather than a single integrated platform. The GO system, implemented under Article 19 of the Renewable Energy Directive, serves disclosure purposes and manages the issuance, transfer, and cancellation of certificates based on a book-and-claim approach aligned with European frameworks. In parallel, the CIC system functions as a compliance registry for the transport sector, applying mass balancing and strict sustainability verification to track renewable fuel volumes used to meet RED targets.

The result is a moderately fragmented registry landscape with parallel systems (Type 4) despite being managed by the same operator. Although both systems are operated by GSE, they remain separate in terms of data structures, accounting methodologies, and regulatory objectives.

11.9.5 Recommendation

While effective in principle, the current approach to prevent double counting depends on robust governance and data verification and is less automated than integrated registry models, making it more comparable to a procedurally aligned parallel system rather than a technically unified one. Italy should strengthen technical and procedural coordination between the GO, CIC and PNRR-related data environments. Underpinning the GO Issuing Body and, the CIC system and the PNRR project register by a single national production database (Type 5) or a common data center (Type 6) for data consolidation before public reporting could significantly simplify market rules and improve market efficiency.

In parallel, policy makers could assess whether biomethane market development should be broadened beyond transport into heat and industrial decarbonisation pathways.

11.10 LT: Lithuania

11.10.1 Main Policy Instrument

The Renewable Energy Law of the Republic of Lithuania (LT: Lietuvos Respublikos Atsinaujinanciu istekliu energetikos istatymas) covers the national implementation of RED II/III. It explicitly recognises biomethane as a renewable energy carrier and aligns with transport decarbonisation targets (RED II / RED III).

It also provides the framework for investment support for capital costs (CAPEX support) which has significantly contributed to market growth, with approximately €70 million allocated to biomethane development since 2020. However, there is no production support for biomethane in Lithuania.

The Lithuanian transmission system operator Amber Grid receives comprehensive mandates via this Act for the Lithuanian biomethane sector with responsibility for grid access, definition for technical specifications of gas quality and the operation of the GO issuing body.

11.10.2 Market Dimensions

Lithuania has a dynamic early stage biomethane market in the Baltic region, combining ambitious renewable gas development. At the beginning of 2026, 12 biomethane plants were operational, with a combined production capacity of approximately 67 MW. The market comprises 277 GWh produced in 2025 and an export of 138 GWh and an import of 55 GWh. National targets aim for approximately 1.4 TWh by 2030.

The Lithuanian biomethane market is developing rapidly due to supportive transport policies, expanding injection infrastructure, and integration into European certificate trading schemes. According to the Website of Amber Grid, biomethane is used predominantly in transport (~99%).

11.10.3 Certificate and Registry Systems

Lithuania operates primarily as a GO-based system (Type 1). Amber Grid, the national transmission system operator for gas, acts as the designated issuing body under Lithuanian renewable energy legislation since 2019. However, for the currently relatively small market, Lithuania has been operating an advanced Guarantee of Origin (GO) issuing body infrastructure since 2024 based on the Certigy system developed by Unicorn Systems and operated by Amber Grid. To serve the European biomethane market, Amber Grid became system participant of the ERGaR Certificate of Origin Scheme in May 2026 and has been part of the AIB EECS Gas Scheme Group since 2025 to review their future connection to the AIB hub.

The Environmental Protection Agency is the key body responsible for documentation collecting sustainability data, verifying compliance with renewable fuel quotas, and ensuring alignment with RED requirements.

11.10.4 Main Challenges

Although the regulatory framework allows biomethane to contribute to ETS decarbonisation and the practical implementation of a GO issuing body (type 1) is highly advanced, biomethane

use in Lithuania is currently highly concentrated in the transport sector, accounting for around 99% of consumption.

The absence of a clearly defined and integrated system linking the GO registry operated by Amber Grid, sustainability certification (PoS), and ETS reporting points towards the emergence of parallel systems (type 4) in Lithuania, as already seen in Austria and Germany.

11.10.5 Recommendation

This structural gap of unharmonized certificate systems in Lithuania could be filled with either a production database (Type 5) to document all production volumes before the respective certificates reach sector application. However, if it is difficult to establish a new system at the beginning of this tracking chain, a common data center (Type 6) for data consolidation after the established registry but before public reporting could significantly simplify market rules and improve market efficiency.

In parallel, Lithuania could clarify and operationalise the documentation pathways for biomethane use beyond transport, particularly for ETS-related applications and broader renewable gas market development.

11.11 NL: The Netherlands

11.11.1 Main Policy Instrument

The transposition of the Renewable Energy Directive (RED II/III) into national legislation, primarily performed through the Environmental Management Act (Wet milieubeheer) and the Gas Act (Gaswet), establishing the legal basis for renewable fuel obligations in transport, regulate grid access and injection of renewable gases, and define the roles of market actors. The quota obligation system for renewable energy targets in transport has been in place since 2015, replacing earlier biofuel obligations, and has been further refined in line with RED II from 2021 onwards.

Electricity from biogas and biomethane CHP plants is eligible under market premium support model of the SDE programme. The SDE has advanced to the SDE++ scheme over the past years and is defined under the Act on Promoting the Dutch Sustainable Energy Transition (Stimuleren Duurzame Energieproductie).

In addition, the Green Gas Blending Obligation Act (Wet bijmengverplichting groen gas) introduces a new regulatory mechanism targeting the gas sector, requiring gas suppliers to include a minimum share of biomethane in their supply portfolio. Compliance is expected to be enforced by the Dutch Emissions Authority, including the application of penalty payments for non-compliance. The start of the obligation has been pushed back to January 2027, with the target adjusted to an equivalent of approximately 1.1 billion cubic metres (3.8 Mton CO₂ reduction) by 2030.

11.11.2 Market Dimensions

The biomethane market in the Netherlands is one of Europe's most developed, with 2,696 GWh produced in 2024 from 82 active plants, the majority grid connected. Current production

volumes average ~2–3 TWh/year, with strong growth expected under policy ambitions targeting ~20 TWh by 2030.

The transport sector plays a key role, with a strong policy framework and an emerging infrastructure with four bio-CNG and four bio-LNG plants in operation and over 170 public filling stations offering bio-CNG.

11.11.3 Certificate and Registry Systems

The Dutch biomethane registry has undergone significant institutional evolution, transitioning from a gas-specific system originally operated by Vertogas, a subsidiary of Gasunie. In 2023, the system was merged with the electricity GO registry (CertiQ) to form a new multi-energy GO issuing body (type 1) under the title VertiCer.

The Netherlands has three different certificate types established:

Compliance with the quota obligation system for renewable transport targets is demonstrated via tradable certificates known as *Hernieuwbare Brandstofeenheden* (HBE, sometimes referred to as HVE), which represent units of renewable energy supplied to the transport sector. The system is administered by the Dutch Emissions Authority, which operates the registry, verifies compliance, and publishes aggregated market data; market participants must register, provide sustainability documentation, and report volumes within a well-established, transparent, and actively traded certificate market.

VertiCer, as GO issuing body (type 1), issues and manages Guarantees of Origin. For European market integration, it is fully integrated in the ERGaR Certificate of Origin Scheme but aims at stopping this participation by mid 2026, while full integration with the AIB hub for cross-border transfers and compliant with EECS Rules only is anticipated.

The Green Gas Blending Obligation Act (*Wet bijmengverplichting groen gas*) introduces an obligation on energy suppliers to blend a growing share of domestically produced biomethane into the gas supply for buildings, transport, and smaller industrial consumers. Compliance is administered through tradeable Green Gas Units (GGEs), which are derived from unsubsidised Guarantees of Origin exchanged at the Dutch Emission Authority (NEa). Only domestic production qualifies for GGE creation, and a buy-out mechanism is available for suppliers unable to acquire sufficient certificates.

11.11.4 Main Challenges

The interaction between GGEs, HBE certificates, and Guarantees of Origin introduces additional complexity. Each certificate type serves a different purpose, compliance in transport, compliance in the gas sector, and disclosure, and is managed within a different IT-system, yet all may relate to the same underlying biomethane volumes. This situation poses risks for double counting.

The Netherlands are faced with a scaling challenge. The domestic production is currently insufficient to meet even the reduced 2027 obligation.

The Dutch policy framework has been challenged by the European Commission on two fronts. The first is the EU internal-market compatibility of the national-only feature of GGE creation: under TRIS notification 2024/0253/NL of 8 May 2024, the Commission issued a Classical Detailed Opinion on 14 August 2024 (followed by a Commission reaction of 16 February 2026 to the Dutch response of 20 November 2025; the Netherlands replied again on 3 March 2026),

finding that the restriction of GGE creation to biomethane produced in the Netherlands and injected into the Dutch grid is incompatible with Article 34 TFEU and not proportionate under Article 36 TFEU. The proceeding is still open, and the national-only requirement remains in the draft. The full TRIS notification trail (including the detailed opinion and all subsequent exchanges) is available online.

technical-regulation-information-system.ec.europa.eu/en/notification/25868

11.11.5 Recommendation

To bridge the gap between the three parallel systems (type 4) in the Netherlands a production database (type 5) to document all production volumes before the respective certificates reach sector application or a data center (type 6) to collect all available information before reporting for national targets could be a suitable solution. Ensuring consistency and avoiding double counting requires either clear rules on certificate issuance, use, and cancellation across systems or a technical solution.

11.12 NO: Norway

11.12.1 Main Policy Instrument

Norway is not an EU Member State but is closely integrated. Through the EEA Agreement (European Economic Area Agreement), Norway participates in large parts of the EU internal market and implements many EU energy, climate and environmental rules, including participation in the EU ETS. However, Norway is not bound by all EU legislation and has not fully aligned certain systems, including RED II/III rules for renewable gas Guarantees of Origin. Responsibility for climate and emissions regulation, including the national emissions trading framework under the Norwegian climate quota law and regulation (Klimakvoteloven and Klimakvoteforskriften), lies primarily with the Norwegian Environment Agency.

Norway does not operate direct production-based or consumption-based support schemes for biomethane but instead provides public support with focus on investment aid and innovation funding. The central institution in this regard is Enova SF, the state-owned climate and energy transition agency financed through the Norwegian Climate and Energy Fund.

An important indirect policy advantage for biomethane in Norway arises from the structure of the national CO₂ taxation system. The Norwegian CO₂ tax is legally based on the Act relating to Excise Duties (Lov om særavgifter) and annual parliamentary tax decisions covering fossil mineral products. Biomethane, being recognised as renewable fuel, is effectively exempt from CO₂ taxation. Since biomethane falls outside the scope of the Norwegian CO₂ tax legislation, the economic benefit arises automatically from the legal definition of taxable fossil fuels rather than from a dedicated biomethane exemption scheme. Norway levies a CO₂ tax on fossil natural gas of NOK 3.26 per m³_{standard} in 2026. Using a standard energy conversion and a standard exchange rate, this is equivalent to approximately 25-26 €/MWh. This tax incentive creates a significant economic advantage for biomethane relative to fossil gaseous fuels in transport and industrial applications.

11.12.2 *Market Dimensions*

Norway has a very small domestic natural gas market, as the country relies predominantly on hydropower and electricity rather than gaseous fuels for heating and power generation. The Norwegian national energy statistics (Statistics Norway – Energy Balance) reported total final energy consumption of approximately 214 TWh in 2024, and domestic natural gas demand around roughly 2–3 TWh per year. According to the International Energy Agency (IEA), natural gas represents only around 1% of Norway's total final energy consumption, with demand primarily originating from industrial applications rather than residential heating.

The EBA Statistical Report explains that with around 79% of the total annual biomethane production, the main part (453 GWh) gets used in the transport sector. Norway is leader of bio-LNG production with 11 bio-LNG filling stations and a further 40 bio-CNG filling stations.

Since there is no nationwide transmission network comparable to other European Member States, biomethane injection into a national grid is structurally constrained and focus is expected to stay on the transport sector and its filling stations.

11.12.3 *Certificate and Registry Systems*

Norway does neither operate its own certificate system nor operate a dedicated registry system. Particularly in the transport sector, it relies on RED-compliant Voluntary certification schemes.

11.12.4 *Main Challenges*

Norway's biomethane market is characterised by a strong focus on transport applications and decentralised use cases. This reflects the country's limited domestic gas grid infrastructure and comparatively small national gas demand. As a result, biomethane development is mainly driven by bio-CNG and bio-LNG markets, while the role of grid-injected biomethane remains structurally limited. At the same time, Norway does not operate a dedicated national biomethane certificate or registry system and relies primarily on voluntary certification schemes for sustainability documentation, especially in the transport sector. This approach may be sufficient for the current market structure, but it provides only limited national visibility on biomethane production, use and claims. Future interaction with EU-style compliance frameworks, cross-border certificate systems or Union Database-related traceability requirements therefore remains unclear. As biomethane markets mature, the absence of a dedicated national tracking framework could become a barrier to transparent reporting, target allocation and recognition of Norwegian biomethane in wider European markets.

11.12.5 *Recommendation*

Norway should assess whether the current reliance on voluntary certification remains sufficient as biomethane markets expand and climate-policy interactions become more important. A lightweight national data or registry framework, or at least clearly defined interfaces between sustainability documentation, tax treatment and future European traceability systems, could improve transparency without imposing unnecessary complexity on a transport-focused market.

11.13 PT: Portugal (BIOMAPE focus country)

11.13.1 *Main Policy Instrument*

Portugal has introduced a feed-in tariff for electricity from biogas with Decree-Law 225/2007, offering different tariffs depending on the biogas substrates. The scheme has been closed for new applicants since 2012 and expires (plant by plant) after a 15-year payment lifetime since the first injection, with complete phase out anticipated in 2027.

Portugal has transposed Art 19 RED II/III but a clarification on the distinction between compliance and voluntary uses of biomethane is expected with the full transposition of RED III. The legal foundations of the Portuguese GO scheme are Law no. 71/2018 of 31 December 2018 (electricity, CHP, heating and cooling) and Decree-Law no. 60/2020 of 17 August (renewable gases), which jointly appoint Rede Eléctrica Nacional, S.A. (REN), the Portuguese electricity and gas TSO, as issuing body under the trading name EEGO (Entidade Emissora de Garantias de Origem).

On 19 March 2026, the Council of Ministers approved a new Decree-Law creating a cost-sharing mechanism, supported by the National Gas System, for the connection of biomethane and other renewable-gas production facilities. According to APPB — Associação Portuguesa de Produtores de Bioenergia, who replied to the BIOMAPE questionnaire, this measure, building on the Biomethane Action Plan 2024–2040 and the National Hydrogen Strategy, is expected to remove a key financial barrier for early-stage projects and facilitate market uptake.

11.13.2 *Market Dimensions*

The 2024 national energy balance recognises biogas (while biomethane is not yet accounted for as a separate category) at around 1 TWh of domestic primary production and primary consumption. Of this, 846 GWh is converted into energy, primarily for electricity generation and cogeneration.

Biomethane production and grid-injected biomethane is at an early stage with three operational biomethane plants in 2024 and remains marginal relative to a national gas demand of approximately 60 TWh/year. According to Associação Portuguesa de Produtores de Bioenergia, the main feedstock potential lies in agro-industrial residues, such as those from olive oil, wine, and pulp and paper industries, as well as municipal organic waste.

11.13.3 *Certificate and Registry Systems*

Rede Eléctrica Nacional, S.A. (REN), the Portuguese electricity and gas TSO has been appointed as the GO issuing body. The custom-built GO issuing body (Type 1) for electricity and gas operates under the trading name EEGO (Entidade Emissora de Garantias de Origem) and is integrated with the AIB Hub for cross-border transfers. The biomethane GO function within EEGO has been operational since July 2024.

There is no national PoS register for sustainability data in the biomethane sector and no practical implementation for biomethane in ETS reporting, and Portuguese economic operators will have to rely on UDB-registered voluntary schemes for sustainability documentation.

11.13.4 Main Challenges

In the coming years, the entry into the gas/biomethane market for current biogas stakeholders, presently relying on the renewable electricity FiT from biogas, will be challenging, especially without additional biomethane production or consumption support. The mechanism for gas grid access is an important step but without stable production-side or demand-side support schemes, the transition will be challenging.

Beyond the transport quota, there are limited domestic demand drivers.

The absence of a national mass-balance / PoS layer means that compliance market integration depends on procedural alignment with importer countries rather than on systemic data exchange.

Biomethane is formally recognised within the Portuguese EU ETS framework under Decree-Law 12/2020 and the EU MRV Regulation, but its practical application remains negligible due to limited production volumes and the absence of an integrated certificate system.

11.13.5 Recommendation

Portugal should accelerate the introduction of a dedicated production- or demand-side support scheme for biomethane, ideally combined with the newly introduced grid-connection cost-sharing mechanism and other targeted investment support where appropriate.

The current GO issuing body (Type 1) is not set up to support sustainability and target reporting. A transition towards a wholesome registry (Type 7) or assistance via a production registry (Type 5) or data center (Type 6) could fill this structural gap and allow for connection to the Union Database and the practical acceptance of biomethane in the ETS to create the necessary market pull for market ramp-up and European competitiveness.

11.14 RS: Serbia (BIOMAPE focus country)

11.14.1 Main Policy Instrument

Serbia is an EU candidate country and is aligning its energy framework with the EU acquis under the Energy Community Treaty and the Renewable Energy Directive. The Ministry of Mining and Energy is the lead authority for renewable-energy policy and EU-alignment; the Energy Agency of the Republic of Serbia (Agencija za energetiku Republike Srbije) is responsible for regulatory oversight. A dedicated biomethane support scheme is not yet adopted at national level, existing instruments (feed-in tariffs and auction-based market premiums) apply exclusively to renewable electricity and do not cover biomethane production.

Articles 19 RED (as transposed through Energy Community obligations) is not yet implemented for renewable gases.

To prepare the regulatory ground for a biomethane market, the Ministry, with the support of UNDP, EY, and the Serbian Biogas Association, has established a working group dedicated to developing the national biomethane regulatory framework. According to information provided by the Serbian Biogas Association via the BIOMAPE questionnaire, these initial steps are intended to align the national system with EU requirements and to build the basis for future market development, including a future Guarantees of Origin scheme for renewable gases.

11.14.2 *Market Dimensions*

The existing biogas sector comprises approximately 45 plants with a total installed capacity of around 45 MW, generating an estimated 350–370 GWh of electricity annually. When including numbers for heat generation from the biogas sector, the total energy provided by the Serbian biogas sector amounts to 670 GWh annually.

Serbia currently has no biomethane production or grid injection, and consequently no recorded biomethane certificate trading.

The Serbian “National Biomethane Gap Analysis” identified a domestic biomethane potential of approximately 0.37 TWh in the short term, 2.16 TWh in the medium term, and 4.24 TWh in the long term, against a national gas consumption of roughly 26–32 TWh per year. This indicates significant development potential for the Serbian biomethane sector, while also illustrating the substantial gap between today’s relatively small biogas-to-power fleet and a future large-scale biomethane market.

11.14.3 *Certificate and Registry Systems*

Serbia does not currently operate any registry for biomethane certificates and has no Issuing Body for renewable gas Guarantees of Origin. There is no national biofuel registry for Proofs of Sustainability and no national tracking system for hydrogen or bio-CO₂.

The Ministry of Mining and Energy is the primary responsible authority for any future implementation of the Union Database, in coordination with relevant supervisory and audit bodies.

11.14.4 *Main Challenges*

The establishment of a functional biomethane market lacks key enabling elements, such as development and alignment of the legal and regulatory framework, as well as the establishment of appropriate incentive mechanisms in line with state aid rules, a certificate and registry system for renewable gases. A coordinated cross-sectoral approach involving the energy, agriculture, waste management and environmental sectors is also necessary, particularly to improve feedstock availability, enable the use of by-products such as digestate, and support the integration of biomethane into the gas system. The funding gap between investment cost and revenue support, in the absence of either a quota mechanism or an operating subsidy, is the binding constraint at project level.

11.14.5 *Recommendation*

Serbia should use its greenfield position to establish a coherent biomethane framework from the outset, rather than replicating the fragmented structures observed in more mature markets. A gradual shift from an electricity-focused biogas framework toward renewable-gas market development could support higher-value use cases for biomethane.

In the first market phase, Serbia should prioritise simple and bankable production-side support, such as a feed-in tariff, feed-in premium or similar production-support mechanism. This should be complemented by targeted investment support for upgrading existing biogas plants and constructing new biomethane plants, as well as clear and predictable grid-access rules. Once initial domestic supply has emerged, demand-side instruments such as transport quotas, green

gas obligations or other consumption incentives can be introduced to create stable long-term market pull.

The economic potential of Serbia's biomethane sector suggests that the country could become an exporting market if favourable policy, certification and trading conditions are created. Current estimates indicate that reconstructed existing biogas plants would require biomethane prices of around 90 €/MWh, while newly built plants would require approximately 115 €/MWh for economically viable operation. These levels could be competitive in European markets with strong demand-side incentives, carbon-price advantages or certificate values, provided that Serbian biomethane can be reliably certified, registered and recognised in cross-border trade. These policy measures should be embedded in an integrated registry architecture from the beginning. A Type 7-style system would allow Serbia to manage production data, certificates, sustainability information and future compliance use cases within one coherent framework, thereby avoiding double counting and reducing administrative complexity. Building on the existing biogas sector, combined with coordinated institutional development and robust governance, could significantly accelerate the establishment of a scalable and resilient biomethane market in Serbia.

11.15 SE: Sweden

11.15.1 Main Policy Instrument

Sweden's biomethane sector is driven by a multi-layered policy framework that combines financial incentives, tax exemptions, investment support, and regulatory measures to accelerate production and usage across transport, heating, and industry.

Sweden has implemented Article 19 RED III for biomethane and hydrogen and prepared for Article 31 of RED III via the Act on Sustainability Criteria for Certain Fuels (Lag (2010:598) om hållbarhetskriterier för vissa bränslen).

Sweden has launched a SEK 1.035 billion (€106 million) support scheme with annual production support premiums (under Förordning (2022:225) om statligt stöd till produktion av viss biogas) for biogas from RED Annex IX advanced raw materials. Sweden also offers subsidies for CBG (compressed biogas) or LBG (liquified biogas). Support is capped under General Block Exemption Rules (GBER) at 50,000 tonnes biomethane equivalent per plant and a maximum of 30 million EUR per project. The scheme is administered by the Swedish Energy Agency (Energimyndigheten).

The Swedish Environmental Protection Agency administers Climate Leap (Klimatklivet), a competitive grant scheme (under Förordning (2015:517) om stöd till lokala klimatinvesteringar). It provides 30–65% investment support for local and regional measures that reduce greenhouse gas emissions, with priority given to projects demonstrating the highest GHG reduction per investment. A large share of grants has been allocated to biogas production projects.

The European Commission has approved two Swedish tax exemption schemes for non-food-based biogas and bio-propane used for heating or as motor fuel, aligning with EU State aid rules. Biogas and biomethane used for transport or as a heating fuel are exempted from energy and/or carbon tax, while Sweden maintains generally high energy and carbon taxes on fossil fuels. (Using a standard energy conversion and a standard exchange rate, the Swedish carbon

tax of SEK 1,520 per tonne of CO₂ is equivalent to approximately 28 €/MWh.) This is administered by the Swedish Tax Authority (under Lag (1994:1776) om skatt på energi). Sweden has allocated SEK 36 billion (€3.3 billion) for Bio-CCS (Carbon Capture and Storage) from 2026 to 2046, supporting carbon removal from biomethane production and combustion. This funding is distributed through reverse auctions, targeting the lowest-cost biogenic CO₂ capture and storage projects.

11.15.2 Market Dimensions

Comparable to Norway, biomethane injection into Sweden's national grid is structurally constrained because the national gas grid is not as widespread constructed as in the mainland EU. Biomethane use cases focus mainly on the transport sector and its filling stations. Sweden's annual natural gas consumption has been relatively low at around 10 TWh (in the years 2020-2023), which reflects the lesser focus on the gas grid and gas applications in the country. According to the EBA Statistical Report, the country's 71 active biomethane plants produced 1,630 GWh in 2024, with approximately 90% used in the transport sector, supported by a network of 270 filling stations (235 bio-CNG and 35 bio-LNG) nationwide. Additionally, the Swedish Energy Agency reported in their response to the BIOMAPE questionnaire that around 547 GWh of energy amounts from biomethane were injected into the two regulated gas grids southwestern Sweden/EU-grid and Stockholm gas grid. They also reported the total biogas use (inclusive net imports of CBG and LBG) in 2024 of 4.1 TWh (which amounts to about 40% of the country's gas demand).

11.15.3 Certificate and Registry Systems

Since beginning of February 2026, a voluntary system for GOs is operated by the Swedish Energy Agency (Energimyndigheten) mandated as issuing body via the Act on Certain Emissions of Greenhouse Gases (Lag (2020:1173) om vissa utsläpp av växthusgaser). The GO issuing body is expected to connect to the AIB EECS gas scheme by end of 2026 to enable cross-border transactions.

The system neither related to any regulations nor ongoing support schemes. There is no database for sustainability information (PoS) in place. However, UDB connection will be necessary to fulfil the RED-sustainability requirements implemented in taxation and ETS-regulation.

11.15.4 Main Challenges

Sweden's biomethane market is well established in the transport sector, but its registry and certificate framework is still at an early stage of development. The newly introduced GO issuing body for renewable gases is an important step, but it is not yet strongly linked to existing support schemes, tax exemptions or compliance-related use cases. At the same time, Sweden does not operate a dedicated national Proof of Sustainability database for gaseous fuels, meaning that sustainability documentation depends on recognised certification schemes and future interaction with the Union Database. This creates uncertainty regarding how biomethane volumes, especially imported volumes, can be consistently documented, claimed and reported for renewable-energy targets, tax treatment and possible future compliance applications. As cross-border biomethane flows remain relevant for Sweden, clearer coordination between GO

issuance, sustainability documentation, SHARES/Eurostat reporting and UDB processes will be necessary to avoid reporting inconsistencies and ensure transparent market development.

11.15.5 Recommendation

Sweden should clarify the interaction between its new GO issuing body, sustainability documentation, tax-exemption requirements and future Union Database processes. A more explicit data-coordination framework would help ensure that domestic and imported biomethane volumes are documented consistently and can be clearly allocated to disclosure, support, tax or target-reporting purposes. This could be achieved by developing the current Type 1 GO issuing body into a broader Type 3 hybrid system, or by adding a Type 6 data-centre function to coordinate GO, sustainability and reporting data. In parallel, Sweden should proceed with the planned connection of its GO system to European transfer schemes, while ensuring that cross-border biomethane flows are accompanied by robust rules for certificate use, cancellation and statistical reporting.

11.16 SK: Slovakia

11.16.1 Main Policy Instrument

Slovakia's biomethane policy framework is embedded in a well-established gas market with a high share of natural gas in the national energy mix and an annual gas demand of around 50 TWh. Act No. 309/2009 Coll. regulates support for renewable energy sources and high-efficiency cogeneration and has been updated to reflect EU requirements, including provisions related to the Union Database (§14ga).

Slovakia has historically supported electricity generation from biogas through a feed-in tariff under Act No. 309/2009. Existing biogas plants may still benefit from this scheme until the end of their 15-year support periods, mostly around 2028.

Slovakia does not currently provide direct operational support schemes for renewable gas production. Instead, policy support is limited to investment aid. Recent investment support for renewable gases in Slovakia has been provided through competitive calls under the Slovak Recovery and Resilience Plan. In particular, Call No. 01I02-26-V05 (closed on 31 October 2023) allocated EUR 17 million to support the conversion of existing biogas plants into biomethane production facilities. In addition, Call No. 01I03-26-V08 (closed on 30 July 2024) provided EUR 13.56 million for the development of renewable hydrogen production and storage infrastructure.

The Slovak Ministry of Environment acts as the competent authority for ETS implementation and verification of emissions reporting. National guidelines define how biomethane injected into the gas grid can be accounted for in the EU Emissions Trading System (ETS).

Slovakia and Lithuania are the only respondents to the BIOMAPE questionnaire who confirm explicitly that Article 31 (Union Database) has been addressed at Member State level, by determining the respective entity to responsible for exchange with Union Database.

11.16.2 Market Dimensions

The EBA Statistical Report lists 80 active biomethane plants in 2024 and the second biomethane production plant starting operation in April 2025.

SPP-distribúcia (SPPD) publishes the official statistics for biomethane registered in the Slovak Registry of Renewable Gases at <https://www.spp-distribucia.sk/dodavatelia/register-obnovitelnych-plynov/statistiky>.

11.16.3 Certificate and Registry Systems

Slovakia has established a comparatively advanced certification framework for renewable gases centered around the registry operated by purpose, the responsible party for operating the gas distribution network. This system manages the issuance, transfer, and cancellation of Guarantees of Origin (GOs) for biomethane and provides the basis for national and EU reporting, including statistics derived from cancelled certificates.

Slovakia has introduced a complementary national instrument with the Biomethane Quantity Certificate (CoA). The purpose of this dedicated domestic certificate type was introduced to enable surcharge payments to CHP plants for electricity produced from biomethane in Slovakia. However, purpose reports in the BIOMAPE questionnaire that this mechanism is currently not applied in practice, mainly due to unfavourable electricity price conditions.

Both certificate types are managed within the system operated by SPP – distribúcia which creates a hybrid system (Type 3) combining disclosure (GO) and support (CoA) functions within the same registry infrastructure. To prevent double counting, a CoA can only be issued after the cancellation of a corresponding GO.

In Slovakia, the Slovak Hydrometeorological Institute (SHMÚ), specifically its Department of Emissions and Biofuels, is responsible for tracking Proof of Sustainability (PoS) for biofuels, including compliance with the renewable energy biofuel quota. The institute coordinates sustainability criteria and greenhouse gas emission calculations for biofuels and bioliquids, as established by national decrees implementing EU requirements

The certification framework is further supported by detailed methodological guidance for the use of biomethane in emissions accounting, including within the EU ETS.

The SPP – distribúcia registry system is aligned with European standards, supporting cross-border trade via the ERGaR Certificate of Origin Scheme.

11.16.4 Main Challenges

Despite this relatively sophisticated certification framework, the practical development of the biomethane market in Slovakia remains at an early stage. The absence of operational support mechanisms and limited demand-side incentives have constrained project development and market uptake. As a result, Slovakia can be characterised as a system with strong institutional and regulatory foundations but with limited actual deployment of biomethane. The technically advanced hybrid registry (Type 3) does not yet integrate a Proof-of-Sustainability layer but is following the activities around the Union Database establishment to prepare the needed connection.

11.16.5 Recommendation

Strengthening production and demand-side incentives, alongside the activation of existing certificate-based support instruments, would be key to unlocking further market development. Enhancing the Type 3 hybrid registry with a Proof of Sustainability (PoS) layer and transforming it to a fully integrated registry system for all market segments (Type 7) would support future compliance and enable smooth cross-border trade.

11.17 SI: Slovenia (BIOMAPE focus country)

11.17.1 Main Policy Instrument

Slovenia's biomethane policy framework is primarily shaped by the transposition of the Renewable Energy Directive into national legislation, particularly through the ZSROVE Act, and is complemented by a range of investment and tax-based measures. Current support mechanisms focus on renewable electricity production from biogas, administered via the Borzen support scheme, which provides feed-in tariffs for smaller installations and market premiums for larger plants, typically over a 15-year support period. Investment support is available under the Common Agricultural Policy (CAP) for small-scale biogas plants, although uptake remains limited in practice.

There is no dedicated operational support mechanism for renewable gas yet. However, Slovenia provides indirect support through tax incentives.

From a climate policy perspective, biomethane is legally accepted within both the EU Emissions Trading System and the national carbon tax framework, allowing for a zero-emission factor if sustainability criteria are met. The system is overseen by the Ministry of the Environment, Climate and Energy, with operational support from the Slovenian Environment Agency. Biomethane is recognised as a carbon-neutral fuel under the national CO₂ tax regime and may benefit from favourable treatment under the Excise Duty Act (ZTro-1), particularly in transport applications such as bio-CNG. However, these measures remain largely declarative, with limited practical uptake due to the absence of a developed biomethane market.

11.17.2 Market Dimensions

Roughly 300 GWh of biogas were produced by 24 operational biogas plants in 2024.

There are as yet no biomethane plants installed in Slovenia, since the legal and regulatory drivers to support its production and use are still under development.

Slovenia has a small natural gas market with annual demand of approximately 10 TWh, of which the great majority is imported. Based on national NECP projections and stakeholder assessments a ~120 GWh biomethane target is anticipated by 2030. If the 2030 target is achieved, ~1.2% of the total domestic gas demand could be covered by biomethane which is a small number but would still play a strategic role as a solid starting point for biomethane market integration.

11.17.3 Certificate and Registry Systems

Borzen is the national electricity market operator and support scheme administrator, responsible for managing renewable energy support mechanisms (e.g. feed-in tariffs and

premiums for renewable power under the ZSROVE framework). In this role, it handles data collection, settlement, and verification related to supported renewable electricity production, including from biogas plants.

The Energy Agency of the Republic of Slovenia (AGEN-RS) has regulatory oversight of the operator of the Power Guarantees of Origin (GOs) in Slovenia, who is Borzen. In alignment with the Slovenian Energy Act and EU RED II/III requirements, the system has received the mandate to expand to renewable gases, including hydrogen.

In Slovenia, the responsibility for checking Proof of Sustainability (PoS) is not centralized in a single national authority but follows the EU RED framework. Bureau Veritas acts as an independent certification and verification body. The Financial Administration of the Republic of Slovenia (FURS) is heavily involved in the practical side of tracking biofuels placed on the market, as they manage the excise duties and the reporting systems that interface with sustainability data.

The Slovenian Biogas Association drew attention to the importance of implementing a UDB connection in Slovenia, in its response to the BIOMAPE questionnaire. According to the Decree on sustainability criteria, any biomethane or biofuel quantity that is not registered and traced through the UDB (or an equivalent recognized chain of custody) cannot be zero-rated in the EU-ETS or the national CO₂ tax system. It is not merely a reference, but a mandatory technical requirement to ensure the "transfer of sustainability" across borders and to prevent double-counting within the Slovenian energy balance.

11.17.4 Main Challenges

Slovenia's biomethane market faces foundational hurdles: no dedicated support scheme, no production or injection sites, and a mandate for Guarantees of Origin (GOs) without a Proof of Sustainability (PoS) database.

This structural gap is critical, as future target-compliance pathways will depend on robust sustainability documentation and, where applicable, interaction with the Union Database or equivalent recognised traceability structures.

11.17.5 Recommendation

With a greenfield market, Slovenia should leverage best practices, which can be especially well supported by BIOMAPE resources.

A tailored support scheme is urgent to kickstart the market, starting with simple, predictable incentives like investment grants or feed-in premiums for the first projects. This should be designed for rapid deployment with minimal bureaucracy, avoiding complex structures that could deter early investment. Prioritising easy gas grid access is equally important to providing a simple, integrated registry system.

A database or registry for PoS management will provide the strongest direct market support. Such a system should be actively working on establishing a UDB connection as all energy amounts for target compliance must be UDB-documented. By setting up an integrated system (Type 7), a production registry (Type 5), or a data center (Type 6) from the outset, Slovenia can tremendously improve market access. Positioning the registry as a market service, while avoiding parallel systems and excessive bureaucracy, can align climate action with energy targets, ensuring efficient scaling from the outset.

11.18 UA: Ukraine (BIOMAPE focus country)

11.18.1 Main Policy Instrument

As an EU candidate country, Ukraine is aligning its renewable-energy framework with the EU under the Energy Community Treaty and as part of the EU accession process.

The country has positioned biomethane as a strategic component of its energy security, agricultural development and EU accession agenda. The primary legal basis is the Law of Ukraine “On Alternative Fuels” (No. 1391-XIV of 14 January 2000), which was subsequently amended to formally recognise biomethane within the Ukrainian legal framework. A major milestone was the adoption of the Resolution of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for the Operation of the Biomethane Registry” (No. 823 of 22 July 2022), which established the national biomethane registry and enabled the issuance and tracking of biomethane volumes injected into the gas system.

Institutionally, Ukraine has established a relatively comprehensive governance structure for renewable gas development. The Ministry of Energy of Ukraine is responsible for overall policy development and implementation of renewable gas legislation, while the SAEE acts as the operational authority for the biomethane registry and guarantees of origin issuance. The Gas Transmission System Operator of Ukraine (GTSOU) and regional gas distribution system operators are responsible for injection procedures, metering and future interoperability with the EU Union Database (UDB). Biomethane policy is further coordinated through a dedicated Bioenergy Coordination Council involving ministries, regulators, industry representatives and other stakeholders. The National Energy and Utilities Regulatory Commission (NEURC) provides regulatory oversight for the energy sector. Ukraine’s strong policy interest in biomethane is closely linked to its very large agricultural resource base, the need to reduce dependence on fossil fuel imports, and the long-term objective of exporting biomethane to EU markets.

In parallel, Ukraine has started establishing the legal basis for a future national emissions trading system (ETS), although the system is not yet operational. The Law of Ukraine “On the Basic Principles of State Climate Policy” (No. 3991-IX of 8 October 2024) created the overarching legal framework for climate governance, including the future introduction of a national ETS aligned with Directive 2003/87/EC. The law sets a greenhouse gas reduction target of 65% by 2030 compared to 1990 levels and climate neutrality by 2050.

11.18.2 Market Dimensions

As of March 2026, Ukraine has six operational or commissioning biomethane projects with a combined installed capacity of approximately 108 million m³/year, representing roughly 1,080 GWh/year of production potential. Actual 2025 production is estimated at 21–22 million m³, or approximately 210–220 GWh, with biomethane exports to the EU commencing in February 2025. All operating Ukrainian projects hold ISCC sustainability certification. Injection is primarily into the Gas Distribution System (GDS), with two projects producing Bio-LNG and one large project (56 million m³/year of capacity) connected directly to the Gas Transmission System (GTS). Cancelled / retired certificate volumes are not yet tracked systematically, as the Ukrainian biomethane registry is in its trial operational phase.

Institutionally, Ukraine has established a relatively comprehensive governance structure for renewable gas development. The Ministry of Energy of Ukraine is responsible for overall policy development and implementation of renewable gas legislation, while the SAEE acts as the operational authority for the biomethane registry and guarantees of origin issuance. The Gas Transmission System Operator of Ukraine (GTSOU) and regional gas distribution system operators are responsible for injection procedures, metering and future interoperability with the EU Union Database (UDB). Biomethane policy is further coordinated through a dedicated Bioenergy Coordination Council involving ministries, regulators, industry representatives and other stakeholders. The National Energy and Utilities Regulatory Commission (NEURC) provides regulatory oversight for the energy sector. Ukraine's strong policy interest in biomethane is closely linked to its very large agricultural resource base, the need to reduce dependence on fossil fuel imports, and the long-term objective of exporting biomethane to EU markets.

11.18.3 *Certificate and Registry Systems*

Although Ukraine is not legally obliged to implement EU RED II or RED III requirements, the Ukrainian biomethane registry has been conceptually aligned with Article 19 RED II. Since its launch on 20th of February 2026, it has been operated in a trial mode by the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) under the Law of Ukraine "On Alternative Fuels" (No. 1391-XIV) and Resolution of the Cabinet of Ministers No. 823 of 22 July 2022. Full alignment with Article 19 RED III is planned within the broader EU accession process.

Ukraine is not yet a participant in the ERGaR Certificate of Origin Scheme or the AIB EECS Gas Scheme. In February 2025, two EU exports were administered through bilateral procedural arrangements with importer-country registries. The Ukrainian government, through the Ministry of Energy and SAEE, is actively working toward UDB connectivity as part of the EU accession process which should be enabled via a Memorandum of Understanding between Ukraine and the EU.

11.18.4 *Main Challenges*

Ukraine faces challenges on several levels: as a non-EU member but as a member candidate, Ukraine will need some additional agreements for recognition despite their ongoing alignment with EU policy frameworks. Although domestic biomethane market is in its infancy with only few (but large) plants and a GO issuing body in start-up, Ukraine has shown clear focus on setting up the necessary framework and institutions in the past few years.

Aligning domestic frameworks with RED III under the EU accession process including a mandatory blending obligations for transport fuels while providing a supportive national policy framework for fast track permitting and gas grid access are main challenges to kick-start the Ukrainian biomethane market.

Despite Ukraine's physical interconnection with the EU gas network (via Poland, Slovakia, Hungary, and Romania), several EU Member States withhold Ukrainian biomethane consignments currently.

Although Ukraine's national biomethane registry and GO-issuing function were officially launched in February 2026, the system remains in an initial operational phase and is not yet

connected to European cross-border schemes such as ERGaR or AIB. As a result, the practical cross-border recognition and use of Ukrainian biomethane certificates remain limited. All current Ukrainian biomethane production volumes are already RED-sustainably certified. Thus, a PoS database with near future UDB-connection is of high importance and will provide highest monetary value to Ukrainian producers.

11.18.5 Recommendation

The Bioenergy Association of Ukraine (UABIO) provides a strong list of required actions to boost Ukraine's biomethane market and unlock the huge biomethane potential:

On the domestic side, the main demand drivers identified by UABIO are the development of national obligations and quotas for transport fuels (aligned with the RED III transposition under way), the establishment of the national Emissions Trading System (to incentivise industrial substitution of fossil gas with biomethane), and the EU accession process itself as a long-term structural driver.

Ukraine's gas network which is physically interconnected with EU Member States (Poland, Slovakia, Hungary, Romania) needs formal recognition as part of the EU interconnected system by the European Commission to ensure Ukraine's gas transmission network qualifies as part of the EU interconnected gas system for UDB purposes.

Non-discriminatory recognition of Ukrainian biomethane certified under EU-recognised voluntary schemes (notably ISCC) is required.

There is the need for an Energy Community Ministerial Council decision on mutual recognition of Ukrainian biomethane Guarantees of Origin.

As a transitional measure, UABIO recommends that EU Member States accept existing ISCC Proofs of Sustainability as sufficient evidence of compliance with RED requirements for Ukrainian biomethane, until the UDB is fully operational for gaseous fuels and Ukrainian operators are formally connected.

11.19 UK: United Kingdom (BIOMAPE lead country)

11.19.1 Main Policy Instrument

Since leaving the European Union, the United Kingdom has developed a self-contained policy framework for biomethane, with no legal obligation to align with RED III, centered around three pillars:

- a transport-fuel quota (the Renewable Transport Fuel Obligation, RTFO),
- a tariff-based support scheme for grid-injected biomethane (the Green Gas Support Scheme, GGSS), and
- a voluntary green-gas certification system (the Green Gas Certification Scheme, GGCS) that issues Renewable Gas Guarantees of Origin (RGGOs).

In parallel, the UK Government has been developing a broader long-term Future Biomethane Policy Framework intended to clarify the post-2030 role of biomethane within the UK's net-zero strategy.

The RTFO remains the principal demand instrument for biomethane in transport. Obligated suppliers comply by redeeming Renewable Transport Fuel Certificates (RTFCs) which are

tradable and create a secondary market for renewable fuel credits. Renewable gaseous fuels such as biomethane receive RTFCs based on energy content, with additional certificate multipliers available for fuels produced from eligible waste and residue feedstocks. The RTFO trajectory currently foresees a gradual increase of the main obligation to 14.6% by 2032. Biomethane supplied as compressed or liquefied renewable gas for heavy-duty transport therefore continues to represent an important compliance pathway within the UK transport decarbonisation framework. Operators can also layer GGSS support with RTFO accreditation to earn extra transport-fuel credits and boost revenue, though double-counting is prohibited. The Green Gas Support Scheme (GGSS), launched in November 2021 and administered by Ofgem, provides a tariff-based support mechanism for new anaerobic digestion plants injecting biomethane into the gas grid. The scheme offers 15-year tariff support and is financed through the Green Gas Levy imposed on licensed gas suppliers. The GGSS supports biomethane produced from wastes, residues, and energy crops, though a 50% crop cap applies to gas production from energy crops. Sustainability criteria require biomethane to meet GHG emissions $\leq 86,4\text{g CO}_2\text{eq/kWh}$ and comply with land criteria for biomass feedstocks, with participants submitting quarterly declarations and annual sustainability audit reports. The Green Gas Certification Scheme (GGCS) complements these support mechanisms by operating a voluntary certification and tracking framework for renewable gas in the UK market. The scheme issues Renewable Gas Guarantees of Origin (RGGOs), enabling suppliers and consumers to verify the renewable origin of biomethane supplied through the gas grid. Although the GGCS is not a statutory guarantees-of-origin system under EU RED II or RED III, it has become the dominant market-based tracking mechanism for green gas claims within the UK.

11.19.2 Market Dimensions

The UK is the largest biomethane producer in Europe outside the EU and, on production volume alone, comparable to several of the largest individual EU Member States. 124 biomethane sites are currently connected to the gas grid, and another 29 in the connections under development. Biofuels, including grid-injected biomethane used for transport, accounted for 7.7% of UK surface transport fuel in 2024.

UK gas demand statistics differ substantially depending on the methodological scope applied. Lower figures of around 319 TWh (according to the latest government data published in the Energy Trends and Prices release, February 2026) typically refer to final gas consumption by end users, whereas higher figures of approximately 700–730 TWh (UK Energy Trends and Prices statistics, DESNZ) include total inland gas demand, notably gas used for electricity generation, transformation processes, and energy-sector own consumption. As gas-fired power generation continues to play a major role in the UK electricity system, total gas demand figures are significantly higher than final consumption statistics. The EBA Statistical Report mentions around 7.5 TWh of biomethane production in 2024.

The majority of biomethane used in the biofuel quota is imported from the EU via the grid. The Green Gas Britain 2025 report is a key industry analysis produced by the Green Gas Taskforce, a collaboration between major UK biomethane generators, gas networks, and industry groups. The report outlines the strategic role of biomethane in defossilising the UK's gas grid, heating, transport, and industry, while enhancing energy security and affordability.

The report highlights that the UK has the potential to produce up to 120 TWh of biomethane by 2050 (about half of the domestic demand), which could significantly contribute to Net Zero targets and reduce reliance on imported fossil gas. Biomethane could cut the cost of achieving Net Zero by £156–218 billion by 2050, with an average saving of £174 billion, by leveraging existing gas infrastructure and providing a scalable, low-carbon alternative to fossil fuels.

11.19.3 Certificate and Registry Systems

Two main certificate types exist separately in the UK:

- Renewable Transport Fuel Certificates (RTFCs): Issued under the Renewable Transport Fuel Obligation (RTFO) by the Department for Transport's Low Carbon Fuels Delivery Unit for compliance in the transport sector.
- Renewable Gas Guarantees of Origin (RGGOs): Issued by the Green Gas Certification Scheme (GGCS), operated by Renewable Energy Assurance Limited (REAL), for grid-injected biomethane based on a voluntary certification mechanism to verify the renewable origin of biomethane supplied through the gas grid.

RGGOs are tradable independently of the physical gas (book and claim) and are retired in the GGCS registry upon a final consumer claim. UK RGGOs are not considered RED-compliant Guarantees of Origin. From EU perspective, the UK is treated as a third country for the purpose of cross-border GO transfers.

The Green Gas Support Scheme (GGSS) itself is a tariff-based support scheme paid for the biomethane at the point of injection and does not issue certificates. However, biomethane producers registered under the GGSS can also generate Renewable Gas Guarantees of Origin (RGGOs). These RGGOs include a label indicating whether the biomethane received production support. Biomethane producers can choose to put their biomethane into the GGSS or the RTFO but cannot do both. The legislation and scheme rules of both schemes specifically exclude this double-counting and annual independent audits are required to verify volumes and claims under both schemes.

11.19.4 Main Challenges

Despite a policy framework with long-term production support and RTFO as demand driver, gaps remain in climate policy integration, as biomethane delivered through the national gas grid is not recognised in the UK ETS, limiting its role in industrial defossilisation. The upcoming 2026 consultation on a new support scheme and potential UK ETS reforms could address these limitations, aligning biomethane more closely with the UK's net-zero targets.

The GGSS was initially launched in 2021 and scheduled to close in 2025. It was subsequently extended to 2028 and more recently has had another extension to 2030. These short-term extensions do not provide confidence to investors. The upcoming consultation on the Future Support Framework must provide long term visibility and confidence to investors. It should include a roadmap out to 2050 on how the support scheme will help the UK meet its 2050 targets and provide long term signals to the market. Since its EU-leave, national certificates so

far have not been recognised as GOs and the practical implementation of a connection to the UDB with non-EU countries is of less priority to the European Commission. This lack of official recognition may hurt cross-border transactions between the EU and the UK.

One main challenge directly involves the UK but poses main risks to its neighbouring country Ireland. Since its leave of the EU, and its treatment as a third country, the recognition of Ireland's gas grid as part of the interconnected European gas grid is being questioned which could put Ireland into a negative position.

11.19.5 Recommendation

Despite having a solid biomethane market with advanced certificate systems, UK's biomethane sector could significantly gain from harmonisation measures within the country and with the European Union.

To unlock the full industrial defossilisation potential of biomethane, the UK ETS should recognise biomethane delivered through the national gas grid as a low-carbon fuel, comparable to directly delivered biomethane. The ongoing consultation process in 2026 could be a sufficient opportunity to reach such an alignment.

To ease entry for new producers and streamline administrative processes for market participants and authorities, the UK could explore consolidating its current tracking and compliance registry systems under a single framework. This could be smoothly done by integrating with a Type 5 production registry or Type 6 data center into the current parallel systems (Type 4).

In order to achieve recognition of UK's certificates for access to the EU's GO market(s), UK would have to actively pursue a formal agreement with the European Commission according to Article 19(5) of RED III, which states: *"The Commission may, by means of implementing acts, recognise guarantees of origin or other proof of origin issued in third countries as equivalent to guarantees of origin issued in the Union, provided that the third country concerned has a system for guarantees of origin that is equivalent to that of the Union."*

To keep UK producers competitive with their RED-certified sustainable biomethane in the EU market, technical and regulatory steps to establish a connection the Union Database should be a priority for UK's policy makers.

11.20 Cross-country findings from the BIOMAPE questionnaire and mapping

The questionnaire responses and complementary desk research point to a recurring set of modification needs across national registry landscapes. These include clearer coordination between parallel certificate systems, stronger safeguards against double counting and double claiming, better alignment between registry data and national support or compliance schemes, improved preparation for future interaction with the Union Database, and more interoperable data exchange structures for cross-border trade. These recurring needs informed both the seven system administration types (see chapter 10.2) and the recommended pathway for national registry development (see chapter 2.5) presented in this report.

The country mapping confirms that the linkage between national biomethane support schemes, compliance mechanisms and certificate systems is highly heterogeneous across Europe. Some countries operate mainly Guarantee of Origin issuing bodies, such as Switzerland and Portugal; others have developed more advanced hybrid registry structures, such as France and Slovakia; while several mature markets are characterised by parallel systems serving different policy purposes, as seen in Austria, Germany and the United Kingdom. Other countries, including Serbia and Ukraine, are not yet aligned with the EU framework to the same extent as Member States, although their registry development is increasingly shaped by European market integration and, in the case of Ukraine, the EU accession process.

This structural diversity reflects the continued coexistence of an emerging European biomethane market with nationally specific support schemes, quota systems and compliance instruments. The implementation of RED III can provide an important stimulus for greater alignment within the EU, but the country mapping also shows that national registry systems will continue to differ in their regulatory functions and institutional arrangements. The diversity of certificate instruments, including CPBs, GGEs, CICs, RTFCs and various PoS-based or CoO-based mechanisms, demonstrates that registries must be able to accommodate multiple certificate types with distinct compliance rules, trading restrictions and regulatory objectives. Where subsidy or obligation schemes create dedicated certificate instruments, registry systems must ensure a clear separation from other instruments, such as Guarantees of Origin or cross-border Certificates of Origin, to prevent double counting and maintain market integrity.

12 Conclusions and Outlook

12.1 Overall conclusion

National biomethane registries have become a central element of renewable gas market development in Europe. Their role extends well beyond the issuance of individual certificates. Registries are increasingly required to connect production data, certificate management, sustainability documentation, support schemes, compliance markets, and cross-border trade in a reliable and transparent manner. This development reflects the growing policy relevance of biomethane and the increasing diversity of market pathways in which renewable gas certificates are used.

The analysis in this report shows that existing European registry landscapes are highly heterogeneous. National systems have developed in response to different regulatory priorities and market conditions, resulting in GO issuing bodies, biofuel registries, hybrid systems, parallel systems, and other emerging structures. This diversity starts creating coordination challenges, particularly where several certificate types and documentation systems coexist. For countries establishing or revising registry systems, the key conclusion is therefore that registry architecture should not be designed for one immediate purpose alone. A future-ready system should be modular, expandable, and capable of supporting different certificate and compliance functions without compromising traceability or market integrity.

12.2 Implications for national registry development

The report identifies a production-data-centred registry approach as the most robust starting point for national registry development. Documenting production facilities, injection points and biomethane volumes independently of individual certificate requests creates a stronger foundation for market transparency, national statistics, subsidy oversight and anti-double-counting controls. On this basis, countries can progressively add certificate modules and interfaces according to their policy needs, including Guarantees of Origin, Certificates of Origin, Proofs of Sustainability, and national compliance instruments.

At the same time, the report emphasises that certificate systems must remain legally and functionally distinct. GOs, CoOs, PoS and national support-related certificates serve different purposes and cannot simply replace one another. Registry systems must therefore provide clear rules for issuance, transfer, cancellation, and interaction between certificate types. Interoperability should likewise be considered from the outset. Even where specific European or national interfaces are not yet operational, registries should be designed so that future connections to cross-border certificate schemes, the Union Database, national compliance systems or market platforms can be introduced without fundamental redesign. The overall objective is not maximal technical complexity at the beginning, but coherent architecture that can evolve with the biomethane market and regulatory framework.

12.3 Relevance for BIOMAPE Focus countries and next project steps

These guidelines provide the analytical basis for the continued work of BIOMAPE with the Focus countries Hungary, Serbia, Slovenia, Portugal and Ukraine. The country mapping, the classification of registry system types, and the recommended architecture pathway offer a common reference point for evaluating existing national arrangements and identifying suitable development options. The findings are especially relevant where registry systems are still in an early stage of development, and architectural choices can still be shaped before fragmented structures become entrenched.

In the next phase of BIOMAPE Work Package 2, the general guidance presented in this deliverable will be translated into country-specific support. Existing IT systems, where available, will be assessed against the needs identified in this report, including operational processes, registry functions, and future interoperability requirements. For countries without established IT infrastructure, practical training activities and test-system support will help explore suitable registry workflows and cross-border ownership transfer processes. In this sense, BIOMAPE D2.1 is the conceptual foundation for the project's subsequent implementation-oriented assistance to Focus countries.

12.4 Outlook

The need for adaptable biomethane registries will further increase in the coming years. The implementation of RED III, the evolving role of the Union Database, the continued development of European certificate transfer schemes and the growing relevance of biomethane in quota systems, ETS-related reporting and industrial defossilisation strategies will all shape future registry requirements. These developments are still evolving and should therefore be reflected through flexible and adaptable registry architectures. This uncertainty strengthens the case for modular and interoperable system design.

A well-designed registry can reduce transaction barriers, improve regulatory implementation, and strengthen confidence among producers, consumers, authorities, and investors. Conversely, fragmented or narrowly scoped systems risk limiting market development and creating costly adaptation needs later. The central outlook of this report is therefore that national registry development should be understood as part of building Europe's renewable gas market infrastructure. Countries that establish transparent, production-aware and expandable systems today will be better positioned to integrate future regulatory requirements, support cross-border trade, and contribute to a credible and efficient European biomethane market.

13 Sources

Desk research for the country mapping including tracking systems draws information and data from the following sources:

- REGATRACE: D6.1 | Mapping the state of play of renewable gases in Europe (2020)
- Gas for Climate: Market state and trends in renewable and lowcarbon gases in Europe (2021)
- Gas for Climate: Action Plan for implementing RePowerEU (2022)
- Gas for Climate: Manual for National Biomethane Strategies (2022)
- Gas for Climate: Market state and trends in renewable and lowcarbon gases in Europe (2023)
- Cluster of Horizon Europe-funded projects on innovative biomethane production (HyFuelUp, BIOMETHAVERSE, METHAREN and SEMPRES-BIO): STATE OF PLAY OF BIOGAS & BIOMETHANE IN EUROPE: An update on market gaps and policy recommendations (2024)
- EBA Statistical Report (2025)
- ERGaR Country Library Guideline (2026)

Desk research to prepare “updated guidelines on for establishing national biomethane registries for certificate management” draws information and data from the following sources:

- BIOSURF D3.1 Comprehensive guidelines for establishing national biomethane registries (2015)
- REGATRACE D2.1 Updated Guidelines for creating the European Biomethane GoO
- REGATRACE D2.2 Report on content and attributes of GoO
- REGATRACE T2.4 Working paper Task 2.4 - Establish communication interfaces between the hub and the participating national issuing bodies/registries
- REGATRACE D2.5 Guidelines for tender process of IT-services
- REGATRACE D2.6 Report on design study and technical specification for dashboard and trading platform
- REGATRACE D3.1 Guidelines for establishing national biomethane registries