[D4.5] Joint policy recommendations by Cluster of Horizon Europe-funded projects on innovative bio-methane production

Biomethane in Europe: From Policy to Deployment

Project lessons, market challenges and recommendations for a resilient energy system

HYFUELUP

SEMPRE-BIO

Value4Farm

METHAREN

innovations in the BIOMETHANE uniVERSE

Co-funded by the European Union

Deliverable: D4.5- Third report on joint policy recommendations
Author(s): Alberto Confalonieri (CIC), Jaqueline Daniel-Gromke (DBFZ), Margarita de Gregorio (Bioplat), Velina Denysenko (DBFZ), Georgii Geletukha (UABio), Francisco Gírio (LNEG), Linus Klackenberg (SGA), José A. Lana (ENAGAS), Eva Maria Lopez Hernandez (CIC), Gonçalo Lourinho (CoLAB-Bioref), Yuri Matveev (UABio), Antonio Montón (ENAGAS), Mabel Mora (EBA), Anna Onida (EBA), Anna Pastukh (UABio), Gabriella Papa (EBA), Paloma Pérez (Bioplat), Enrique Alejandro Perdomo Echenique (UFZ), Stefano Proietti (ISINNOVA), Daniela Thrän (UFZ), Christos Tzagkas (ERGaR).
Version: Final Version
Date: 7/10/2026
Dissemination level: Public (PU)
EU-funded sister projects: Biomethaverse, Sempre-Bio, HyFuelUp and Metharen. With the additional support from Value4Farm
Disclaimer: Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Co-funded by the European Union

CONTENTS

Executive Summary 7
1. Introduction 9
2. Update on measures to promote biomethane production in the European Union Member States 11
2.1. Analysis of the National Energy and Climate Plans 11
2.2. Countries' potential VS identified potential 13
3. Policy, regulatory market gaps and recommendations 26
3.1. General overview 26
3.2. Projects' overview: policy recommendations 26
3.2.1. BIOMETHAVERSE 26
3.2.2. SEMPRE-BIO 28
3.2.3. METHAREN 32
3.2.4. HYFUELUP 33
3.2.5. VALUE4FARM 34
3.3. Preliminary and summarised policy recommendations 36
4. Sustainability and Guarantees of Origin 37
4.1. Proof of Sustainability (PoS) 38
4.2. Guarantees of Origin (GOs) 39
4.3. Towards a harmonised cross-border transfer of biomethane certificates 39
5. Challenges and regulatory barriers 42
5.1. Regulatory barriers for the biogas sector 42
5.2. Challenges concerning biomethane trading 44
6. Conclusory remarks 46
REFERENCES 48

FIGURE INDEX

Figure 1: Countries' NECPs with a 2030 biomethane target. (Source: EBA) 16

Figure 2: Countries' NECPs with a 2030 biomethane target (Source: EBA, based on the MS NECPs as of 08/2025) 20

Figure 3: Targets and planning on the regulation of the internal markets for renewable and natural gases and for hydrogen (Source: EBA) 22

Co-funded by the European Union

Figure 4: Targets and planning on the regulation of the internal markets for renewable and natural gases and for hydrogen (Source: EBA) 24

Figure 5: Green Deal Industrial Plan (Source: EBA) 25

Figure 6: Gas consumption trajectory and biomethane potential 2030-2050. (Source: Own elaboration) 28

Figure 7: Biomethane potential (bcm/year) for 2030. (Source: 2026, Guidehouse) 30

Figure 8: Biomethane potential (bcm/year) for 2040. (Source: 2026, Guidehouse) 31

Figure 9: Biomethane potential (bcm/year) for 2050. (Source: 2026, Guidehouse 32

TABLE INDEX

Table 1: Sector-relevant 2030 projections in final NECPs and assessed 2030 biomethane potential (Source: own elaboration based on Member States' final NECPs as of 08/2025 and Gas for Climate country potential estimates) 17

GLOSSARY and ABBREVIATIONS

AD: Anaerobic Digestion

AIB: Association of Issuing Bodies

BAP: Biomethane Action Plan 2024-2040

bcm: Billion Cubic Metres

BPA: Biomethane Purchase Agreements

BPC: Biogas Production Certificates

CAPEX: Capital Expenditures

CBAM: Carbon Border Adjustment Mechanism

CCUS: Carbon Capture, Use and Storage

CHP: Combined Heat and Power

CINEA: European Climate, Infrastructure and Environment Executive Agency

CNG: Compressed Natural Gas

Co-funded by the European Union

CoO: Certificate of Origin

CO_2: Carbon Dioxide

CPB: Certificats de Production de Biogaz

C&D: Communication and Dissemination

EBA: European Biogas Association

EC: European Commission

EEG: Renewable Energies Act

ENTSOG: European Network of Transmission System Operators for Gas

ETS: Emissions Trading System

EU: European Union

GEG: Buildings Energy Act

GO: Guarantees of Origin

GHG: Greenhouse Gas

GW: Gigawatt

GWh: Gigawatt hour

HE: Horizon Europe

i.e.: *id est* (=that is)

kWe: Kilowatt electric

LNG: Liquefied Natural Gas

MRR: Monitoring and Reporting Regulation

Mtoe: Million tonnes of oil equivalent

MWh: Megawatt hour

NECCS: Negative Emissions Carbon Capture and Storage

NECP: National Energy and Climate Plan

Nm^3: Normal Cubic Meter

OJEU: Official Journal of the European Union

PJ: Petajoule

PoS: Proof of Sustainability

Co-funded by the European Union

PPE: Programmations Pluriannuelles de l'Énergie

PRTR: Recovery, Transformation and Resilience Plan

R&D: Research and Development

RFNBO: Renewable Fuels of Non-Biological Origin

SAEE: Ukrainian State Agency for Energy Efficiency and Energy Savings

SFEC: Stratégie Française pour l'Énergie et le Climat

SNG: Synthetic Biomethane

t/a: Tons per annum

t/d: Tons per day

TWh: Terawatt hour

UABio: Bioenergy Association of Ukraine

UDB: Union Database for Biofuels

WPG: Heat Planning Act

WTP: Wastewater Treatment Plants

Co-funded by the European Union

Executive Summary

This third joint update from Horizon Europe-funded projects on innovative biomethane production reviews Europe's policy and market position, incorporates evidence from project implementation and identifies priorities for scaling deployment. It finds that biomethane produced from sustainable domestic feedstocks can advance EU decarbonisation while reducing fossil-gas imports, strengthening security of supply and improving energy-system resilience.

The final updated National Energy and Climate Plans picture remains well below the REPowerEU ambition of 35 bcm per year by 2030. At the report's cut-off, 26 final updated NECPs were available. The merged table records 12.14 bcm of biomethane projections, 7.75 bcm of biogas projections and 6.1 bcm of combined biogas-and-biomethane projections; because national categories and scopes may overlap, these figures should not be mechanically summed. They nevertheless show that clearer national trajectories and stronger delivery measures are needed.

The April 2026 Guidehouse assessment indicates a larger resource base than current policy commitments capture. It estimates combined biomethane and e-methane potential in 2030 at 34–35 bcm/year across Europe and 31–32 bcm/year in the EU-27, rising to 116–132 bcm/year in 2040 and 181–205 bcm/year in 2050. Anaerobic digestion remains central, while thermal gasification and e-methane become increasingly important after 2030.

The EU framework is moving in a supportive direction. The Gas Package strengthens internal-market rules, monitoring and transparency for renewable gases; RED III and the Net-Zero Industry Act seek to accelerate permitting; and the EU ETS and FuelEU Maritime create demand signals in industry and shipping. The REPowerEU Roadmap, prospective Tripartite Contracts and AccelerateEU add mechanisms to coordinate national action, improve demand visibility and support domestically produced renewable gas.

Implementation gaps remain substantial. Demand and investment signals are unstable, rules are fragmented, and projects face slow permitting, costly or uncertain grid access, uneven certification and restricted cross-border trade. Delays to the Union Database, weak markets for digestate and biogenic CO2, and insufficient operational conditions for renewable hydrogen and methanation further constrain deployment and the full value of circular biomethane systems.

Until the Union Database is fully operational and integrated with national systems, the report supports the interim approach emerging through Eurostat's SHARES Manual: traded biomethane should be accounted for in the country of consumption rather than automatically in the country of production, with coordinated reporting used to prevent double counting. This bridge should evolve into interoperable EU traceability linking Proofs of Sustainability, Guarantees of Origin and mass-balance information.

Project experience reinforces these findings. BIOMETHAVERSE stresses durable demand, harmonised certification, proportionate sustainability rules and markets for digestate and biogenic CO2. SEMPRE-BIO identifies the need for technology-specific regulation, infrastructure and longer operational demonstration for upgrading, pyro-gasification and methanation. HyFuelUp shows that first-of-a-kind integrated projects need staged, flexible and performance-linked support. METHAREN generated no new recommendations in this reporting period because its suspension limited further analytical work.

Co-funded by the European Union

In addition, the report adds recommendations from the project Value4Farm, a Horizon Europe funded project that decided to contribute to the report with its own insights on scale-sensitive farm regulation, sustainable feedstock traceability and patient scale-up finance.

The report therefore recommends five mutually reinforcing actions: establish stable long-term targets, demand and finance; harmonise certification, sustainability and cross-border trade; accelerate permitting and access to gas, electricity, hydrogen and CO2 infrastructure; provide dedicated support for innovation scale-up and sustained operational demonstration; and create circular feedstock and co-product frameworks that unlock sustainable residues, digestate-derived products and traceable biogenic CO2. Together, these measures would convert Europe's technical potential into bankable production, credible trade and resilient decarbonisation outcomes.

Co-funded by the European Union

1. Introduction

In recent years, the biogas sector and, particularly, the biomethane sector, has become one of the EU's key players in accelerating the ecological transition, boosting energy efficiency and resilience, and reducing geopolitical tensions arising from the import of fossil fuels.

The REPowerEU Plan[1], aimed at reducing Europe's dependence on fossil fuel and accelerating the transition to green energy, in addition to setting a target of producing 35 bcm of biogas and/or biomethane by 2030, laid the groundwork for steering cooperation between policymakers, investors and the biomethane value chain to drive technological innovation, address bottlenecks and gaps and, ultimately, accelerate the expansion of the sector.

One of the many ramifications of this cross-border collaboration is the joint work of the four European projects funded under the HORIZON-CL5-2021-D3-03 'Hybrid catalytic conversion of renewable energy to carbon-neutral fuels[2] call under the topic HORIZON-CL5-2021-D3-03-16 'Innovative biomethane production as an energy carrier and a fuel': HyFuelUp, BIOMETHAVERSE, METHAREN and SEMPRE-BIO. These four HE-funded biomethane projects involve a total of 65 partners, 14 countries and 10 demonstration plants (demo sites) in 8 countries. In addition, the third version of this report also includes specific recommendations from Horizon Europe funded Value4Farm project. The project aims to decarbonise European agriculture by demonstrating sustainable, circular value chains combining biogas, biomethane and other renewable energy technologies with farming, while addressing farmers' needs for energy, mobility, waste and land management[3].

After publishing the first report on 'Joint Policy Recommendations on Biomethane' in October 2023, a second report was published one year later in October 2024. This new report, namely the third updated version, focuses mainly on reviewing and updating market gaps and policy recommendations to overcome the main barriers, as well as discussing the main policy results from all four HE-funded projects.

The four sister projects were funded in the context of REPowerEU, when reducing the European Union's dependence on Russian fossil fuels became an urgent priority. Since then, the geopolitical context has become even more complex, with new conflicts and continued uncertainty in international energy markets. This has reinforced the need to diversify energy supply, reduce dependence on imported fossil fuels and strengthen the resilience of the European energy system.

Biomethane has a role to play in this context. Produced in Europe from locally available resources, including agricultural residues, organic waste and other sustainable feedstocks, it can contribute to replacing natural gas imports while supporting the EU's decarbonisation objectives. Increasing European biomethane production is therefore relevant not only from a climate perspective, but also in terms of security of supply and energy resilience.

Over the last four years, the four sister projects have been developing and demonstrating different technologies and approaches for biomethane production in different European contexts. The work

[1] REPowerEU Plan: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483

[2] European Commission: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl5-2021-d3-03-03

[3] VALUE4FARM project website | European Commission – CORDIS project page

Co-funded by the European Union

carried out has also provided experience on some of the regulatory, market and infrastructure issues that can affect the development of these solutions. These lessons can complement the analysis of the policy and market situation presented in this report and help identify where further action may be needed.

This third joint report is therefore an opportunity to build on the experience gained through the four projects and go beyond an update of the previous report. Together with the latest developments in the European biomethane sector, the results and lessons learned from the projects can provide a useful basis for identifying more concrete recommendations for policymakers and for considering how biomethane can further contribute to Europe's energy security and resilience.

Co-funded by the European Union

2. Update on measures to promote biomethane production in the European Union Member States

Identifying what measures are being taken in terms of promotion, support, and legal regulation of biomethane in different European countries, including those contained in each National Energy and Climate Plan (NECP), is key. It is also convenient to analyze whether the implemented measures are appropriate for the development of the sector or not, considering countries' potential and their identified targets, according to those plans.

2.1. Analysis of the National Energy and Climate Plans

The NECPs were established under the Regulation on the Governance of the Energy Union and Climate Action (EU) 2018/1999, part of the Clean Energy for All Europeans package adopted in 2019.

These plans delineate how EU countries aim to address the five dimensions of the energy union:

- Decarbonisation
- Energy efficiency
- Energy security
- Internal energy market
- Research, innovation, and competitiveness

This comprehensive approach needs coordinated efforts across all government sectors and facilitates planning to attract both public and private investments.

The European Commission's NECPs Guidance to Member States: What's in it for biomethane

The European Commission's 'Notice on the Guidance to Member States for the update of the 2021-2030 National Energy and Climate Plans underscores the necessity for Member States to incorporate specific infrastructure and incentive measures to meet ambitious renewable energy targets. The updated NECPs must reflect the deployment strategies aligned with the REPowerEU initiative, which aims to produce 35 bcm (350 TWh) of sustainable biogas and/or biomethane by 2030.

The Commission called on Member States to redouble their efforts, since projections indicated that the EU-27 would only reduce their carbon dioxide (CO_2) emissions by 51% by 2030 compared to 1990 and would fall short of the 55% they have committed by law.

Furthermore, the Commission encourages Member States to outline any initiatives, planned actions, or international partnerships that support this goal. The guidance also calls for a comprehensive component of sustainable biogas and biomethane production, urging countries to assess their national potentials and establish clear trajectories to meet these targets by 2030 and

Co-funded by the European Union

2050. This approach aims to ensure that NECPs are not only aligned with EU-wide climate goals but are also robust and forward-looking in their planning and execution.

The REPowerEU Roadmap

An additional milestone in 2025 was the publication of the REPowerEU Roadmap4, which aims to phase out the EU's remaining dependence on Russian fossil fuels. The roadmap sets out nine targeted actions to reduce and ultimately eliminate this reliance and forms part of the EU's broader strategy to strengthen competitiveness and resilience while accelerating the clean energy transition.

Within this context, the European Commission recognises that gaseous fuels, including biomethane and biogas, will continue to play an essential role in the EU energy mix through 2040 and 2050, particularly in hard-to-electrify sectors and as industrial feedstocks. According to the roadmap, total EU gas consumption is expected to range between 105 and 155 Mt by 2040 and between 70 and 80 Mt by 2050.

Following the publication of the roadmap, the European Commission announced that it will introduce new legislation requiring Member States to develop specific national plans to support, monitor and coordinate the EU-wide phase-out of Russian gas. These plans will need to include clear timelines and concrete actions to diversify the Union's energy supply.

In addition, the REPowerEU Roadmap introduces the possibility of establishing Tripartite Contracts5. For the biogases sector, these agreements would bring together Member States, biogas producers and end-users, with the European Commission acting as facilitator. Their purpose is to secure concrete commitments and actions from all parties, promote the exchange of best practices, improve planning and the predictability of off-taker demand, and address barriers to the development of the sector.

To further reinforce this policy direction, the European Commission presented in April 2026, the AccelerateEU Communication which is a series of action to help Member States and EU achieve energy security and by accelerating the transition towards clean, affordable and domestically produced energy. As part of the initiative, the Commission committed to continue supporting the scale-up of sustainable biogas and biomethane production, including on-farm and cooperative projects, while addressing permitting bottlenecks, facilitating the expansion of existing plants and improving the transport of sustainable feedstocks. AccelerateEU therefore represents a further step towards creating the conditions needed to increase the production and use of biomethane in the EU.

Overall, the existence of a European biogas/biomethane pathway towards 2030 provides the sector with promising prospects in the medium term and can also act as a driver for investments to take place. However, as the analysis below demonstrates, the heterogeneity of the NECPs in terms of quality, units of measurement and details provided leads to complexity and, with this, comes uncertainty.

Biomethane targets and incentives in the updated NECPs – status in 2026

[4] REPowerEU Roadmap: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1131

[5] Tripartite Contracts between industry stakeholders, Member States and the European Commission. Final agreements are yet to be finalized.

Co-funded by the European Union

At the time of preparation of the present report, 26 countries had published their final updated NECPs (Poland is the only one still missing out of the five countries – Belgium, Estonia, Croatia, Poland, Slovakia – against which the European Commission started an infringement procedure in 2025 for delayed adoption). These final plans do not provide any new information on national biomethane targets and incentives for 2030 compared with the draft updated versions published in late 2023 and early 2024.

Of the 26 updated NECPs, almost all refer to biogas and biomethane, while 21 countries include specific provisions relevant to the sector. 14 countries provide a specific growth projection for biomethane: Belgium, Czechia, Denmark, Estonia, France, Greece, Hungary, Luxembourg, the Netherlands, Poland, Romania, Slovakia, Ireland and Lithuania. 9 countries set a specific growth projection for biogas: Belgium, Croatia, Cyprus, France, Greece, Luxembourg, Poland, Slovenia and Spain. Two countries, Hungary and Italy, provide a combined projection for both biogas and biomethane, while Portugal and Spain present projections for advanced biogas and renewable fuels of non-biological origin (RFNBOs). In addition, Austria, Estonia, Portugal and Slovakia include projections for renewable gases. The targets for biogas and biomethane in every NECP are listed below.

Countries' NECPs with a 2030 biomethane target			
Belgium	**0.11 bcm** (Walloonia)	Ireland	**0.58 bcm** (5,7 TWh)
Czechia	**0.5 bcm**	Italy	**5.7 bcm**
Denmark	**0.4 bcm** (biomethane production to cover 100 % of the gas consumption in 2030)	Lithuania	**0.13 bcm** (1,4 TWh)
Estonia	**0.04 bcm** (380 GWh/year)	The Netherlands	**2 bcm**
France	**4.15 bcm** (44 TWh)	Slovakia	**0.3 bcm**
Greece	**0.2 bcm** (2,1TWh)	Slovenia	**0.05 bcm**
TOTAL: 14.16 bcm			

Figure 1: Countries' NECPs with a 2030 biomethane target. *Source: EBA.*

2.2. Countries' potential VS identified potential

To assess the level of ambition of Member States regarding the 35 bcm/year REPowerEU target, this report sets out the sector-relevant projections included in the final NECPs of all 27 member states. The sector-relevant projections reported in the final NECPs amount to 12.14 bcm for biomethane, 7.75 bcm for biogas and 6.1 bcm for combined biogas and biomethane. As national categories and scopes may overlap, these figures should not be mechanically summed. This projection is based on the targets set by the countries listed below (19 member states in total, with eight countries lacking specific targets for biogases).

Co-funded by the European Union

Table 1: Sector-relevant 2030 projections in final NECPs and assessed 2030 biomethane potential (Source: own elaboration based on Member States' final NECPs as of 08/2025 and Gas for Climate country potential estimates)

Country	2030 biomethane projection	2030 biogas projection	2030 biogas & biomethane projection	2030 potential (Gas for Climate, bcm)
Austria	—	—	—	0.57
Belgium (Wallonia)	0.73 bcm (7.6 TWh)	—	—	0.62 (Belgium total)
Belgium (Flanders)	—	0.076 bcm (0.774 TWh)	—	
Bulgaria	—	—	—	0.67
Croatia	—	No quantified projection	—	0.21
Cyprus	—	No quantified projection	—	0.04
Czechia	0.49 bcm	—	—	0.72
Denmark	1.4 bcm + additional 0.4 bcm (100% green gas in grid)	—	—	0.83
Estonia	0.076 bcm (0.8 TWh/a)	—	—	0.10
Finland	—	—	—	0.72
France	4.2 bcm (44 TWh)	4.78 bcm	—	6.96
Germany	—	—	—	8.14
Greece	0.2 bcm (2.1 TWh)	No quantified projection	—	0.54
Hungary	0.18 bcm	—	—	1.03

Co-funded by the European Union

Ireland	0.54 bcm (5.7 TWh)	—	0.6 bcm	0.70
Italy	—	—	5.5 bcm	5.79
Latvia	—	—	—	0.16
Lithuania	0.13 bcm (1.4 TWh)	—	—	0.38
Luxembourg	0.008 bcm (93 GWh)	0.03 bcm	—	0.03
Malta	—	—	—	0.01
Netherlands	2 bcm	—	—	1.34
Poland	—	—	2.276 bcm	3.26
Portugal	—	—	—	0.63
Romania	5% biomethane in grid	—	—	1.99
Slovakia	0.3 bcm	—	—	0.30
Slovenia	—	0.05 bcm (480 GWh)	—	0.10
Spain	—	1.9 bcm (20 TWh)	—	4.09
Sweden	—	—	—	1.14
Total	**12.14 bcm**	**7.75 bcm**	**6.1 bcm**	**41.07 bcm**

Note: A dash indicates that no sector-specific quantified projection is reported in the supplied 2025 NECP table. "No quantified projection" indicates that the NECP refers to the sector but does not provide a numerical value. Belgium's 2030 potential is shown once across the Wallonia and Flanders rows to avoid double counting. The final-column country potentials and their 41.07 bcm (approximately 411 TWh) total remain the original Gas for Climate estimates; the updated final-NECP projections total 12.14 bcm (approximately 121 TWh) for biomethane, 7.75 bcm (approximately 78 TWh) for biogas and 6.1 bcm (61 TWh) for combined biogas and biomethane. For Poland, the updated NECP shows that the plan includes a projection of 2.276 bcm of renewable gases (biogas/ biomethane/ renewable hydrogen) by 2030 and 6.858 bcm by 2040. The NECP directly envisages biomethane consumption only in the transport sector: 0.466 bcm by 2030 and 0.911 bcm by 2040. In other cases, biomethane is classified more generally as renewable gas.

Co-funded by the European Union

Based on the spread between the target and the sustainable potential identified in the study, countries are divided into 5 categories, as shown in Figure 3 below:



Figure 2: Countries' NECPs with a 2030 biomethane target. *Source: EBA, based on the MS NECPs as of 08/2025*.

Fit for 55: Drivers and challenges for biomethane development

The Fit for 55 Package, a cornerstone of the European Green Deal[6], includes several positive drivers for the development and deployment of biomethane, which are crucial for achieving the EU's climate targets.

The Gas Package

The Gas Package establishes common internal market rules for renewable and natural gases and hydrogen[7]. The regulation and directive of the Gas Package were published[8] in the Official Journal of the European Union (OJEU) on 13 June 2024. This regulation is part of the hydrogen and gas markets decarbonisation package, which also includes a directive; and both the regulation and the directive are part of the Fit for 55 Package.

[6] European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
[7] Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and for hydrogen: https://data.consilium.europa.eu/doc/document/ST-16522-2023-INIT/en/pdf
[8] OJEU: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1789&qid=1727693604834

Co-funded by the European Union

To aim to diversify gas supplies and phasing out dependence on Russian gas, the co-legislators agreed on Member States having the possibility to take proportionate measures to temporarily restrict gas supplies including Liquefied Natural Gas (LNG) from Russia and Belarus.

As a way of upscaling renewable gas and low-carbon gas in coal and carbon-intensive regions, the European Commission will be invited to support and encourage the penetration of renewable and low-carbon gas, in particular hydrogen and biomethane, into the Union energy system.

As regards biomethane production and to avoid mentioning a biomethane target in the Articles, two new recitals were added: first, specifying that the Commission has proposed in its RePowerEU Plan to significantly increase the production of sustainable biomethane in the Union up to 35 bcm per year by 2030; second, stressing the link to NECPs. In addition, the European supply adequacy outlook will need to include a monitoring of the progress on the annual production of sustainable biomethane.

The percentage of blending hydrogen is set at 2% in the Article on cross-border coordination of gas quality in the natural gas system (Article 19). Up to this threshold, Member States will be able to launch a conciliation mechanism regarding the gas quality and restriction to flows.

Also, to promote biomethane, regulation Article 20b empowered the European Commission to establish common specifications for biomethane in specific situations if market stakeholders are not able to reach a common agreement.

In Article 23 of the regulation, a Gas Quality Monitoring report is required for the European Network of Transmission System Operators for Gas (ENTSOG) in which the amount of biomethane/renewable natural gas (and hydrogen) added to the gas system should be shown. Additionally, new transparency requirements oblique the publication of the main gas quality parameters, including oxygen (of special importance for biomethane) in the ENTSOG transparency platform at relevant points of the gas network.

In case both the European supply outlook and the final updated national energy and climate plans show that the annual production is not sufficiently progressing or that the natural gas consumption is not sufficiently decreasing in view of the available potential, the Commission may issue recommendations to the Member States, if necessary to achieve the objectives of the Energy Union.

Co-funded by the European Union

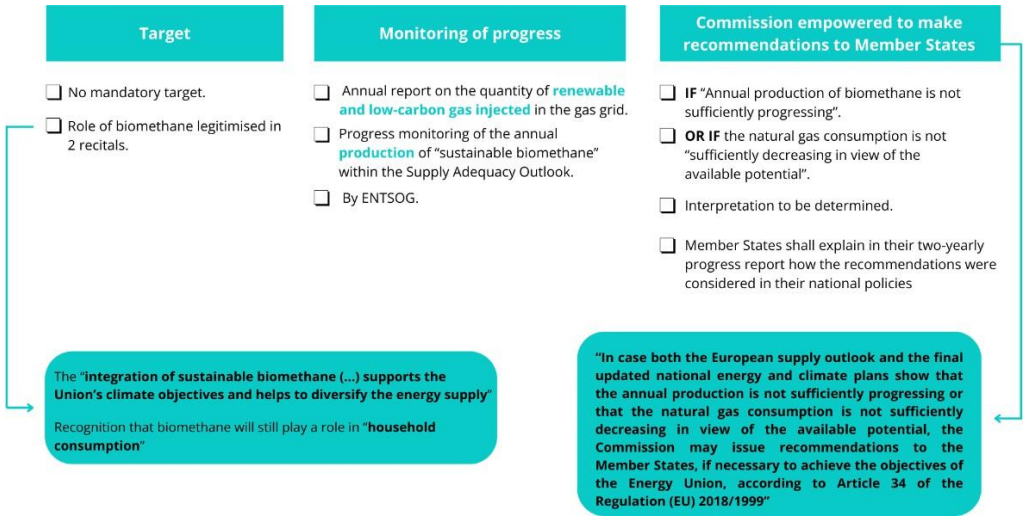


Figure 3: Targets and planning on the regulation of the internal markets for renewable and natural gases and for hydrogen. *Source: EBA*.

Enabling a faster scale-up with REDIII and NZIA

Both the European Union's new Renewable Energy Directive (RED III[9]) and the Net-Zero Industry Act (NZIA)[10] have set out to facilitate the growth of the European Union's renewable energy sector and guarantee acceleration of renewable energy and energy savings to phase-out dependence on Russian fossil fuel, always by the REPowerEU plan.

Even though it is still limited to a small number of Member States and large undertakings, with significant administrative, technical, and financial barriers remaining in large parts of the Union's market, the market for renewable power purchase agreements is rapidly growing and provides a complementary route to the market of renewable generation in addition to support schemes by Member States or to selling directly on the wholesale electricity market.

The existing measures provided for in Article 15 of REDIII to encourage the uptake of renewable power purchase agreements should therefore be strengthened further, by exploring the use of credit guarantees to reduce the financial risks of such agreements, considering that those guarantees, were public, should not crowd out private financing.

In addition, measures in support of renewable power purchase agreements should be extended to other forms of renewable energy purchase agreements.

In that context, the Commission should analyse the barriers to long-term renewable energy purchase agreements, to the deployment of cross-border renewable energy purchase agreements, and issue guidance on the removal of those barriers.

[9]Renewable Energy Directive (RED III). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AL_202302413

[10] Net Zero Industry Act. https://single-market-economy.ec.europa.eu/publications/net-zero-industry-act_en

Co-funded by the European Union

On the other hand, further streamlining of administrative permitting procedures would be advisable to remove unnecessary administrative burdens and thus establish renewable energy projects and related grid infrastructure projects.

Based on the National Energy and Climate Plans (NECPs), the European Commission has two years from the entry into force of this Regulation to consider whether additional measures are needed to further support Member States in implementing the provisions of REDIII on permitting procedures. That includes the requirement for the single contact points set out by Article 16 and to ensure compliance with the deadlines for permit granting procedures set out in REDIII.

Such additional measures should be able to include indicative key performance indicators on, inter alia, the duration of permitting procedures for renewable energy projects located inside and outside renewable energy acceleration zones. The NZIA also aims to ease the conditions for investing in green technologies by simplifying permitting procedures and supporting strategic projects. NZIA requires Member States to implement maximum permitting periods - maximum 18 months for large net-zero technology manufacturing projects (above 1 GW) and maximum 12 months for small projects (below 1 GW).



Figure 4: Targets and planning on the regulation of the internal markets for renewable and natural gases and for hydrogen. *Source: EBA*.

Co-funded by the European Union

Facilitate industrial utilisation of biomethane

REDIII introduces annual renewable energy targets for the industrial sector and requires member states to report on progress.

The EU emissions trading scheme (EU ETS) recognises biomethane as zero-rated if compliant with the RED sustainability criteria. Also, e-methane is zero-rated if it fulfils the RED criteria for RFNBO (Renewable Fuels of Non-Biological Origin).

Installations that fall under the scope of the EU ETS may purchase biomethane or e-methane to replace their natural gas consumption. In this way, they reduce their Greenhouse Gas (GHG) emissions and no longer need to surrender emission allowances for their gas consumption. With increasing prices on emission allowances as the emission cap for the EU ETS sector is gradually decreased biomethane is becoming more competitive with natural gas in large industries.

Regulation (EU) 2018/2066 on Monitoring and Reporting Regulation (MRR)[11] sets out the rules for the monitoring and reporting of GHG emissions from activities covered by the EU ETS.

The MRR being an implementing regulation, it is therefore of direct application in the Member States and prevails over national laws that would contradict it. This ensures that the regulation is implemented in a harmonized way across the EU. However, some Member States have incorporated the regulation into their national law by adjusting existing national legislation.



Figure 5: Green Deal Industrial Plan. *Source: EBA*.

[11] Regulation (EU) 2018/2066 on Monitoring and Reporting Regulation (MRR). https://eur-lex.europa.eu/eli/reg_impl/2018/2066/oj

Co-funded by the European Union

Finally, not all Member States that allow the use of domestic GOs in the EU ETS allow the use of GOs imported from other EU countries. Where permitted, conditions specific to each country may apply.

At national level, Spain made significant progress in 2026 towards establishing a dedicated regulatory framework for biomethane. Royal Decree-Law 7/2026 established a mandate for the Government to set mandatory biomethane targets for non-transport uses and mandated a "seal of excellence" for projects, covering criteria such as circular economy, waste valorisation, local employment and decarbonization.

In May, MITECO proposed quotas starting at 0.5% of national natural gas and LNG consumption in 2028, rising to 6% by 2035, with compliance based on Guarantees of Origin. The draft also includes measures to facilitate grid connections, reverse flow and direct lines, while linking new plants to the seal of excellence. Royal Decree 611/2026 further developed the Guarantees of Origin framework under RED III. The biomethane decree is still under development, so its final impact remains to be seen.

Scaling up biomethane utilization in the maritime sector

Biomethane and e-methane have become increasingly competitive in the maritime sector thanks to two new EU policy instruments: the extension of EU ETS to the maritime sector and the FuelEU Maritime. EU ETS puts a price on maritime emissions, while FuelEU Maritime sets fuel GHG-intensity limits. Together, they are the two main EU policies driving the transition to renewable fuels in shipping.

The EU Emissions Trading System (EU ETS) was extended to maritime transport from 1 January 2024. Under the scheme, shipping companies must purchase and surrender emission allowances (EUAs) for the greenhouse gas emissions generated by ships above 5,000 gross tonnages calling at EU/EEA ports. The system covers 100% of emissions from voyages between EU/EEA ports, 100% of emissions generated while ships are at berth in EU/EEA ports and 50% of emissions from voyages between an EU/EEA port and a non-EU port. The obligation is being phased in gradually and from 2026 emission allowances must be surrendered for all GHG emissions. For shipping, the EU ETS creates a direct carbon cost on fossil marine fuels, thereby improving the competitiveness of low-carbon alternatives such as biomethane (bio-LNG), e-methane, and other renewable fuels. This has incentivized many shipping companies to invest in LNG-ships. As biomethane and e-methane are zero-rated in EU ETS the incentives for switching to biomethane and e-methane are increasing.

FuelEU Maritime is an EU regulation (Regulation (EU) 2023/1805) designed to decarbonise maritime transport by reducing the greenhouse gas (GHG) intensity of the energy used onboard ships. It applies to commercial vessels above 5,000 gross tonnage calling at EU ports and has been fully applicable since 1 January 2025. FuelEU Maritime requires the GHG intensity of marine energy to fall by 2% (2025), 6% (2030), 14.5% (2035), 31% (2040), 62% (2045), and 80% (2050) compared with the FuelEU reference value, creating a strong demand pull for biomethane and e-methane in shipping. FuelEU Maritime covers 100% of the energy used on voyages between EU ports, 100% of the energy used while a ship is in an EU port and 50% of the energy used on voyages between an EU port and a non-EU port. To stimulate early uptake of renewable fuels of non-biological origin (RFNBOs), such as e-methane, FuelEU Maritime provides double counting of

Co-funded by the European Union

RFNBO energy towards compliance until the end of 2033. If RFNBOs account for less than 1% of maritime energy use in 2031, a 2% RFNBO sub-target may apply from 2034.

For ship operators, FuelEU Maritime creates a long-term market signal for renewable gaseous fuels. LNG-powered vessels can gradually reduce their GHG intensity by blending or switching to liquefied biomethane (bio-LNG/LBG) and e-methane, helping them comply with increasingly stringent FuelEU requirements while also reducing exposure to EU ETS costs.

The future: Biomethane's contribution in the decade 2030 to 2040

The EU's focus extends to 2040 as an essential milestone towards climate neutrality. The European Commission aims for a 90% reduction in GHG emissions by 2040 compared to 1990 levels, necessitating extensive decarbonization efforts across all economic sectors. Despite accelerated electrification, there will remain a significant demand for gas, which renewable gases like biomethane can increasingly fulfil.

The 2040 Climate Target Communication initiates the procedure for establishing the EU's 2040 climate objective, sparking a political discourse on the pathways available to European citizens and governments. In 2025, the Commission incorporated the 2040 target into the European Climate Law, ensuring the implementation of an equitable and cost-effective post-2030 policy framework to achieve the 2040 objective.

The 2040 Climate Target recognize that biomethane represents a "win-win solution" in achieving the EU climate and energy objectives.

While the Impact Assessment projects heavy electrification of end uses the role of gas will still be important, although reduced. "The consumption of natural gas, biomethane and biogas reaches approximately 105 – 155 million tonnes of oil equivalent (Mtoe) by 2040 (4.5– 6.5 EJ)".

Grid-injected gaseous fuels consumption would amount to 100 Mtoe for 2040 (~ 119 bcm or 1,190 TWh) i.e. 1/3 of the EU's natural gas consumption of 2019 and 80 Mtoe by 2050 (i.e. ~95 bcm or 950 TWh).

Co-funded by the European Union

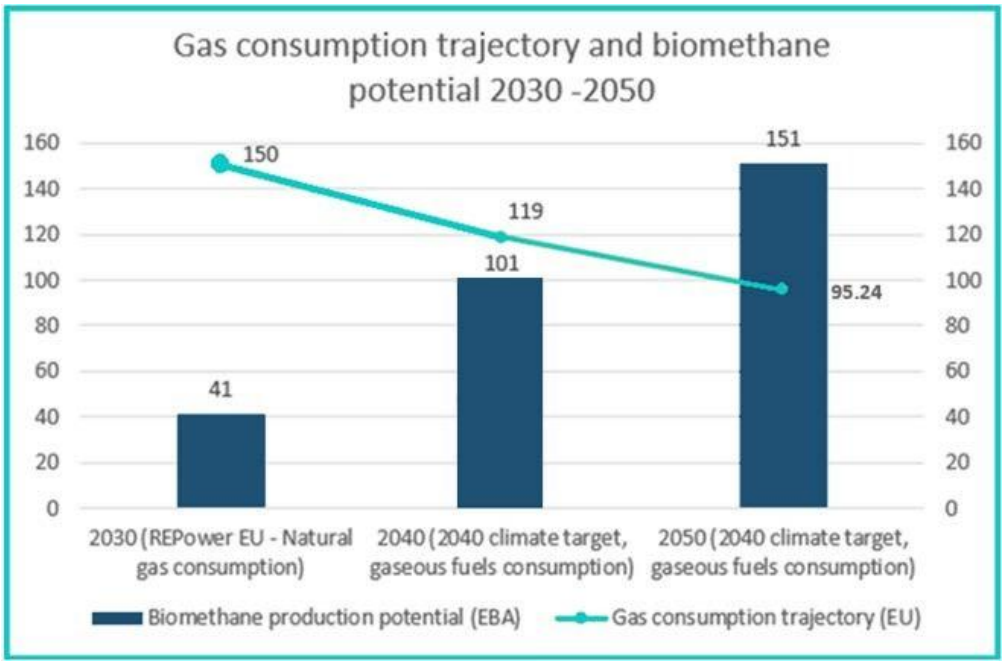


Figure 6: Gas consumption trajectory and biomethane potential 2030-2050. *Source: Own elaboration.*

How substantial could the role of biomethane be by 2030 and 2040? The recently updated report by Guidehouse of April 2026[12] indicates that in 2024, around 22 bcm of biogases were produced in Europe, of which 5 bcm is biomethane. Current production is almost exclusively via anaerobic digestion.

The Guidehouse report forecasts that the total potential of biomethane and e-methane in 2030 is between 34-35 bcm/year (almost all based on biomethane from anaerobic digestion). The production potential is expected to increase in the coming decades, with a biomethane and e-methane potential between 116-132 bcm/year in 2040 and between 181-205 bcm/year in 2050, with anaerobic digestion remaining the dominant technology.

For biomethane specifically, Europe's production potential for 2030 is estimated at 33 bcm/year, of which 30 bcm/year is expected to come from the 27 member states. This assessment is based exclusively on biomethane produced through anaerobic digestion, as thermal gasification is not considered sufficiently close to commercial deployment to make a significant contribution to production by 2030. The five European countries with the highest biomethane potential are Germany, France, Italy, Poland and the United Kingdom, which together account for more than 60% of Europe's total biomethane potential. The main feedstocks expected to support biomethane production in 2030 are agricultural residues (25%), animal manure (24%), sequential crops (19%) and industrial wastewater (15%), which collectively represent 81% of the total feedstock potential. Moreover, Europe is estimated to have an e-methane potential of 0.8–1.4 bcm/year by 2030, including 0.7–1.2 bcm/year in the EU-27. This would bring the total renewable gas potential to approximately 34–35 bcm/year in Europe and 31–32 bcm/year in the EU-27. Looking towards 2040, e-methane deployment could

[12] Biogases: Europe's overlooked path to energy independence? https://www.europeanbiogas.eu/wp-content/uploads/2026/04/Biogases.-Europes-overlooked-path-to-energy-independence-1.pdf

Co-funded by the European Union

substantially increase renewable gas production, as it can be incorporated into most larger biomethane facilities. By converting renewable hydrogen and biogenic CO_2 into additional methane, plant output could rise by an estimated 50-70%, enhancing the scalability of the biomethane sector.

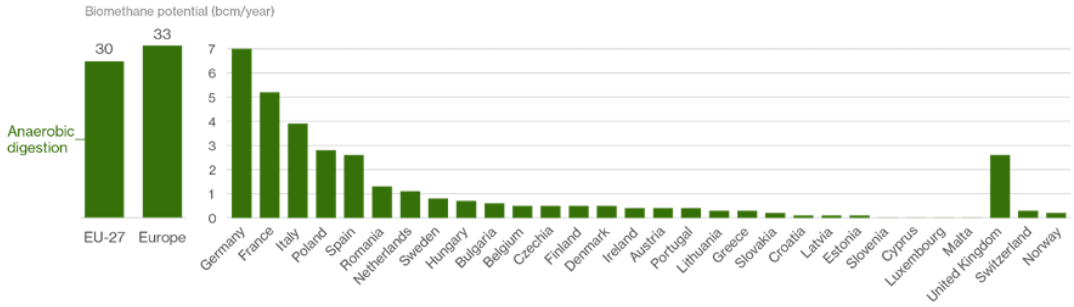


Figure 7: Biomethane potential (bcm/year) for 2030. *Source: 2026, Guidehouse.*

Innovative feedstocks and technologies can further scale biomethane production without adverse effects on land use or food/feed production and can contribute to soil restoration. Prominent feedstocks include marginal and contaminated land, seaweed, and digestate. Technological advancements such as hydrothermal gasification offer versatile processing capabilities for various biogenic and fossil wastes, presenting benefits over traditional waste treatment methods such as incineration. Biomethane upgrading processes also offer additional potential for technical carbon dioxide removal (CDR), as the biogenic CO_2 separated during upgrading can be captured and permanently stored or utilised. With the enabling framework for technical CDR developing through mechanisms such as the Carbon Removal Certification Framework (CRCF), the EU ETS and the emerging carbon removals market, CO_2 capture from biomethane upgrading represents a relatively cost-effective opportunity to generate additional carbon removals while supporting biomethane production.

Another promising technology is methanation, which produces e-methane by combining renewable hydrogen with biogenic CO_2. This carbon-neutral gas can replace conventional fuels and leverage existing natural gas infrastructure. Several demonstration projects across Europe are currently exploring the potential of methanation, highlighting a growing trend towards larger and more numerous plants. Methanation is a mature technology, with a Technology Readiness Level (TRL) of 6–9 and several demonstration projects already operating across Europe. The number and scale of methanation plants have increased in recent years, with several large-scale projects being developed in countries such as France and the Netherlands. A leading example comes from the BIOMETHAVERSE project, which demonstrates innovative biomethane production pathways, and combines captured CO_2 from anaerobic digestion or gasification with green hydrogen or renewable electricity to produce additional biomethane through methanation. According to the project partners, these technologies could increase biomethane production by up to 66% while reducing production costs by up to 44%.

For 2040, the report estimates that Europe will have a biomethane production potential of 101-107 bcm, of which 91-96 bcm in the 27 member states. The countries with the highest biomethane production potential are Spain, driven by its significant potential from marginal land, followed by Germany, France, Poland and Italy. The main feedstocks contributing to this potential are sequential crops (38%), animal manure (19%) and agricultural residues (17%), which together

Co-funded by the European Union

account for 73% of the total. Industrial wastewater and marginal land each contribute a further 10% of the overall biomethane production potential in 2040.

Thermal gasification and e-methane are expected to become increasingly relevant from 2040 onwards. Biomethane production potential from thermal gasification of woody biomasses such as forest residues and recovered wood-waste is estimated to 31 bcm by 2040. The total potential of thermal gasification and e-methane production is projected to increase significantly after 2030, reaching an estimated 116–132 bcm/year in 2040 and 181–205 bcm/year in 2050. Of this, 105–119 bcm/year and 163–184 bcm/year are expected to be available in the EU-27 in 2040 and 2050, respectively.

Anaerobic digestion is expected to remain the dominant technology, accounting for approximately 67% of the total potential in 2040. At the same time, the contribution of complementary technologies is expected to grow as they become increasingly commercialised, with thermal gasification accounting for approximately 25% of the total potential in 2040 and 32% in 2050.

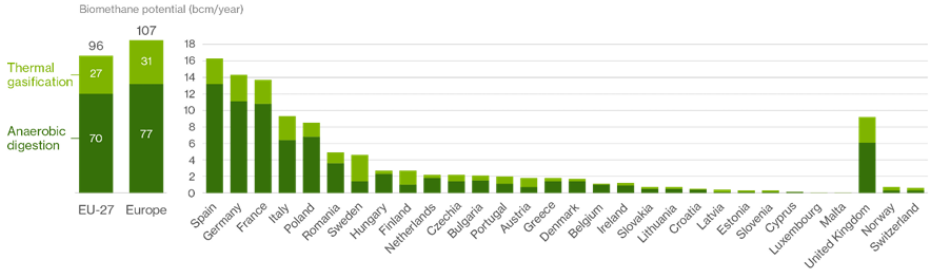


Figure 8: Biomethane potential (bcm/year) for 2040. *Source: 2026, Guidehouse*.

And finally, for 2050, the European biomethane potential is expected to be between 158-166 bcm/year, of which 142-149 bcm/year in the 27 member states. The updated estimate indicates that biomethane production could reach up to 165 bcm by 2050, of which 150 bcm produced in the EU-27. Although it remains the dominant production pathway, its share declines slightly compared with 2040 as thermal gasification is expected to scale up further over the intervening period.

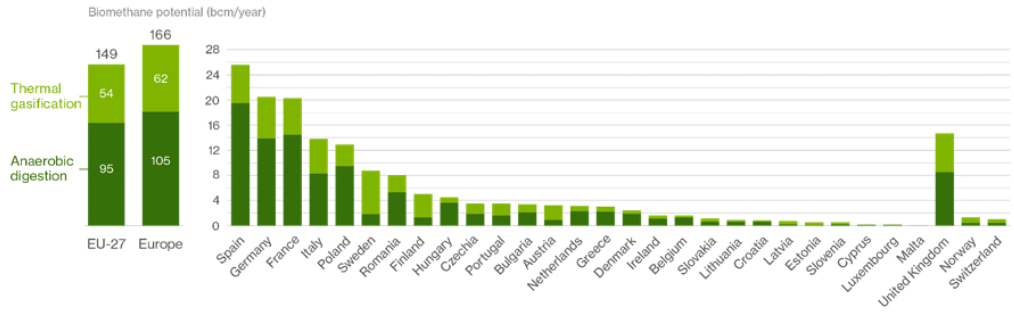


Figure 9: Biomethane potential (bcm/year) for 2050. *Source: 2026, Guidehouse*.

Co-funded by the European Union

3. Policy, regulatory market gaps and recommendations

To address further country-specific gaps and preliminary policy recommendations from the second report (October 2024), information on the current cost of biomethane production contained in the BIP Europe Report, among other sources, has been considered.

3.1. General overview

The European Commission recognises the important benefits of biomethane in enhancing Europe's energy security and reducing GHG emissions (including the ability to generate negative emissions). Biomethane has other important benefits as an enabler of more environmentally friendly and circular agriculture and as a storable, energy-dense renewable energy source which can be transported through existing gas infrastructure.

For these reasons, there is a clear need to scale up biomethane by 2030 and beyond, as outlined in the REPowerEU Plan. Additionally, the European Commission is preparing a new post-2030 renewable energy framework that will heavily influence the role of renewable gases and biomethane in the next decade. This will be an important opportunity to build on the ambitions of REPowerEU, remove existing barriers to the internal market for biomethane and create the long-term regulatory and investment conditions needed to further scale up biomethane production and use across Europe. As a renewable and dispatchable energy source, increasing the production and use of biomethane also helps to address the climate crisis. The EU's biomethane production, either as biogas or its upgraded version, needs to reach 35 bcm per year by 2030 and the estimated investment need for the period amounts to €37 billion. Every country in the European Union must identify their regulatory market gaps and policies and try to solve them to achieve those objectives.

3.2. Projects' overview: policy recommendations

3.2.1. BIOMETHAVERSE

BIOMETHAVERSE is a Horizon Europe project that aims to make biomethane production more efficient, affordable and widely used across Europe. It demonstrates five innovative production pathways at sites in France, Greece, Italy, Sweden and Ukraine, combining approaches such as anaerobic digestion or gasification with renewable hydrogen, renewable electricity and captured biogenic CO_2. The project also assesses the environmental, social and economic performance of these solutions and works to support their replication, scale-up and market uptake.

Provide a stable, long-term demand framework for renewable gases. EU and national policy should set a credible and binding pathway for replacing fossil gas, supported by a predictable carbon-price signal, a stable and ambitious EU ETS, and an Energy Taxation Directive that consistently reflects the climate costs of fossil fuels. Agreed targets should not be weakened or repeatedly postponed, as regulatory reversals undermine investor confidence and delay projects. Demand-side incentives should cover all relevant uses of biomethane and e-methane, including industry, transport, heating, electricity generation, and their use as renewable feedstocks in chemicals and materials.

Co-funded by the European Union

Create markets for biomethane co-products and circular-economy benefits. Policy should reward the full environmental value of biomethane production, not only the energy produced. This requires clearer market access and incentives for biogenic CO_2, digestate, compost and biofertilisers, including recognition of durable biogenic carbon removals, support for using biogenic CO_2 in e-fuels, measures that stimulate renewable nutrient use and carbon farming, and accounting rules that recognise the avoided emissions from replacing fossil fertilisers. Feedstock rules should also enable the sustainable use of agricultural residues, manure, sequential crops, wastewater and separately collected urban biowaste, while safeguarding soil quality, biodiversity and food production.

Turn hydrogen and methanation targets into investable delivery measures. Renewable e-methane depends on reliable supplies of competitively priced renewable hydrogen, biogenic CO_2 and renewable electricity. The EU and Member States should therefore translate hydrogen strategies into operational instruments that accelerate renewable-power deployment, electrolyser investment, grid connections and long-term contracting. Coordinated planning should give project developers confidence in electricity availability and price stability, while dedicated demonstration and scale-up support should help methanation technologies progress from pilot projects to commercial deployment.

Make permitting faster, simpler and measurable. Member States should fully implement the permitting provisions of RED III and the Net-Zero Industry Act, including effective single contact points, clear application requirements and enforceable decision deadlines. Authorities should publish performance indicators on processing times, identify recurrent bottlenecks and coordinate permits for production plants, upgrading units, grid injection, CO_2 handling and associated infrastructure. This would reduce project risk without weakening environmental safeguards.

Require comprehensive national biomethane strategies. Every Member State should adopt a biomethane or renewable-gas plan aligned with its NECP and the EU pathway beyond 2030. Plans should map sustainable feedstock and production potential, set measurable production and use trajectories, identify priority end-use sectors, assess gas-grid and transport infrastructure needs, and specify permitting, financing and skills measures. Regular monitoring against common indicators would reveal delivery gaps early and improve coordination between energy, agriculture, waste, climate and industrial policy.

Complete the EU single market for biomethane and e-methane. Certification and traceability rules should be harmonised so renewable gas can be traded across borders with the same confidence and administrative simplicity as renewable electricity. The Union Database should provide one interoperable backbone linking sustainability information, Proofs of Sustainability and Guarantees of Origin, while preserving the mass-balance approach required for RED compliance. Harmonised, common data standards, mutual recognition and clear rules against double counting would reduce fragmented national procedures and make certificates usable across relevant EU policies, including the EU ETS, quotas, support schemes, and proof of compliance with any other EU legislation.

Keep RED sustainability rules robust, stable and proportionate. Sustainability safeguards should remain credible, but compliance should be simplified and aligned across EU legislation to avoid overlapping or frequently changing requirements. Legislators should provide workable default values and clearer treatment for common feedstocks, including manure, agricultural residues, sequential and ley crops, wastewater and biowaste. Greenhouse-gas accounting should consistently capture relevant benefits such as avoided manure emissions, soil-carbon improvements, renewable fertiliser

Co-funded by the European Union

substitution and the use or permanent storage of biogenic CO_2, while maintaining strong protections for biodiversity, soils and sustainable land use.

Use transitional support to bridge the competitiveness gap. Until durable demand, carbon pricing and a functioning single market make projects financeable without public intervention, Member States should provide complementary and predictable support. A balanced package can combine investment aid with operating support, such as contracts for difference, feed-in premiums or well-designed quota obligations. Schemes should be technology-appropriate, open to innovative production and upgrading routes, and designed to phase down as market revenues become sufficient rather than ending abruptly. For scaling methanation and e-methane, support measures for biomethane should specifically target also e-methane.

Establish a transparent route for sustainable biomethane imports from neighbouring third countries. The EU should operationalise the legal pathways for recognising biomethane from countries whose systems are aligned with EU renewable-energy requirements, including Energy Community Contracting Parties such as Ukraine. The Commission should publish compatibility criteria and a standard procedure for agreements on mutual recognition of Guarantees of Origin under Article 19(11) of the Renewable Energy Directive. In parallel, Union Database rules should define objective conditions for connecting eligible third-country registries: compliance with RED sustainability and greenhouse-gas-saving criteria, certification under an EU-recognised scheme, secure exchange of transaction data and enforceable prevention of double counting. For mass balance purposes, physically interconnected gas systems should be assessed according to verified traceability and regulatory compliance rather than the external border alone, with exported volumes removed from the exporting country's renewable-energy accounting. This would enable reliable imports while protecting environmental integrity and market transparency.

3.2.2. SEMPRE-BIO

Within the project SEMPRE-BIO innovative biomethane production technologies were demonstrated through 3 case studies:

- Baix Llobregat in Spain: combining proton exchange membrane water electrolysis (PEM) and CO_2 bio-methanation at wastewater treatment plant (WWTP).
- Bourges in France: combining thermo-chemical pyrolysis process and bio-methanation
- Adinkerke in Belgium: production of bio-LNG and liquified CO_2 (LCO_2) by cryogenic process, followed by the production of value-added products from LCO_2 and H2 such as biopolymers, biochemicals, and alternative sources of protein.

This part focuses on main barriers regarding investigated technologies in SEMPRE-BIO and the policy recommendations addressed as results of the biomethane survey 2026. The responses reflect the view of involved project partners focused on the countries with investigated demo plants within SEMPRE-BIO project.

Main barriers regarding investigated technologies:

Several obstacles were identified during the project's progress and summarised as feedback from the surveys carried out by involved the project partners. On the technical side, challenges remain in scaling

Co-funded by the European Union

innovative upgrading technologies in an energy- and cost-efficient way and integrating them into existing facilities. Regulatory challenges include complex and time-consuming permitting procedures, as well as regulations that are not always tailored to new applications. Economically, the high investment costs and the uncertainty surrounding market prices and support mechanisms remain a challenge. Social and market barriers involve limited infrastructure, skills gaps, and uncertain markets for biomethane and co-products, all of which slow wider deployment Finally, there is a need for sufficient support and clear communication about the added value and sustainability of biogas and biomethane projects to improve their social acceptance.

The main barriers regarding technologies and the bottlenecks to be improved are described in the following. Based on the survey results, the main barriers reported for cryogenic upgrading are high CAPEX and energy consumption, requirement of the stable CO_2 offtake markets, which are still emerging in Europe. Further barriers are represented by more complex operation, regulatory uncertainty around CO_2 quality and permitted uses (technical regulation not yet implemented). In Flemish case, one barrier is also a limited number of biomethane plants large enough to justify cryogenic systems in terms of the costs. In the view of one further Belgian survey participant, permits are the most critical issue in Belgium.

With respect to methanation technologies and in the view of the Spanish survey participants, the critical barriers are already mentioned high electricity consumption, criticism towards green H2 and low social acceptance of renewable energies. For some of the studied technologies, industrial scale-up has not yet been sufficiently demonstrated. In other cases, integration with both stable renewable electricity sources and renewable hydrogen production at an affordable cost must be achieved.

In France, the support architecture (feed-in tariffs, the CPB certificate mechanism, and ICPE permitting categories) was designed specifically around methanation/ AD with subsequent biogas upgrading. As a result, newer technologies remain structurally disadvantaged despite explicit policy backing, since PPE3 names all of them as strategic priorities without yet providing an equivalent financial or regulatory framework, which represents a barrier for the deployment of newer technologies. Pyro-gasification is furthest along in closing this gap in France, with integration into the CPB mechanism currently in progress. Power-to-gas and biological methanation remain at an earlier stage, where the immediate priority is still demonstrating technical viability at scale, ahead of any dedicated support mechanism being designed. The binding constraint is not biomass availability or process chemistry, but the fact that regulatory and financial infrastructure has not yet caught up with stated policy ambition.

The main barrier for conventional biogas upgrading technology such as membrane upgrading is the fact that CO_2 stream cannot be directly valorised without extra purification. In addition, methane slip must be controlled, grid injection costs remain high, there are limited incentives for upgrading – all the factors providing a weak business case for many biogas plants.

One of the bottlenecks in view of the Belgian survey participant is the fact of CO_2 valorisation markets being still small and fragmented with the regulatory framework for CO_2 use not yet finalised. The Spanish perspective on the bottlenecks is that the studied technologies won't be a cost factor, but biomethane will bring in revenues. The cost competitiveness with natural gas must be considered. One Spanish market participant has criticized the lack of the legal biomethane obligation pointing out that the biomethane market won't develop on its own.

Advantages and disadvantages of the studied technologies:

Co-funded by the European Union

According to feedback from the survey, cryogenic upgrading with CO2 valorisation is a favoured technology which offers very high methane purity and enables CO2 valorisation. In terms of legal framework, CO2 valorisation benefits indirectly from EU ETS zero-rating of biogenic CO2 plus active industry-led support (in France: French primary gas distribution system operator GRDF's 2025 call for projects, French gas transmission system operator NaTran's planned pipeline network). It monetises the CO2 byproduct already generated by the existing methanation plants. It means this is the lowest-risk, fastest-payback option since it layers onto infrastructure that already exists. One further benefit of (cryogenic) upgrading is the production of a drop-in fuel for heavy-load land and marine transportation. Main disadvantages of cryogenic upgrading are higher CAPEX and the production cost competing with low prices for natural gas, higher energy use and the need for a stable CO2 market.

In terms of legal framework, pyro-gasification with syngas biological methanation as the second most favored technology in accordance with survey results is explicitly named in French PPE3 as a priority diversification technology and actively being integrated into the French CPB certificate mechanism itself. In terms of biomass potential, this technology delivers the strongest fit for unexploited biomass — it unlocks the dry, non-fermentable, lignocellulosic pool (used wood, sorting rejects, CSR) that methanisation structurally cannot touch, directly addressing France's largest underused biomass category (forest/dry agricultural residues). In provides the highest medium-term volume potential of any single new technology (6 TWh by 2030, 90 TWh by 2050). In the view of one Spanish survey participant, syngas biological methanation represents a more robust technology than catalytic methanation.

In accordance with the response of Spanish market participants, in Spain, the methanation routes are still at a relatively low level of industrial maturity. One of the greater disadvantages of methanation is the high electrical consumption and water stress from green H2 generated by electrolysis. Consequently, it requires more renewable energy and must be placed in zones with less water scarcity.

Along with innovative technologies, the conventional biogas upgrading such as membrane separation represents the most widely deployed technology in Europe due to its lower OPEX, high availability and modular design. It is a proven, cost-effective and modular technology suitable for most European (but also Flemish) biogas plants. It is easy to operate and commercially mature. It produces a CO2-rich off-gas, but this stream is not directly valorisable without additional purification and liquefaction. CO2 valorisation is technically possible but requires additional treatment steps that are not standard in most European (but also Flemish) membrane installations. PSA is also a well-established technology, but its losses are higher than in membrane systems. Amine washing is also used but involves greater operational complexity. One further benefit of the conventional biogas upgrading technologies is that they require less electricity in comparison with production of H2 based on electrolysis which is later used for methanation.

Potential for cost savings of investigated technologies:
With respect to the investigated technologies, market participants have provided feedback that energy consumption in upgrading processes can be reduced, modular plant designs can be standardized, digitalization for process automation and energy integration between anaerobic digestion, and upgrading can be improved. Specifically for membrane upgrading, they have reported that more efficient 3-stage membrane systems can reduce methane slip, lower cost membranes can be installed due to market maturity, improved pre-treatment can reduce membrane replacement frequency.

Co-funded by the European Union

In accordance with survey results for cryogenic upgrading, larger units can achieve economies of scale by reducing specific costs of biomethane produced. The energy efficiency of refrigeration cycles can be improved, while better integration with CO_2 valorisation can be targeted (with local hubs reducing logistics cost by pooling CO_2 capture across nearby methanation sites and selling to nearby buyers instead of shipping CO_2 far). According to information of market participants, the capture costs of CO_2 are already relatively low, while the costs of transportation and distribution for instance in France are high (~80 €/t on top of ~20 €/t capture costs).

About methanation technologies, the market participants suggest that CAPEX (specifically the cost of compressors and reactors) can be reduced without compromising the overall plant performance. The electricity efficiency can be further improved. Besides, qualified personnel are required to keep the staff costs low. Pyro-gasification with syngas biological methanation itself does not represent a significant cost item according to the survey respondents. The lack of a standard permit category and tariff framework means every project pays its own legal/financing risk premium from scratch. Once a clear ICPE classification and support comparable with CPB in France exist, costs drop through faster permitting and repeatable plant designs.

Another option for cost reduction is "clustering", meaning that facilities are shared between industrial entities and/or users to exploit economies of scale. Clustering of small facilities to generate larger clusters can reduce the CAPEX and OPEX through economies of scale.

Potential for improvement of investigated biomethane technologies:
For conventional biogas upgrading technologies, the reported measures are increasing methane recovery, reducing fugitive emissions, advancing automation, as well as using CO_2 capture and valorisation technologies. Specifically for membrane upgrading, higher-selectivity membranes have been named which led to lower methane slip, better integration with CO_2 polishing for CO_2 valorisation.
From the perspective of market participants, advanced methanation technologies can be improved during good techno-economic analysis, LCA, and integrated analysis predicting potential production and valorisation pathways. Furthermore, the need for simulation tools has been also emphasised. For pyro-gasification with syngas biological methanation, the clearest improvement is closing the syngas-to-methane conversion step, which is technically more complex than methanation's biogas upgrading. Better biological methanation efficiency would directly raise net gas output per ton of feedstock, on top of the regulatory fixes (in France: ICPE, tariffs) already mentioned.

With respect to cryogenic upgrading, automation to reduce operational complexity, more compact and modular systems for mid-scale plants as the potential to improve the technology regarding the scope of application have been named. The main improvement runway can be seen on the demand side, not the technology side. The French survey respondent reported that CO_2 capture works already well but only ~30 of 700+ injection sites in France (which is applicable to other European biomethane plants as well) use the captured CO_2 because there are no guaranteed CO_2 sales to local buyers (greenhouses, food-grade users). Therefore, in case of France, developing the NaTran pipeline/storage backbone and certifying biogenic CO_2 for carbon-removal markets (the Rainbow/CRCF work) would let sites without a local buyer still monetise their CO_2 rather than venting it. The developing appropriate infrastructure in form of CO_2 grids to valorise the captured CO_2 was pointed out. The need to develop appropriate infrastructure in form of CO_2 grids to valorise the captured CO_2 combined with the need of certification of biogenic CO_2 amounts is necessary for biomethane plants in all Member States.

Co-funded by the European Union

To increase biomethane production in the short and medium term, legal and administrative barriers must be reduced. The main barriers for the development of biomethane are a lack of planning security, missing or complex regulations which are less harmonized with faster amendments in shorter time, lack of the overall political strategy, and ambiguity relating the priority of the pathways for biomethane use. It is important to continue to adjust the political and economic framework to facilitate trade between different countries and to create more purchase opportunities for biomethane.

A further increase in production of biomethane can be achieved with appropriate support (for example, for the digestion of farm manure) or through the expanded use of other residues, straw, catch crops and alternative crops for biomass. Additional quantities of methane can also be produced using the biogenic CO_2 generated during the conversion of biogas to biomethane, in combination with green H_2 (for example, from the electrolysis of water using wind or solar power).

The following **policy recommendations** can be addressed:

- Regulatory simplification and harmonization of regulatory frameworks; adapting regulations, clear policy frameworks, adapted permitting procedures, Providing planning security for investors.
- Stable policy support for biomethane production (tax incentives, injection targets and quotas, simplifying grid access regulations to enable biomethane injection).
- Developing and communicating biomethane strategies. Setting national targets for biomethane expansion (e.g. Germany without Biomethane target).
- Amended regulations governing the injection of biomethane into the gas grid (e.g. in France, as it would allow to claim to inject the produced biomethane directly into the gas grid), permit for gasification; innovative technologies often not included in legislation; framework adaptations necessary to clarify the rules and to provide certainty in planning.
- Increasing energy/biomethane price or subsidies. EU funding opportunities and green finance mechanisms to stimulate these initiatives.
- Coordinated industrial deployment of technologies for improved upgrading of biogas, the production of products from digestates and biogenic CO_2. Further development of infrastructure (e.g. CO_2 grids or pipelines) to valorise the captured CO_2 combined with the need of certification.
- Knowledge transfer, Information the public about EU projects and their results. Civil society can actively support and contribute to innovative initiatives by providing targeted support for small-scale projects.
- Due to the long period of time until the pilot plants were commissioned, very little operational data could be incorporated. The integration of operational data from the pilot plants is helpful in verifying and validating the assumptions and can be achieved as part of follow-up projects by further monitoring the pilot plants after project end.
- More flexibility for innovative technologies in funded EU Projects. Need for more flexibility in projects regarding adaptations to make the necessary adjustments required to achieve the objectives, rather than to meet the requirements of the proposal.

3.2.3. METHAREN

No additional policy recommendations could be developed for this reporting period. This is primarily due to the prolonged suspension of the METHAREN project, which significantly limited the continuation of project activities and the further development of the analytical work required to

Co-funded by the European Union

formulate concrete policy recommendations. Consequently, the period between the second and third joint reports did not provide sufficient opportunity to advance the relevant work to a stage were new, evidence-based recommendations could be formulated.

3.2.4. HYFUELUP

HyFuelUp is a first-of-a-kind demonstration project that addresses one of the central barriers to biomethane scale-up: the need to diversify production routes beyond mature anaerobic digestion while maintaining sustainability and greenhouse gas savings. The project demonstrates an integrated pathway based on gasification of low-grade biomass residues, including forest residues and sludge digestate from anaerobic digestion plants, followed by gas clean-up and catalytic methanation with flexible renewable hydrogen addition. The objective is to validate a pre-commercial value chain capable of producing renewable methane for offtake to conventional gas markets.

The Tondela demonstration site in Portugal is especially relevant from a policy perspective because it combines several interlinked aspects such as technology integration, feedstock mobilisation, industrial refurbishment, permitting, and offtake in a single deployment pathway. This makes HyFuelUp a practical example of the type of FOAK project that is needed to move advanced biomethane from research and pilot activity towards commercial replication. It also illustrates why these projects should not be assessed only through the cost and timeline assumptions normally applied to conventional anaerobic digestion or upgrading projects.

From the HyFuelUp experience, advanced biomethane projects require policy instruments that recognise higher initial complexity and risk. Calls should allow sufficient time and flexibility for all needed activities, and a realistic implementation framework should include staged go/no-go milestones that function as de-risking and decision-support tools rather than rigid administrative deadlines. This would help public funders protect resources while giving consortia enough flexibility to solve technical, contractual and regulatory bottlenecks that are inherent to FOAK deployment.

The following **policy recommendations** stem from the project:

Develop dedicated first-of-a-kind support frameworks for advanced biomethane technologies: EU and national funding calls should distinguish between mature deployment projects and FOAK demonstrators based on gasification, methanation, power-to-Methane and other advanced biomethane routes. These projects should be assessed not only on short-term cost competitiveness, but also on their ability to diversify feedstocks, improve carbon efficiency, validate scalable industrial configurations and unlock production capacity beyond what conventional technologies are capable of.

Require a structured go/no-go package for FOAK demonstrators: Advanced biomethane calls should request a practical go/no-go package covering permitting status, procurement and contracting strategy, feedstock mobilisation, grid injection or liquefaction pathway, offtake strategy, certification route, risk register, safety plan and milestone-based implementation schedule. This package should be used to identify barriers early and support corrective actions, not simply to penalise projects for delays caused by permitting, supply-chain or contracting constraints outside the consortium's direct control.

Adapt project timelines to the real complexity of integrated demonstration projects: FOAK biomethane projects often combine several technology blocks and regulatory domains, including waste management, energy production, renewable hydrogen, CO_2 handling, gas quality, transport fuels and industrial permitting. Calls should therefore allow longer and more flexible timelines, with

Co-funded by the European Union

staged milestones for engineering, permitting, procurement, construction, commissioning and performance validation. Corrective action periods should be available where milestones are delayed by administrative decisions, public procurement rules or long-lead equipment delivery.

Create technology-specific incentives for advanced biomethane were justified by decarbonization and system value: First-of-a-kind routes may require higher initial support than mature anaerobic digestion, including CAPEX grants, feed-in premiums, contracts for difference, or dedicated auctions. Support levels should be transparent, evidence-based and linked to verified performance and scale, including greenhouse gas savings, carbon efficiency, biogenic CO_2 valorisation, use of residual feedstocks and contribution to hard-to-electrify sectors. This would reduce the risk of market distortion while avoiding financial imbalances between companies and Member States.

Promote replication rather than isolated demonstrations: Public support should require FOAK projects to produce replication packages, including lessons learned on permitting, contracting, technology integration, offtake models, certification and cost reduction. This would help ensure that projects generate policy and market knowledge that can be reused by other regions and Member States, accelerating the transition from individual demonstrators to a European advanced biomethane project pipeline.

Facilitating the replication and scale-up of these advanced biomethane technologies would also help diversify European biomethane production routes and feedstocks, contributing to increased domestic production and greater energy resilience.

3.2.5. VALUE4FARM

Value4Farm's involvement in the report will build on the project's work on policy and regulatory aspects and its contribution to the development of policy recommendations. As a Horizon Europe project, Value4Farm brings complementary insights from its analysis of the regulatory framework, policy barriers and opportunities for scaling innovative biomethane solutions. Including these findings in the joint report will help ensure that the recommendations reflect the broader lessons and perspectives emerging across the four sister projects, while clearly recognising Value4Farm's specific contribution to the policy and regulatory dimension.

Specific to the EU:

- European bioeconomy policy should treat commercialization as an innovation-system challenge. Promising technologies require demonstration infrastructure, patient capital, regulatory support, market incentives and stakeholder participation. Public–private investment mechanisms should cover both technology development and subsequent commercial scale-up.
- European farm-biogas policy should distinguish small, same-farm manure-based systems from large industrial plants and regulate them according to their actual scale and risk.
- The EU and its Member States should harmonize the implementation of fire-safety requirements for small farm-scale biogas installations. Common requirements should be based on previously demonstrated risk, installation scale and operational characteristics, while allowing site-specific solutions that provide equivalent safety. This could reduce inconsistent national interpretations and unnecessary redesign costs.
- EU and national bioeconomy policy should correct the structural incentives that favor fossil-based production, cheap imports, and high-volume monocultures. A more coherent framework would support diversified farms, safe experimentation with residual streams, demand for sustainable

Co-funded by the European Union

local products, targeted social protection, long-term bioregional programs, and equitable international research partnerships.

- EU support for biogas and biomethane should prioritise manure, agricultural residues and unavoidable organic waste. Eligibility should require feedstock traceability, lifecycle greenhouse-gas savings and compliance with the waste hierarchy, while limiting feedstocks that compete with food, feed or higher-value uses.

Specific for Belgium:

- Flemish bioeconomy policy should establish a common Belgian classification framework with consistent definitions and procedures for biomass, residues, by-products, waste and end-of-waste status across the Belgian regions.
- Belgium should evaluate manure-based biogas as an integrated agricultural, energy and nutrient-management system, rather than assessing the biogas plant, nitrogen emissions and digestate use under separate policy frameworks.
- It would be beneficial to establish a scale-up financing pathway for innovative biogas projects that cannot yet obtain conventional commercial finance. Funding should be conditional on technical milestones, verified environmental performance, regulatory readiness and independent assessment.
- Belgian policy should not assume that every agricultural biogas plant must upgrade its gas to biomethane. Farmers should be able to select the energy pathway that provides the greatest environmental and economic benefits under local conditions. Support should focus on achieving greenhouse-gas reductions, efficient energy delivery, and methane-leakage control, rather than a preference for a single energy carrier.

Specific for Denmark:

- Publish a long-term Danish biogas and biomethane roadmap. The roadmap should contain production objectives, priority uses, infrastructure requirements, sustainability criteria and legislative milestones.
- Differentiate certified biomethane from fossil natural gas in taxation. Certified biomethane should not automatically face the same tax treatment as fossil natural gas when it provides verified greenhouse-gas reductions. A tax deduction or differential could create demand from industrial and commercial consumers. Eligibility should require sustainability certification, traceability and credible lifecycle-emissions accounting.
- Danish policy should replace uniform restrictions on biogas crops with evidence-based differentiation. Monitored grass and clover-grass systems could potentially combine reduced nitrogen leaching, improved soil carbon and rotation, protein production, and biogas supply. Pilots should measure nitrogen leaching, soil carbon, biodiversity, crop rotation, biomass yield and lifecycle emissions.
- Reward manure-related methane reductions and share the value with farmers. Farmers supplying manure to biogas plants should receive an appropriate share of the economic value generated by avoided methane emissions. Denmark could use verified certificates or results-based payments, supported by standard contracts defining ownership, calculation methods and revenue distribution.

Co-funded by the European Union

Specific for Poland:

- Establish an integrated national biogas and biomethane framework. Poland should create a national roadmap coordinating agricultural, energy, waste, climate, fertilizer, spatial-planning and grid policies. It should define responsible institutions, deployment targets, sustainability criteria and regional implementation responsibilities.
- Consolidate the 2023 agricultural-biogas reforms. Rather than immediately introducing another legislative reform, Poland should ensure that the 2023 rules are applied consistently. This requires practical guidance, common templates, training for municipal authorities and advisers, and monitoring of permitting times and completed projects.
- Introduce a one-stop, time-bound permitting pathway. A single coordinating authority should manage spatial-planning, environmental, construction, feedstock, digestate and grid-connection procedures. Applicants should receive a clear list of requirements, responsible authorities and decision deadlines.
- Harmonize the classification of biogas feedstocks. Poland should establish nationally consistent definitions for agricultural residues, food-service residues, processing side streams, waste, by-products and fertilizing materials. The rules should clarify the evidence, traceability and safety requirements for using each material in biogas plants.

3.3. Preliminary and summarised policy recommendations

1. **Establish stable long-term targets, demand and finance**. The EU and Member States should set clear, binding targets for biomethane and other renewable gases beyond 2030. These targets should be supported by predictable funding, purchase agreements and market incentives. Public support, guarantees and long-term contracts should help reduce investment risks, especially for first-of-a-kind projects, while rewarding proven emissions reductions. BIOMETHAVERSE shows that stable demand, carbon prices and support schemes are needed across industry, transport, heating, power generation and renewable feedstocks. National strategies linked to the NECPs should turn EU goals into measurable production and use targets, infrastructure plans and regular monitoring. HyFuelUp also shows that complex first-of-a-kind projects need realistic timelines, staged decision points and financial support linked to performance.

2. **Harmonise certification, sustainability rules and cross-border trade**. The EU should create compatible rules for Guarantees of Origin, mass-balance accounting, lifecycle emissions and sustainability checks for biomethane, renewable hydrogen and related fuels. The same clear rules should apply to imports, and certificates should be recognised across borders without double counting. BIOMETHAVERSE identifies the Union Database as a possible common system linking sustainability data, Proofs of Sustainability and Guarantees of Origin while keeping RED mass-balance rules. It should also provide simple rules for renewable hydrogen, e-methane and cross-border trade. Value4Farm stresses that feedstocks must remain traceable, deliver lifecycle emissions savings and follow the waste hierarchy. Harmonisation should therefore reduce unnecessary administration without weakening environmental standards or placing disproportionate burdens on small farm-based systems.

Co-funded by the European Union

3. **Accelerate permitting and infrastructure access**. Member States should create coordinated one-stop permitting systems with clear requirements and reasonable deadlines for production plants, upgrading, methanation, storage and grid injection. Producers also need timely, transparent and fairly priced access to gas and electricity grids. Infrastructure planning should reflect regional feedstock supplies and demand. SEMPRE-BIO shows why the whole value chain must be considered together: its sites combine biomethane production with electrolysis, methanation, bio-LNG and CO_2 recovery, so they need coordinated access to electricity, gas, hydrogen and CO_2 infrastructure. Current rules often favour established technologies, while newer options face unclear permitting and high connection or transport costs. Authorities should close these gaps and develop shared hubs or pipelines where useful, without weakening safety or environmental protection.

4. **Support innovation scale-up and operational demonstration**. The EU and Member States should provide dedicated funding to move promising technologies from research to commercial use. Support should cover full-scale, long-term demonstrations of biological and catalytic methanation, renewable-hydrogen integration, advanced upgrading and flexible plant operation. Funding should include performance monitoring, shared operating data, replication support and skills development. SEMPRE-BIO shows that some advanced methanation technologies still need to be proven at industrial scale and monitored for longer. HyFuelUp also recommends specific support for first-of-a-kind projects, including clear go/no-go stages, flexible schedules and practical replication plans covering permits, contracts, technology integration, certification, offtake and cost reduction. Value4Farm adds that successful scale-up requires demonstration facilities, patient capital, regulatory support and market incentives.

5. **Enable circular feedstocks and valuable co-products.** EU rules should support sustainable wastes, residues and sequential crops while protecting soils and avoiding harmful land-use effects. They should also clarify when digestate-based fertilisers and other co-products can enter the market and recognise captured biogenic CO_2 as a traceable resource for methanation, industrial use and permanent storage. BIOMETHAVERSE calls for stronger markets for digestate, compost and biogenic CO_2, including its use with renewable hydrogen to produce e-methane. It also calls for emissions accounting that better reflects the avoided emissions delivered by biomethane systems. SEMPRE-BIO highlights fragmented CO_2 markets and the need for clearer quality standards, use rules and transport infrastructure. Rules should reflect the different size, risks and local conditions of biogas projects, distinguish small farm units from industrial plants, and consider manure-based biogas together with nutrient management. Support should prioritise manure, agricultural residues and unavoidable organic waste, while allowing each farm to choose the most suitable energy use.

Co-funded by the European Union

4. Sustainability and Guarantees of Origin

Since renewable gases are expected to play an important role in the decarbonization efforts of the European Union to become carbon neutral by 2050, biomethane has gained more recognition, and the trend is expected to continue as the demand for it keeps growing.

To ensure that both the production of biomethane is sustainable, but also that the consumers are well informed on what they are using, the European Union has created two types of documentation to track and trace biomethane. Such documentation is also being used in the biomethane trading market and increases the attractiveness of this energy source both from an economical and sustainability perspective. The two types of documentation are the Proof of Sustainability (PoS) and Guarantees of Origin (GO), both having a legal basis in the REDIII. Alongside them, there are national certificates created by Member States (e.g. Germany) for compliance purposes (e.g. transport quotas).

4.1. Proof of Sustainability (PoS)

This type of certification ensures that the biomethane produced is sustainable, following the criteria outlined in REDIII[13]. RED III sets binding requirements for the sustainable production and processing of biomass. Only biomethane meeting these requirements can be used for the renewable energy targets for Member States set by RED III. Compliance with the sustainability criteria is also required for biomethane to be eligible for financial support (such as tax exemption or zero-rated in EU ETS) or counted towards quota obligations (such as national transport mandates or FuelEU Maritime).

To be able to issue Proof of Sustainability, a producer of biomethane must first be certified by one of the voluntary schemes recognised by the European Commission. Such voluntary schemes[14] ensure that the feedstock used to produce biomethane is sustainable and meets the criteria set by RED III. They are run privately, but they must be recognised by the European Commission as compliant with the rules set in the Renewable Energy Directive II.

The recognised voluntary schemes for the certification of renewable gases are[15]:

- REDcert
- International Sustainability and Carbon Certification (ISCC)
- Better Biomass
- 2BSvs
- SURE

[13]Renewable Energy Directive (RED) III. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023L2413&qid=1699364355105

[14]Voluntary schemes. https://energy.ec.europa.eu/topics/renewable-energy/bioenergy/voluntary-schemes_en

[15] The Commission currently lists 18 formally recognised voluntary/national certification schemes, but only a subset have a meaningful scope for biomethane. https://energy.ec.europa.eu/topics/renewable-energy/bioenergy/voluntary-schemes_en

Co-funded by the European Union

- Roundtable on Sustainable Biomaterials
- KZR INiG

All information is well documented. Companies are audited before they start to participate in the scheme and retroactive audits take place regularly. The auditors have both the generic and specific auditing skills needed regarding the scheme's criteria.

The recognition by the European Commission of a voluntary scheme has a validity of five years. A producer must apply to be certified by a voluntary scheme to be able to issue a PoS. It is the responsibility of the voluntary scheme to conduct verifications on the producers to ensure they are compliant and to prevent fraud.

The PoS also forms a key part of the evidence that a mass balance of renewable gas is achieved, and that mass balance can be cross-border. Each producer and trader needs to ensure the balance and is audited regularly. For instance, the European interconnected gas infrastructure is defined as one single place for mass balancing – allowing biomethane to be blended with natural gas and efficiently traded cross-border via purchase agreements and PoS.

4.2. Guarantees of Origin (GOs)

The Guarantees of Origin (GOs) have the purpose of showing to a final customer that a given share or quantity of energy was produced from renewable sources, as outlined in Article 19 of the Renewable Energy Directive (REDIII)[16]. All member states are required to set up GO registries for renewable gases, and GOs shall be mutually recognized between member states to enable cross-border trade of GOs. The implementation of gas GO registries (or adoption of existing biomethane registries to the GO regulation in Article 19) is still ongoing in some countries and cross-border trade of gas GOs is not yet functional between all registries. Even though gas Gos remain voluntary for both producers and suppliers, lately with the transposition of RED III by Member States, there are some countries where the use of GO together with the PoS is mandatory to ensure compliance with the national targets. Furthermore, with the implementation of the Gas Market Directive (which shall be transposed into national law by 5 September 2026) gas suppliers on regulated gas grids are obliged to cancel GOs corresponding to the renewable gas supplied to final customers.

4.3. Towards a harmonised cross-border transfer of biomethane certificates

Guarantees of Origin

An important element that helps drive a more developed and harmonised market for biomethane in Europe is the cross-border transfer of such certificates (PoS & GO).

Some of the biomethane produced has a PoS if the producer has been certified by a voluntary scheme, and sometimes the biomethane produced can have a GO if such a registry exists in the country of production and the producer has requested a GO. The biomethane can also have both

[16] Directive (EU) 2018/2001. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001

Co-funded by the European Union

a GO and a PoS. To facilitate the cross-border transfer of renewable gas certificates (incl. biomethane), the European Renewable Gas Registry (ERGaR) has created the Certificate of Origin Scheme[17] (CoO Scheme), which has been operational since June 2021 and facilitated the cross-border transfer of over 11 TWh of biomethane certificates until today. The ERGaR CoO Scheme has seven System Participants: AGCS (Austria), the German Energy Agency (Dena, Germany), GGCS (United Kingdom), Energinet (Denmark), SPP Distribucia (Slovakia), Pronovo (Switzerland) and Amber Grid (Lithuania). Since the beginning of 2024, the Association of Issuing Bodies (AIB)[18] has also launched its gas scheme with current members from 36 countries, including Spain, Austria, Finland, Italy, Czech Republic and Latvia. The AIB gas scheme only allows mandated GO issuing bodies. Given that there are two schemes now in operation at the European level (ERGaR and AIB) and trade between the two schemes is not possible, there are barriers to trade biomethane within Europe. The two associations managing the two schemes are working now to create one harmonised market and avoid fragmentation. Considering that transfers between the participants in the two schemes are not possible unless bilateral agreements are reached, the two organisations hope to reach an agreement and find a solution to support the harmonisation of the market for biomethane certificates.

Proof of Sustainability

For the cross-border trade of biomethane with proof of sustainability (PoS), there are fewer barriers. Particularly after the implementation of Regulation 2022/996 which states the EU gas grid is a single logistical facility and thus one single place for mass balancing. This means that as of this year capacity bookings at the interconnection point are not needed anymore. Now, the PoS can be sent all over Europe if there is a connection to the EU gas grid.

One major development in the cross-border transfer of biomethane certificates is the introduction of the Union Database for Biofuels (UDB). It should have been operational for liquid biofuels from 15 January 2024[19]. However, the final implementing regulation (a revised Implementing regulation 2022/996) is still missing and the functionality of the IT-system is still under testing and development and testing. The upcoming Union Database is designed to cover transactions of all biomethane and e-methane produced which comply with RED sustainability criteria, thus biomethane with a PoS, including biomethane that has a PoS plus a GO. It will track the ownership of the Proof of Sustainability in its centralised database. GOs issued for sustainable biomethane that is registered in the UDB will be locked in the UDB and will not be possible to transfer outside the UDB, to avoid risks for double counting.

Biomethane that does not comply with the sustainability criteria will not be registered in the UDB, meaning that there will be approximately 15% of biomethane with only a GO (for instance biomethane used in small installations or for non-energy purposes).

Thus, schemes such as the ERGaR CoO scheme and the AIB gas scheme will continue to play a role in the cross-border transfer of biomethane certificates until 2030. With the post-2030 renewable energy framework under development and the mandatory implementation of the UDB, the situation may change for both schemes.

[17] Certificate of Origin Scheme. https://www.ergar.org/ergar-schemes/ergar-coo-scheme/
[18] Association of Issuing Bodies. https://www.aib-net.org/
[19] Union Database for Biofuels (UDB). https://energy.ec.europa.eu/news/eu-database-biofuels-becomes-operational-2024-01-15_en

Co-funded by the European Union

The Union Database is meant to be a mass balance system; thus, the cross-border transfer of certificates and cross-border trading should become much easier once this has been fully implemented and integrated with the different national systems.

While there is general support by stakeholders for the concept of the Union Database, as it can contribute to the harmonization of the European biomethane market, there are concerns about the practical implementation that need to be tackled and discussed. The implementation has been delayed and there are still concerns and questions about the practical functionality of the system. The timeline has shown too ambitious and experience from the liquid biofuels showed that there should be sufficient time available for testing the system.

Furthermore, it seems that the development process can be improved as the different relevant industry associations requested the European Commission for a robust stakeholder consultation to provide constructive comments.

Co-funded by the European Union

5. Challenges and regulatory barriers

5.1. Regulatory barriers for the biogas sector

Long-term demand for renewable gases must be assured in all major user sectors

The EU demand policies such as EU ETS I and II FuelEU Maritime or national policies such as production support schemes, tax exemptions or transport quota obligations are still not effective enough or are not covering all relevant user sectors for biomethane or e-methane to be fully competitive with fossil fuels. Uncertainty of the future demand and competitiveness hamper investments. Last year´s discussions in EU and in some Member States on the long-term targets and climate policy ambition increase the investment uncertainty. Therefore, it is of utmost importance to keep the already decided targets and ambitions, and to continue developing and strengthening the demand policy instruments for renewable and circular energy and products.

Investment uncertainty

The biomethane sector continues to face regulatory uncertainty that weakens investment signals and slows market development. While the REPowerEU Plan established an indicative target of 35 bcm of biomethane production by 2030, the absence of legally binding long-term targets and sufficiently robust demand-side policies creates uncertainty for investors and limits the mobilisation of capital for large-scale deployment. Existing EU instruments, such as the EU ETS I and II and FuelEU Maritime, as well as national measures including production support schemes, tax incentives and transport quotas, do not yet provide sufficiently strong or comprehensive demand signals across relevant end-use sectors. This is further compounded by limited access to dedicated EU funding, insufficient financial incentives for renewable methane production, and the absence of market-based mechanisms such as green gas contracts, Biomethane Purchase Agreements (BPAs) and blending obligations. Strengthening and maintaining existing climate and renewable energy targets, while ensuring stable and predictable demand and investment frameworks, is therefore essential to provide long-term certainty and unlock the sector's full potential.

Market barriers across end-use sectors

Across transport, heating, buildings and industry, EU legislation continues to prioritise electrification as the primary decarbonisation pathway, limiting the role of renewable gases despite their ability to deliver equivalent greenhouse gas reductions. Current policy frameworks provide strong incentives for electrification while offering limited recognition of biomethane as a technology-neutral solution that can decarbonise existing infrastructure and hard-to-abate sectors. In transport, the current regulation for CO_2 emission standards for light and heavy vehicles do not recognise carbon-neutral fuels, excluding the opportunity to recognise sustainable methane as a renewable fuel for road transport. This, together with insufficient refuelling infrastructure and reduced purchase incentives for renewable fuel vehicles, further constrains market uptake. In heating and buildings, legislation promoting the gradual phase-out of fossil fuel boilers and encouraging full electrification risks overlooking the continued use of existing heating systems with renewable methane. Similarly, industrial decarbonisation policies often incentivise electrification while providing insufficient recognition of biomethane for

Co-funded by the European Union

industrial heat and process energy. Overall, the lack of a technology-neutral regulatory framework prevents renewable methane from competing on equal terms with other decarbonisation solutions.

Infrastructure, permitting and market integration

Access to infrastructure remains one of the main barriers to biomethane deployment, particularly for smaller and decentralised producers. Fragmented national rules governing grid connection rights, injection conditions and cost allocation create uncertainty and hinder the development of a functioning internal market for biomethane. For example. developers frequently face lengthy delays in obtaining the connection approval from gas distribution system operators (DSOs). Moreover, biomethane and e-methane producers often face complex and lengthy permitting procedures for their projects, which often leads to bureaucratic burdens increased project costs.

Competition with other renewable energy sources

Biomethane continues to face challenging market conditions that reduce its competitiveness. Competition with lower-priced natural gas, low electricity prices and taxation frameworks that often benefit electricity over gas or do not differentiate between fossil and renewable at all do not create a level playing field across all renewable nergy sources. These barriers often create unfair market conditions for the contribution of renewable methane to Europe's energy system resilience. In addition, the full greenhouse gas mitigation benefits of biomethane and its co-products, including biogenic CO_2 and digestate, are not consistently recognised across EU climate, energy and financial legislation. This reduces incentives to fully valorise the environmental and circular economy benefits of anaerobic digestion and methanation. As a result, large volumes of manure, biowaste and industrial residues remain underutilised across Europe, despite their significant potential to improve Europe's waste management practices and produce circular, renewable energy.

Lack of market for full valorization of circular solutions and biomethane´s co-products

The policy infrastructure does not yet incentivize the use of recycled biogenic nutrients or CO_2 in the market – leading to an untapped potential as well as a missed opportunity for additional income for biomethane producers. As circular solutions and products are better valorized the need for other support for biomethane scale-up decreases, while at the same time the resource efficiency increases.

Business case for e-methane (methanation) is dependent on better conditions for hydrogen solutions

Strategies and targets for the new hydrogen economy are not yet followed by real policies and incentives to materialize the scale-up of hydrogen projects and demand. The business case for methanation is dependent on competitive renewable hydrogen production – which requires both scale-up of electrolysers and hydrogen production systems (scale may reduce investment and management costs) and access to low-cost renewable electricity. Until this is the case other support mechanisms should be considered and implemented for investments in methanisation to scale-up.

Addressing these regulatory and market barriers would support the further development of biomethane production in Europe. In the current geopolitical context, increasing European biomethane production can also contribute to reducing dependence on fossil fuel imports and strengthening EU energy security and resilience.

Co-funded by the European Union

5.2. Challenges concerning biomethane trading

With the existing REDIII there is a legal framework for the renewable gas certificates. However, with the development of the biomethane market, there are several challenges with respect to sustainability requirements and biomethane trading. Below are several examples of issues that impact the biomethane market and could potentially negatively impact production growth.

National requirements

Several countries are currently introducing national biomethane blending requirements. This means that a certain percentage of the gas consumed in the country should be biomethane. Examples include blending obligations in France and the Netherlands, as well as the proposed biomethane quota system currently under development in Spain. In most countries, these blending requirements can only be met by using national certificates. In France imported biomethane is not allowed to count towards these targets. While there could be good reasons for the introduction of such a scheme and it is expected to be beneficial for total production, restrictions on the use of imported biomethane from other Member States hinder the European integration of the biomethane market.

Clarity of statistics

Each Member State has renewable energy targets as set in the Renewable Energy Directive which can be met by biomethane with a PoS. and in some cases, together with the GO or national certificate. However, the current rules are not clear enough if the biomethane can be claimed by the country where the biomethane is produced or in the country where the biomethane with the PoS is consumed. Different Member States have different interpretations which increases the risk of double counting the biomethane in both countries. Clarity is thus important, and the expectation is that the Union Database will provide more clarity on the calculation methods coming from the SHARES manual and that target accounting will follow the biomethane trade and accounted for in the country of consumption rather than in the country of production. Eurostat's latest SHARES Manual efforts therefore provide an interim statistical and reporting solution while the Union Database (UDB) is not yet fully operational—a temporary bridge pending full UDB operation, not a replacement for it. Eurostat is already engaging with Member States to identify and resolve inconsistencies in the reporting of tradable biomethane volumes.

Regulatory stability

Investments in biomethane production plants are a long-term investment with often long-term off-take agreements to reduce risks. For these investment decisions and contracts regulatory stability is important to allow for the projects to become viable.
One example from 2024 concerns the updated interpretation of the GHG emission calculations of co-digested biomethane. This has a major impact on the existing contracts. However, there was no consultation or public information provided by voluntary schemes or the European Commission before the new rules entered into force. Such a procedure is detrimental to the long-term trust that is needed to make investment decisions.
It would be beneficial for the market if there was stability in the rules and interpretations or to inform market participants well in advance of such major changes.

Biogenic CO_2 – towards a certification framework

One essential step towards decarbonising the European Union is carbon capture and utilisation, as well as permanent storage. On 6 February 2024, the European Commission released its Industrial Carbon Management Communication, with the view of creating a single market for CO2

Co-funded by the European Union

in Europe. In the meantime, the Carbon Farming Certification Framework has also been implemented with fully fledged secondary legislation and legal frameworks on carbon capture, utilization and capture. By 2050, around 450 million tonnes of CO2 would have to be captured, and by 2040, about half of the CO2 that is captured annually is expected to come from biogenic sources.

In the production of biomethane, the CO2 is already being captured but it is released back into the atmosphere in most cases when the biogas gets upgraded to biomethane. By capturing the biogenic CO2, it can be stored or utilised in industries such as food processing or construction or to produce RFNBOs such as e-methane. It can also be a source of income for biomethane producers, especially if there can be a premium for biogenic CO2. However, it will be necessary to differentiate between fossil/industrial CO2 and that coming from biogenic sources. Therefore, a certification framework to be put in place for tracking and tracing such biogenic CO2 is helpful.

The European Renewable Gas Registry has been working with different stakeholders, including European associations, companies and voluntary schemes to develop such a biogenic CO2 certification scheme. The aim is to support a future market and in the long-term lead towards a European single market for biogenic CO2.

As regards the Sempre-Bio project, the deliverable report 4.1 was submitted by the end of November 2023 with the aim to provide an overview of the current and future options of biogenic CO2 valorisation derived from biogas and biomethane in Europe while mapping the biogas and biomethane sites capturing biogenic CO2, the CO2 production capacities as well as the valorisation sectors of captured biogenic CO2. Thereby, the focus was on commercial-scale Carbon Capture and Utilisation (CCU) projects without further consideration of possible Carbon Capture and Storage (CCS) developments. The report provides an overview of the selected options for the valorisation of biogenic CO2 from biogas such as in agriculture, the food and beverage industry, energy production and the chemical industry. The report provides further insight into the requirements for the use of food-grade CO2 uses, especially for, but also not limited to food and beverage industry. In addition, it delivers the mapping and listing of the biogas and biomethane plant sites with the CO2 valorisation (current and expected by the end of 2023) in Europe as well as the description of the selected project examples in European countries.

Co-funded by the European Union

6. Conclusory remarks

Geopolitical tensions arising from fossil fuel imports have in recent years led the EU (EU) to look to the biomethane sector as one of the most plausible (and already available) ways to foster resilience, accelerate the ecological transition and drive greater energy efficiency. The REPowerEU Plan, in addition to setting a target of producing 35 bcm of biogas and/or biomethane by 2030, laid the groundwork for steering cooperation between policymakers, investors and the biomethane value chain to drive technological innovation, address bottlenecks and gaps and ultimately accelerate the expansion of the sector.

In line with the plan's objectives, the European Commission has called on Member States to strengthen their efforts and outline additional initiatives. Recent projections indicate that current policies would deliver a 47% reduction in net greenhouse gas emissions by 2030 compared to 1990 levels, while the full implementation of planned measures could raise this to approximately 54%, placing the EU close to its legally binding 55% emissions reduction target for 2030[20].

Thus, since the publication of the first report in October 2023, updates to the National Energy and Climate Plans (NECP) have emerged, more in line with EU climate targets and including a comprehensive component on sustainable biogas and biomethane production.

This has not only allowed countries themselves to assess their national potentials but also enables all stakeholders to identify the barriers that the sector faces, discuss sustainability and Guarantees of Origin (GO) and establish clear trajectories to reach these targets by 2030 and 2050. In addition, this report provides an updated overview of the technology pathways for increasing biomethane and e-methane production and their valorisation, drawing on four biomethane projects funded under Horizon Europe. It also identifies key barriers to scaling up the sector and provides policy recommendations to support the further development and growth of biomethane in Europe.

Drawing on the five recommendations set out in Section 3.3, the report calls for: stable long-term targets, demand signals and financing frameworks; harmonised certification, sustainability and cross-border trade rules; faster permitting and coordinated access to gas, electricity, hydrogen and CO_2 infrastructure; dedicated support for first-of-a-kind scale-up, longer operational demonstration and replication; and circular frameworks that unlock sustainable feedstocks, digestate-derived products and traceable biogenic CO_2. These priorities reflect the projects' practical experience: stable and interoperable rules are essential for investment and trade, innovative upgrading and methanation routes need technology-appropriate regulation and infrastructure, and complex demonstration and farm-scale projects require realistic timelines, proportionate requirements and patient finance. Turning these lessons into a coherent EU framework would help move biomethane from demonstration to bankable deployment, expand sustainable domestic production, reduce reliance on fossil-gas imports and strengthen Europe's energy security and resilience.

[20] European Environment Agency. https://www.eea.europa.eu/en/analysis/indicators/total-greenhouse-gas-emission-trends

Co-funded by the European Union

Taken together, the analysis and the experience of the contributing projects show that Europe's biomethane challenge is no longer primarily a question of technical potential, but of converting that potential into timely, investable and replicable deployment. BIOMETHAVERSE demonstrates the importance of durable demand signals, coherent national strategies, harmonised sustainability certification and traceability, and functioning markets for digestate and biogenic CO_2; SEMPRE-BIO shows that innovative upgrading, pyro-gasification and methanation routes require technology-appropriate regulation, coordinated access to electricity, gas, hydrogen and CO_2 infrastructure, and sufficient operational evidence beyond initial commissioning; HyFuelUp confirms that integrated first-of-a-kind projects need realistic timelines, staged and flexible support, clear permitting and offtake pathways, and replication packages that transform individual demonstrations into a wider project pipeline; and Value4Farm highlights the need for proportionate farm-scale rules, sustainable feedstock traceability, integrated nutrient and manure management, and patient finance adapted to the actual scale and risks of deployment.

These lessons reinforce the report's five central priorities: stable long-term targets, demand and finance; interoperable certification and cross-border trade; faster permitting and infrastructure access; dedicated support for innovation, demonstration and replication; and circular frameworks that unlock sustainable wastes and residues while valorising digestate-derived products and traceable biogenic CO_2. Implemented together and embedded in national strategies and the post-2030 EU framework, these measures would help mobilise Europe's substantial sustainable feedstock and technology potential, expand domestic renewable-gas production, create bankable demand in industry, transport, maritime and other hard-to-electrify uses, and make better use of existing gas infrastructure.

By replacing part of imported fossil-gas consumption with renewable methane produced from locally available resources, Europe can diversify supply, reduce exposure to volatile international markets and geopolitical disruptions, support rural and industrial value chains, and provide a storable and dispatchable energy source that complements electrification. Scaling biomethane should therefore be understood not only as a decarbonisation and circular-economy objective, but as a strategic contribution to Europe's energy sovereignty, security of supply and long-term resilience.

Co-funded by the European Union

REFERENCES

Biomethane Industrial Partnership Europe (2023): Insights into the current cost of biomethane production. https://bip-europe.eu/wp-content/uploads/2023/10/BIP_TF4-study_Full-slidedeck_Oct2023.pdf

Biomethane Industrial Partnership Europe (2024): Task Force 6 was kicked off, marking the beginning of collaborative efforts to integrate Ukraine as a supplier of sustainable biomethane into the EU, retrieved 17/09/2024. https://bip-europe.eu/2024/04/17/task-force-6-was-kicked-off-marking-the-beginning-of-collaborative-efforts-to-integrate-ukraine-as-a-supplier-of-sustainable-biomethane-into-the-eu/

BNE IntelliNews (2024): Zelenskiy launches biomethane market in Ukraine, aims to attract international investment, retrieved 25/09/2024. https://www.intellinews.com/zelenskiy-launches-biomethane-market-in-ukraine-aims-to-attract-international-investment-327532/

Bundesgesetzblatt (2023): Gesetz für die Wärmeplanung und zur Dekarbonisierung der Wärmenetze. https://www.bmwsb.bund.de/SharedDocs/gesetzgebungsverfahren/Webs/BMWSB/DE/kommunale-waermeplanung.html

Cluster of Horizon Europe-funded projects on innovative biomethane production (2023): Joint Policy Recommendations on Biomethane. https://bioplat.org/wp-content/uploads/2024/04/D8.12_Joint-Policy_EU_Biomethane_Projects_v2.2.pdf

Comisión Nacional de los Mercados y la Competencia (2024): Resolución de 19 de abril de 2024, por la que se establece el procedimiento de gestión de conexiones de plantas de generación de biometano con la red de transporte o distribución. https://www.boe.es/boe/dias/2024/04/30/pdfs/BOE-A-2024-8702.pdf

Council of EU (2023): Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and hydrogen. https://data.consilium.europa.eu/doc/document/ST-16522-2023-INIT/en/pdf

DBFZ; ESE; IEE (2023): Vorbereitung und Begleitung bei der Erstellung eines Erfahrungsberichts gemäß. https://www.bmwk.de/Redaktion/DE/Downloads/E/erfahrungsbericht-biomkdg-230818.pdf?__blob=publicationFile&v=2

Denysenko, V.; Daniel-Gromke, J.; Binder, P. M.; Foix, L. (2023): Opportunities for the valorisation of CO_2 extracted from biogas. Deliverable 4.1 Report with the current state, progress made up to date and future challenges of advanced technologies for efficient CO_2 valorisation at multiple scales, from pilot to market scale, in the European Union. EU-Projekt SEcuring doMestic PRoduction of cost-Effective BIOmethane (SEMPRE-BIO), GA 101084297, 30.11.2023.

Co-funded by the European Union

Departament d'Acció Climàtica, Alimentació i Agenda Rural (2024): Estratègia Catalana de Biogàs i Pla d'acció. https://icaen.gencat.cat/web/.content/30_Plans_programes/40_Estrategia-Catalana-biogas-2030/Estrategia-Catalana-Biogas-2030_AdG.pdf
Deutsche Energie-Agentur (2023): Marktmonitoring Bioenergie 2023. https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2023/ANALYSE_Marktmonitoring_Bioenergie_2023.pdf
EBA (2024): European Biomethane Map 2024. https://www.europeanbiogas.eu/european-biomethane-map-2024/

DiXi Group (2024): Policy brief СПІВПРАЦЯ УКРАЇНИ ТА ЄС В БІОМЕТАНОВОМУ СЕКТОРІ: ПЕРСПЕКТИВИ ТА ПЕРЕШКОДИ, March 2024, retrieved 25/09/2024. https://dixigroup.org/wp-content/uploads/2024/03/policy-brief_spivpraczya-ukrayiny-ta-yes-v-biometanovomu-sektori.pdf

Energy Community (2024): Assessment of the Law of Ukraine No 3613 On amendments to the Customs Code of Ukraine and other laws of Ukraine on the specifics of customs control and customs clearance of certain categories of goods — focus on biomethane, July 2024, retrieved 17/09/2024. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.energy-community.org/dam/jcr:40c1b5cb-4937-48e4-a3d8-ed4dc7d474c6/Note12-2024.pdf

European Biogas Association (2022): Biomethane production potentials in the EU, https://www.europeanbiogas.eu/wp-content/uploads/2022/07/GfC_Biomethane-potentials_2022.pdf

European Commission (2022): Directorate-General for Energy, Commission Notice on the Guidance to Member States for the update of the 2021-2030 National Energy and Climate Plans. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A52022XC1229%2802%29&amp%3Bfrom=EN

European Commission (2021): Directorate-General for Energy, Proposal for a Regulation of the European Parliament and the Council on the internal markets for renewable and natural gases and for hydrogen. https://eur-lex.europa.eu/resource.html?uri=cellar:0c903f5a-5d8b-11ec-9c6c-01aa75ed71a1.0001.02/DOC_1&format=PDF

European Commission (2022): Directorate-General for Climate Action, Communication from the Commission to the European Parliament, the European Council, the Council, The European Economic and Social Committee and the Committee of the Regions, REPowerEU Plan. https://eur-lex.europa.eu/resource.html?uri=cellar:fc930f14-d7ae-11ec-a95f-01aa75ed71a1.0001.02/DOC_1&format=PDF

European Commission (2023): Memorandum of understanding between the European Union and Ukraine on a Strategic Partnership on Biomethane, Hydrogen and other Synthetic Gases, retrieved 17/09/2024. https://energy.ec.europa.eu/document/download/0b10e313-1084-49e5-a320-9460108d4cb7_en?filename=MoU_UA_signed.pdf

Co-funded by the European Union

European Commission (2018): Regulation (EU) 2018/2066 on Monitoring and Reporting Regulation (MRR). https://eur-lex.europa.eu/eli/reg_impl/2018/2066/oj

European Commission (2020): Regulation (EU) 2020/2085 on the Monitoring and Reporting of Greenhouse Gas Emissions. https://eur-lex.europa.eu/eli/reg_impl/2020/2085/oj

European Commission (2024): Secretariat-General, Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions, securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0063)

European Parliament; Council (2018): Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. http://data.europa.eu/eli/dir/2023/2413/oj

European Parliament; Council (2018): 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. http://data.europa.eu/eli/dir/2018/2001/oj

European Parliament; Council (2018): Directive (EU) 2018/2001 on Renewable Energy (RED). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

European Parliament; Council (2023): Proposal for a regulation of the European Parliament and of the Council on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act). https://single-market-economy.ec.europa.eu/publications/net-zero-industry-act_en

European Parliament; Council (2024): Regulation (EU) 2024/1789 of the European Parliament and of the Council of 13 June 2024 on the internal markets for renewable gas, natural gas and hydrogen, amending Regulations (EU) No 1227/2011, (EU) 2017/1938, (EU) 2019/942 and (EU) 2022/869 and Decision (EU) 2017/684 and repealing Regulation. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1789&qid=1727693604834

European Parliament; Council (2018): Regulation on the Governance of the Energy Union and Climate Action (EU) 2018/1999. https://eur-lex.europa.eu/eli/reg/2018/1999/oj

Energy Traders Europe; Eurogas; European Biogas Association; European Renewable Gas Registry; Gas Infrastructure Europe; European Network of Transmission System Operators for Gas (2024): Hybrid workshop on Union Database concept. https://www.entsog.eu/sites/default/files/2024-04/Conclusions.pdf

Geletukha (2023): Prospects of biomethane in Ukraine. Business Forum on bio-methane and green hydrogen Business to Business / Europe to Ukraine (EUB2BUA). Vienna, 27/09/2023,

Co-funded by the European Union

retrieved 25/09/2024. https://www.energy-community.org/dam/jcr:2faa4d31-3eb8-4cc8-a6ff-9b8b322e3c09/S1_4_UABIO_Geletukha.pdf

Guidehouse (2024): Biogases towards 2040 and beyond. https://www.europeanbiogas.eu/wp-content/uploads/2024/04/Biogases-towards-2040-and-beyond_FINAL.pdf

Guidehouse (2022): Biomethane production potentials in the EU. https://www.europeanbiogas.eu/wp-content/uploads/2022/07/GfC_Biomethane-potentials_2022.pdf

Golz, A.-K.; Romanov, O.; Delidon, R. (2023): Potential benefits: Structuring German-Ukrainian cooperation in the biomethane sector, October 2023, retrieved 25/09/2024. https://gas.info/fileadmin/Public/PDF-Download/policy-paper-de-ukr-biomethan-kooperation-libmod-en.pdf

IEA Bioenergy (2021): Implementation of bioenergy in Norway — 2021 update. https://www.ieabioenergy.com/wp-content/uploads/2021/11/CountryReport2021_Norway_final.pdf

IEE (2023): Vorbereitung und Begleitung bei der Erstellung eines Erfahrungsberichts gemäß § 97 Erneuerbare-Energie-Gesetz (EEG 2021) Teilvorhaben ‚Biomasse sowie Klär-, Deponie- und Grubengas'. Endbericht des Fraunhofer IEE, DBFZ Deutsches Biomasseforschungszentrum,

ESE Büro für EnergieSystemEffizienz im Auftrag des Bundesministeriums für Wirtschaft und Klimaschutz. Kassel, August 2023. verfügbar unter: https://www.bmwk.de/Redaktion/DE/Downloads/E/erfahrungsbericht-biomkdg-230818.pdf?__blob=publicationFile&v=2

Instituto para la Diversificación y ahorro de la Energía; Ministerio para la Transición Ecológica y el Reto Demográfico (2023): Resolución de la Secretaria de Estado de Energía y Presidenta de E.P.E Instituto para la Diversificación y Ahorro de la Energía (IDAE), M.P., por la que se conceden ayudas correspondientes a la 'Primera Convocatoria de Programa de incentivos a proyectos singulares de instalaciones de biogás, en el marco del «Plan de Recuperación, Transformación y Resiliencia — Financiado por la Unión Europea–NextGenerationEU»'. https://sede.idae.gob.es/sites/default/files/documentos/2023/BIOGAS/(356)_BIOGAS_Resolucion_Definitiva_SEE_fdo.pdf

Ministère de l'économie des finances et de l'industrie (2024): Décret no 2024-718 du 6 juillet 2024 relatif à l'obligation de restitution de certificats de production de biogaz. https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000049891497?init=true&page=1&query=2024-718&searchField=ALL&tab_selection=all

Ministère de l'économie des finances et de l'industrie (2024): Regulatory framework, objectives and support mechanisms for biomethane in France. https://energie-fr-de.eu/de/veranstaltungen/leser/online-konferenz-zu-biomethan-in-deutschland-und-frankreich-1645.html?file=files/ofaenr/02-conferences/2024/240529_Biomethan/Presentations/02_Matthieu_Boulanger_MEFSIN_OFATE_DFBEW.pdf

Co-funded by the European Union

Ministerio para la Transición Ecológica y el Reto Demográfico (2022): Hoja de Ruta del Biogás. https://www.miteco.gob.es/content/dam/miteco/es/energia/files-1/es-es/Novedades/Documents/00HR_Biogas_V6.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico (2024): Integrated National Energy and Climate Plan. https://www.miteco.gob.es/content/dam/miteco/es/energia/files-1/pniec-2023-2030/PNIEC_2024_240924.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico (2022): Real Decreto Real Decreto 376/2022, de 17 de mayo, por el que se regulan los criterios de sostenibilidad y de reducción de las emisiones de gases de efecto invernadero de los biocarburantes, biolíquidos y combustibles de biomasa, así como el sistema de garantías de origen de los gases renovables. https://www.boe.es/buscar/doc.php?id=BOE-A-2022-8121#:~:text=A%2D2022%2D8121-,Real%20Decreto%20376%2F2022%2C%20de%2017%20de%20mayo%2C%20por,origen%20de%20los%20gases%20renovables

Ministero dell'ambiente e della sicurezza energética (2024). Decreto 13 marzo 2024, n. 99. https://www.reteambiente.it/normativa/54210/dm-ambiente-13-marzo-2024-n-99/
Ministero dell'ambiente e della sicurezza energética (2024). Decreto 19 giugno 2024 recante "Incentivazione degli impianti a fonte rinnovabile innovativi o con costi di generazione elevati che presentino caratteristiche di innovazione e ridotto impatto sull'ambiente e sul territorio" https://www.mase.gov.it/sites/default/files/Archivio_Energia/Archivio_Normativa/dm_19-06-2024_FER2.pdf

Ministerul Energiei (2024): Strategia Energetică a României 2025-2035. https://energie.gov.ro/strategia-energetica-a-romaniei-2025-2035-cu-perspectiva-anului-2050-versiunea-actualizata-care-a-rezultat-in-urma-procesului-de-consultare-publica-desfasurat-in-perioada-14-iunie-13-iulie-2024-si/

Polovtseva, M. (2024): Review of blending obligations across Europe, veyt, https://www.veyt.com/articles/review-of-blending-obligations-across-europe

Presidência do Conselho de Ministros (2022). Decreto-Lei n.º 30-A/2022 de 18 de abril. https://diariodarepublica.pt/dr/detalhe/decreto-lei/30-a-2022-182213906

Presidência do Conselho de Ministros (2022). Decreto-Lei n.º 84/2022 de 9 de dezembro. https://diariodarepublica.pt/dr/en/detail/decree-law/84-2022-204502328

Presidência do Conselho de Ministros (2024). Resolução do Conselho de Ministros n.º 41/2024. https://files.diariodarepublica.pt/1s/2024/03/05400/0003000080.pdf?lang=EN

Rensberg, N.; Denysenko, V.; Daniel-Gromke, J. (2023): Biogaserzeugung und -nutzung in Deutschland: Report zum Anlagenbestand Biogas und Biomethan. (DBFZ-Report, 50). Leipzig: DBFZ. VII, 9-122 S. ISBN: 978-3-949807-02-2. DOI: 10.48480/zptb-yy32

Co-funded by the European Union

Secretaria de Estado de la Energía, Ministerio para la Transición Ecológica y el Reto Demográfico (2022): Hoja de Ruta del Biogás. https://www.miteco.gob.es/content/dam/miteco/es/energia/files-1/es-es/Novedades/Documents/00HR_Biogas_V6.pdf

UABio (2024): Георгій Гелетуха виступив на Першому українському форумі з біометану, retrieved 25/09/2024. https://uabio.org/news/16062/
Українська Енергетика (2022): Україна змушена зупинити експорт природного газу, retrieved 25/09/2024. https://ua-energy.org/uk/posts/ukraina-zmushena-zupynyty-eksport-pryrodnoho-hazu

Українська Енергетика (2023): Уряд продовжив заборону на експорт газу на 2024 рік, retrieved 25/09/2024. https://ua-energy.org/uk/posts/zaboronu-na-eksport-hazu-prodovzhyly-na-2024-rik#:~:text=%

Верховна Рада України (2024): ЗАКОН УКРАЇНИ Про внесення змін до Митного кодексу України та інших законів України щодо особливостей здійснення митного контролю та митного оформлення окремих категорій товарів, entered into force 16/05/2024. https://zakon.rada.gov.ua/laws/show/3613-20#Text

Co-funded by the European Union