

# Biomethane





## Contents

<b>Executive Summary</b>	<b>2</b>
<b>1. Introduction</b>	<b>2</b>
1.1. Definition	4
1.2. Difference between biogas and biomethane	4
<b>2. Technology implementatio</b>	<b>5</b>
2.1. The technology (technical characteristics)	5
2.2. Main advantages	7
2.3. Contribution to the energy transition	8
2.4. Examples of projects successfully implemented at European level	9
<b>3. Implementation opportunities in Romania</b>	<b>12</b>
3.1. Romania's potential	12
3.2. Technological potential	12
3.3. Relevant areas for biomethane technology implementation	13
<b>4. The need to implement biomethane</b>	<b>13</b>
<b>5. Missing elements and Recommendations to update the legislation</b>	<b>14</b>
<b>Conclusions</b>	<b>15</b>

## Executive Summary

Biomethane is a renewable and sustainable energy source which can be integrated into existing natural gas infrastructure. This characteristic makes it a suitable and versatile option for heating, electricity generation and as a vehicle fuel (often referred to as bio-CNG – compressed natural gas). The ability to use existing infrastructure reduces the need for further investments, thus facilitating the adoption of renewable energy sources.

Another significant advantage is that biomethane production supports **circular economy** principles by turning waste materials into valuable resources which can be integrated in the larger value chains. This aspect supports waste management while also producing economic benefits for agricultural and rural communities through the creation of additional income streams and new jobs.

In the transport sector, the use of biomethane as a vehicle fuel has the potential to significantly decrease air pollutants such as nitrogen oxides.

According to the European Biogas Association (EBA), biomethane prevents emissions across the entire value chain, with a three-fold emissions mitigation effect.<sup>1</sup> First of all, the use of biomethane avoids emissions that would otherwise occur naturally: organic residues are taken to the controlled environment of biogas plants, preventing the emissions produced by the decomposition of the organic matter from being released into the atmosphere.

Secondly, biogas and biomethane could gradually replace fossil fuels as energy sources. Thirdly, the use of the digestate obtained in the biogas production process as biofertiliser helps return organic carbon into the soil and reduces demand for the carbon-intensive production of mineral fertilisers.

Romania has the potential to become a major producer of biomethane in the EU, given the significant size of its agricultural sector, providing the feedstock for biomethane production. However, a set of key legislative changes are required with respect to the primary legislation, in order to facilitate significant investments in this sector and rapid technological uptake.

EU member states such as France and Italy provide examples of financial incentives and schemes suitable for biomethane producers' needs, while also considering how units' plans take into account the specificity of local communities. Italy particularly provides examples of strong collaboration between biomethane producers, local authorities and farms located near production units, to maximise benefits and revenues for all stakeholders.

Key changes required in Romania's national legislation should cover traceability and certification, as well as a clear definition of biomethane and biogas as green gases.

## 1. Introduction

Biomethane or upgraded biogas is produced by qualitative processing of raw biogas through several steps to remove impurities, mainly carbon dioxide. Biomethane as a fuel provides new opportunities at different levels of society, particularly for the transport sector.

According to data from the European Biogas Association (EBA) and Gas Infrastructure Europe (GIE)<sup>2</sup>, the number of biomethane plants across Europe has increased by 51% between 2018 and 2020. Europe is currently the largest biogas and biomethane producer in the world. Germany has the highest share of biomethane plants, followed by France and the UK.

Germany is by far the largest market, currently hosting two-thirds of Europe's biogas plant capacity, according to the International Energy Agency (IEA).<sup>3</sup> Energy crops represented the main choice of

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1-About biogas and biomethane | European Biogas Association.

2-Biomethane\_map\_Press-Release\_EBA\_GIE.pdf.

3-An introduction to biogas and biomethane – Outlook for biogas and biomethane: Prospects for organic growth – Analysis – IEA.

feedstock that supported the growth of Germany's biogas industry. However, policy has recently shifted more towards the use of crop residues, sequential crops, livestock waste and the capture of methane from landfill sites.

As of July 2024, Europe has reached an installed capacity of 6.4 billion cubic metres (bcm) of biomethane per year. The total installed capacity of European biomethane can contribute to avoiding around 29 million tonnes of CO<sub>2</sub> emissions annually, in addition to producing 830,000 tonnes of organic fertilisers every year. These plants can provide renewable energy for 5 million European households throughout the year, while helping Europe achieve energy security and climate mitigation targets.<sup>4</sup>

The development of biogas has been uneven across the world, as it depends not only on the availability of feedstocks but also on policies able to stimulate its production and use.

According to the IEA, most of the biogas currently produced is used in the power sector. Almost two-thirds of biogas production in 2018 was used to generate electricity and heat (with an approximately equal split between electricity-only facilities and co generation facilities). Around 30% was consumed in buildings, mainly in the residential sector for cooking and heating, with the remainder upgraded to biomethane and blended into the gas networks or used as transport fuel.

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Currently, there is around 18 GW of installed power generation capacity running on biogas around the world, most of which being in Germany, the United States and the United Kingdom. Capacity increased on average by 4% per year between 2010 and 2018.<sup>5</sup>

The relatively high costs of biogas power generation mean that the transition from feed-in tariffs to technology-neutral renewable electricity auction frameworks (such as power purchase agreements) in many countries could restrict the future prospects for electricity-only biogas plants. However, unlike wind and solar PV, **biogas plants can operate in a flexible manner** and subsequently provide balancing and other auxiliary services to the electricity network.

**According to the IEA, in cases where local heat off-take is available, the economic case for biogas co generation is stronger than for an electricity-only plant.** The main reason is that co generation can also have the co benefit of providing treatment for waste while also supplying on-site heat and electricity.

The biomethane industry is currently very small, although it is generating growing amounts of interest in several countries for its potential to deliver clean energy to a wide array of end users, especially when this can be done using existing infrastructure.

Currently around 3.5 Mtoe of biomethane are produced worldwide. The great majority of production is located in European and North American markets, with countries such as Denmark and Sweden having more than 10% shares of biogas/biomethane in total gas sales.

Biomethane represents about 0.1% of natural gas demand today. Nevertheless, an increasing number of government policies are supporting its injection into natural gas grids and for decarbonising transport. For example, Germany, Italy, the Netherlands and the United Kingdom have all introduced **support for biomethane in transport**. Brazil's RenovaBio programme has a target of reducing the carbon intensity of fuels in the transport sector by 10% by 2028. Subnational schemes are also emerging, such as low-carbon fuel standards in the US state of California and in British Columbia, Canada.

The percentage of biogas produced that is upgraded varies widely between regions: in North America it is around 15%, while in South America it is over 35%; in Europe, the region that produces the most biogas and biomethane, around 10% of biogas production is upgraded (although in countries such as

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4-New edition of the Biomethane Map shows 37% increase in biomethane capacity in the EU compared to the previous map - Gas Infrastructure Europe/Gas Infrastructure Europe (gie.eu).

5-An introduction to biogas and biomethane - Outlook for biogas and biomethane: Prospects for organic growth - Analysis - IEA.

Denmark and Sweden the percentages are much higher); in Asia, the figure is 2%.

The main co product of biogas upgrading is CO<sub>2</sub>, which is produced in a relatively concentrated form and therefore could be used for industrial or agricultural purposes or combined with hydrogen to yield an additional stream of methane. Another option would be to store it underground, in which case the biomethane would be a CO<sub>2</sub>-negative source of energy.

As noted above, the alternative method to produce biomethane is through thermal gasification of biomass. There are several biomass gasification plants currently in operation, but these are mostly at demonstration scale producing relatively small volumes. Some of these plants have struggled to achieve stable operation, as a result of the variable quality and quantity of feedstock. Since this is a less mature technology than anaerobic digestion, thermal gasification arguably offers greater potential for technological innovation and cost reductions. Prospects would be enhanced if incumbent gas producers were to commit resources to its development, as it would appear a better fit with their knowledge and technical expertise.

## 1.1. Definition

Biomethane is **produced naturally from organic sources**, through biogas purification, and has in its composition the same elements found in natural gas extracted from reservoirs.

Biomethane is the **cheapest and most easily scalable form of renewable gas that is currently available**. Biomethane is a near-pure source of methane produced either by **upgrading biogas** (by removing any CO<sub>2</sub> and other contaminants present in the biogas) or through the **gasification of solid biomass followed by methanation**, as follows:

- Upgrading biogas – this accounts for around 90% of total biomethane currently produced around the world.
- Thermal gasification of solid biomass followed by methanation – woody biomass is first broken down at high temperature (between 700 and 800 degrees Celsius) and high pressure in a low -xygen environment. Under these conditions, biomass is converted into a mixture of gases, mainly consisting of carbon monoxide, hydrogen and methane (sometimes called syngas).

To produce a pure stream of biomethane, syngas is cleaned to remove any acidic and corrosive components. The methanation process then uses a catalyst to promote a reaction between the hydrogen and carbon monoxide, to produce methane. Any remaining CO<sub>2</sub> or water is removed at the end of this process.

A wide variety of feedstocks can be used to produce biogas. The different individual types of residue or waste were grouped into four broad feedstock categories: crop residues, animal manure, organic fraction of MSW, including industrial waste, and wastewater sludge.

## 1.2. Difference between biogas and biomethane

Biomethane is biogas that has gone through a **purification process** in order to make its composition as similar as possible to that of fossil natural gas. However, unlike fossil gas, biomethane is a much eco-friendlier resource. Biogas is a renewable energy carrier that can be exploited directly as fuel or feedstock for production of hydrogen or as synthesis gas.

The main components of biogas consist of carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>), but there are also quantities of contaminants such as hydrogen sulphide (H<sub>2</sub>S), ammonia (NH<sub>3</sub>), moisture and siloxanes.

Biogas is thus produced from the decomposition of organic remains (agricultural or livestock waste, sludge from water treatment plants) by anaerobic digestion, that is without oxygen. The process mainly removes CO<sub>2</sub>, the major component, while moisture, hydrogen sulphide, ammonia, volatile organic compounds, O<sub>2</sub> and N<sub>2</sub>, amongst others, are also eliminated.<sup>6</sup>

## 2. Technology implementation

### 2.1. The technology (technical characteristics)

Biomethane can be produced by gasification or power-to-methane technologies.

Biomethane **can be injected into and taken up by both the natural gas distribution and transmission networks, without the need to modernise/adapt existing networks**, but only extending them on a case-by-case basis to connect production units.

With mature technologies in place in production, transportation and storage, biomethane can easily be deployed throughout the energy system.

Most biomethane production comes from **upgrading biogas**, based on the following feedstocks:

- **Crop residues** from the harvest of wheat, maize, rice, other coarse grains, sugar beet, sugar cane, soybean and other oil seeds.
- **Animal manure** from livestock including cattle, pigs, poultry and sheep.
- **Organic fraction** of MSW – food and green waste (consisting of leaves and grass), paper and cardboard that is not otherwise used.
- **Wastewater sludge** – semi-solid organic matter recovered in the form of sewage gas from municipal wastewater treatment plants.

The **upgrading process** removes certain impurities from the biogas like CO<sub>2</sub> for example, the gas is brought to a methane ratio of around 95%. This purity grade allows for it to be incorporated into the gas network, mixed with conventional natural gas, in a way that it can be used to generate electricity and heat as well as to power vehicles.

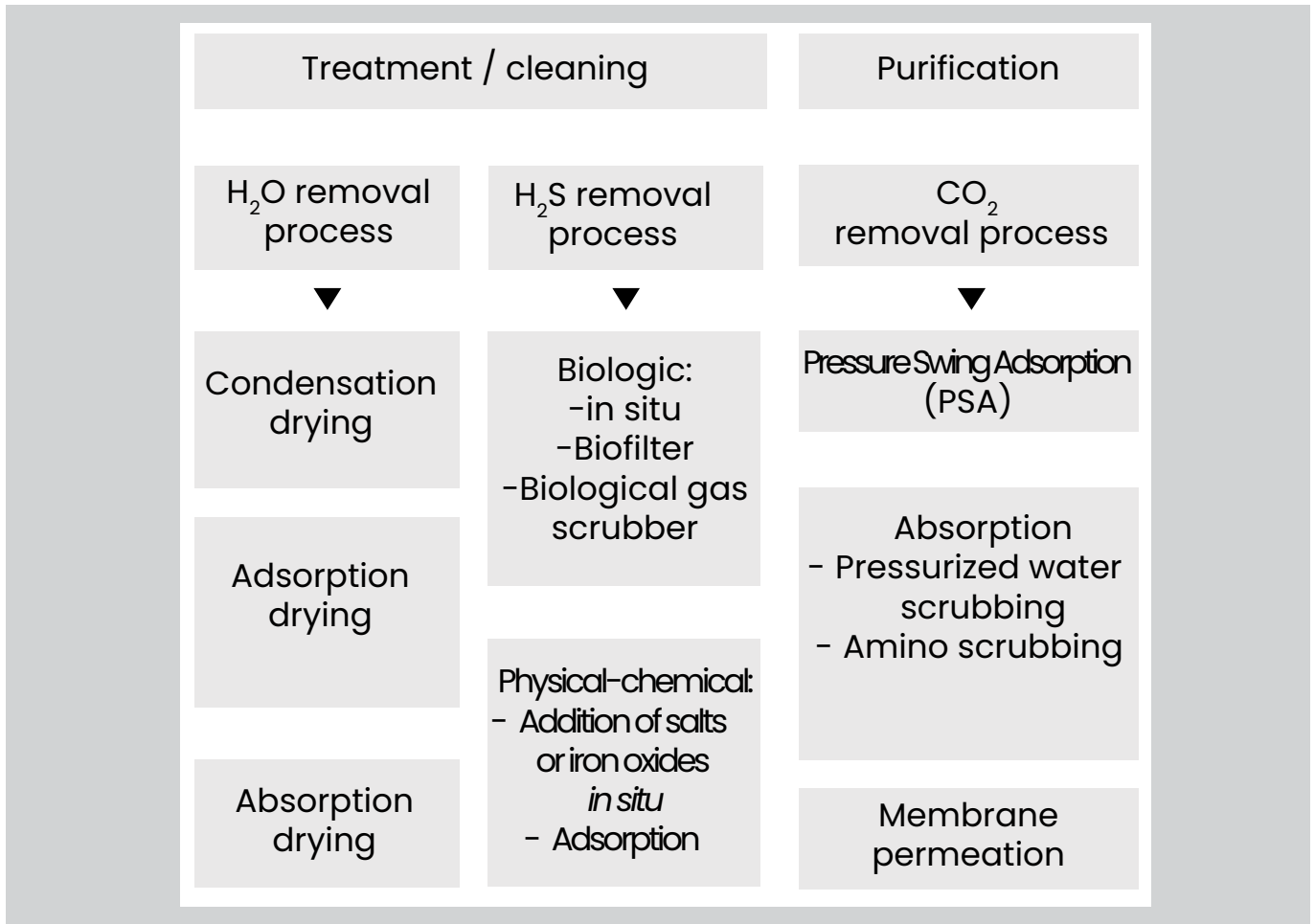
According to the IEA, specific energy crops, such as low-cost and low-maintenance crops grown solely for energy production rather than food, have played an important part in the rise of biogas production in some parts of the world, notably in Germany. Using waste and residues as feedstocks avoids the land-use issues associated with energy crops. Energy crops also require fertilisers (typically produced from fossil fuels), which need to be considered when assessing the life-cycle emissions from different biogas production pathways. Using waste and residues as feedstocks can capture methane that could otherwise escape to the atmosphere as they decompose.

However, the **gasification route** to biomethane can use **woody biomass** (in addition to agricultural residues) as a feedstock, which consists of residues from forest management and wood processing.

Biomethane production generally involves a cleaning stage aiming to remove minor unwanted components of biogases such as hydrogen sulfide (H<sub>2</sub>S) and moisture (H<sub>2</sub>O) and upgrading in a process that requires the removal of carbon dioxide (CO<sub>2</sub>) to increase the concentration of CH<sub>4</sub> to 95–99%.

Controlling the level of impurities in biogas is essential for the success of its recovery. The implementation of treatment and purification technologies must take into consideration the requirements of each specific application of biogas and biomethane. These technologies aim to adjust the **calorific value** and remove contaminants affecting the quality of biogas and the useful life of the equipment. The most demanding techniques aim to purify biogas to obtain biomethane.

Currently, different techniques that allow the treatment and purification of biogas are commercially available, such as the one presented in the figure below.<sup>7</sup>



Source: [Biogas Production and Applications | IntechOpen](#)

The choice of biogas treatment and purification technology is a function of factors including the volume of biogas produced, its composition, the level of purification required, and process costs in terms of capital, energy consumption and operational expenditure (CAPEX and OPEX). In biogas requirements, a mix of processes is used, as no technology can remove all contaminants from biogas.

The degree of biogas treatment depends on the intended application and the initial composition of raw biogas. Most common treatments require the removal of H<sub>2</sub>S and H<sub>2</sub>O.

Hydrogen sulfide (H<sub>2</sub>S) is a gaseous chemical found in many fuel gases, biogas, natural gas, syngas, coke oven gas, landfill gas and refinery gas. Hydrogen sulfide is flammable and toxic, these being the main reasons why it should be captured and removed from biogas.

**Water removal** is usually conducted at an early stage of the treatment, to protect the downstream equipment against corrosion and allow the biogas feedstock to meet the requirements of subsequent purification steps.

Biogas may contain moisture concentration of between 3 to 10%. The image below details the advantages and disadvantages of processes for H<sub>2</sub>O removal from biogas.

PROCESS	ADVANTAGES	DISADVANTAGES
<b>Condensation drying</b>	<ul style="list-style-type: none"> <li>• Simple process, suitable for any biogas flow</li> <li>• Elimination of hydrocarbons and oils particles</li> <li>• application as pre-treatment in all systems</li> </ul>	<ul style="list-style-type: none"> <li>• High energy consumption</li> <li>• Requires installation of long tubes with slope and freeze-resistant</li> <li>• High investment and maintenance costs</li> </ul>
<b>Adsorption drying</b>	<ul style="list-style-type: none"> <li>• Adsorbent materials can be regenerated</li> <li>• High removal rate, which allows the process to be applied to any type of biogas use</li> <li>• Low operating costs</li> </ul>	<ul style="list-style-type: none"> <li>• Requires prior removal of particles and oil</li> <li>• High investment costs</li> <li>• Suitable for small and medium biogas flows</li> </ul>
<b>Adsorption drying</b>	<ul style="list-style-type: none"> <li>• Materials can be regenerated</li> <li>• High removal rate, allowing the process to be applied to any type of biogas use</li> <li>• Elimination of hydrocarbons particles</li> </ul>	<ul style="list-style-type: none"> <li>• High investment costs</li> <li>• Economic viability only for high biogas flow rates</li> <li>• Absorbent material regeneration conducted at high pressure and temperature</li> </ul>

[Source: Biomethane Production and Applications | IntechOpen](#)

**Condensation** involves high energy consumption and is expensive in terms of investment and maintenance. Nevertheless, the process is simple and effectively removes hydrocarbons and oil particles. In condensation, separation of steam and water from biogas is affected by the use of cyclone separators. Condensation of water can be improved further by cooling biogas below the dew point of the gas.

On the other hand, the **adsorption** process has low operating costs, presents a high removal rate and the absorbent materials are regenerated, as main advantages. As part of this process, cylindrical reactors containing absorbent materials are used in adsorption drying. Most common materials used are silica gel, activated carbon, aluminium oxides, and magnesium oxides. The absorption materials are installed in a fixed bed, which can be exchanged and regenerated when it gets saturated. However, the process has high investment costs and requires the prior removal of oil.

The third technique presented above, the **absorption process**, is used to effectively remove hydrocarbons, having high removal rates. Furthermore, absorption materials can be regenerated. However, this method has **high investment costs**, making it **viable only for high biogas flow rates**.

In **absorption drying**, biogas flows through an absorption tower, in opposite direction with a solution of glycol or other hygroscopic materials. In the process, moisture or steam and hydrocarbons are chemically absorbed. Absorption operations take place at high pressure of between 20 and 40 bars, when regeneration occurs at around 200°C. This fact makes operations and maintenance process expensive.<sup>8</sup>

## 2.2. Main advantages

Biomethane is a carbon-neutral fuel, acknowledged by the EU ETS Directive as having zero Scope 1 emissions (direct emissions associated with combustion) or even *carbon negative*.

By removing CO<sub>2</sub> from the raw biogas to obtain biomethane, a highly concentrated CO<sub>2</sub> stream is produced, which can be used in the production of synthetic hydrogen-based methane, as feedstock for

the chemical industry or synthetic fuels, in industrial processes such as new building materials, food industry, etc.

Biomethane contributes to improving waste management problems. Also, through certification (Proof of Sustainability), biomethane can contribute to the RES targets under RED II and III.

Another important advantage that biomethane presents is the fact that it requires **minimal intervention on nature**.

**Furthermore, biomethane is a flexible and easy to store fuel**, having similar properties and applications as natural gas with no need to modify the settings for natural gas devices and equipment.<sup>9</sup> Biomethane can be used for industrial and domestic applications ranging from thermal and power generation and feedstock for processes like the Fischer-Tropsch for fuel manufacturing and direct power generation in hydrogen or biogas fuel cells like production of green hydrogen.

Production and use of biogas has several environmental, social and economic benefits. It is a source of renewable energy, and its production is also considered as a manure production factory.

**Biomethane has wider industrial applications**, therefore biogas upgrading may be preferable. Some of the key drivers of biogas up-gradation is the increase in the price of fossil fuels and growing concerns over global climate change due to greenhouse gas (GHG) emissions. There are multiple biogas upgrading technologies which are available on commercial scale, while others are still developing and are at laboratory scale.<sup>10</sup> The technologies that are currently widely accepted have gained prominence mainly based on their operational efficiency, technical reliability, and future outlook for further development.

On the other hand, biomethane production requires more complex and expensive techniques compared to biogas treatment methods aimed at attaining a high degree of purity for biogas.

## 2.3. Contribution to the energy transition

Biomethane has the potential to play a leading role in the energy transition through hydrogen, electricity, and other renewable fuels production. Biomethane production by biogas upgrading methods include the pressure swing adsorption, which has an option of temperature swing adsorption, absorption technics based on amine, membrane separation, cryogenic separation, and biological separation.

Biogas, in addition to being a renewable source, emits up to 90% less GHGs than fossil fuels and very low percentages of particulate matter, reducing the impact on the environment.

It is important to note that the technology adopted may depend on factors such as costs, quality of products, location, technology maturity and specific legislative requirements.

Biomethane can play a significant role towards achieving the EU's clean energy objectives. It can also be used to further diversify the EU's gas supplies, phasing out Europe's dependency on Russian fossil fuels and reducing the exposure of consumers to volatile natural gas prices.

For these reasons, there is a clear need to scale up biomethane production by 2030, as outlined in the REPowerEU Plan of 18 May 2022. As a renewable and dispatchable energy source, increasing the production and use of biomethane also helps address the climate crisis. The EU's biomethane production, either as biogas or its upgraded version, needs to reach 35 billion cubic metres (bcm) per year by 2030, while the estimated investment need for the period amounts to €37 billion.

An important aspect is to ensure public acceptance of this new technology, also by working with public authorities to organise public awareness campaigns about the benefits of this new technology.

Progress achieved so far in the biomethane sector aligns closely with the 2030 objectives set forth in the REPowerEU plan. €25 billion in private investments have been so far secured by 2030 and this will result in the installation of 950 new biomethane plants.

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9-<https://www.intechopen.com/chapters/88212>.

10-<https://www.intechopen.com/chapters/88212>.

## 2.4. Examples of projects successfully implemented at European level

Many EU Member States have set ambitious targets at national level, either in their National Energy and Climate Plans (NEEAPs), or in other strategies and policy documents.

### France

In July 2024, the EU<sup>11</sup> awarded France €1.5 billion to encourage sustainable biomethane production, through the state aid Temporary Crisis and Transition Framework (TCTF).<sup>12</sup> In this case, aid will be provided through two-way contracts for difference (CfD) lasting 15 years. The aid amount represents the difference between the beneficiary's strike price and the market price of natural gas. If the market price exceeds the strike price, the difference is paid back to the state. France notified the European Commission, under the TCTF, the scheme aiming to support the production of sustainable biomethane to be injected into the natural gas grid.

The new measure will be open to new installations with a projected annual production of biomethane of more than 25 GWh per year.

Beneficiaries will be selected based on a competitive and transparent bidding process, using the strike price per MWh of biomethane offered. Installations must be finalised and operational within 36 months after the granting of the aid. The measure is expected to support the production of 1.6 TWh of sustainable biomethane per year. Also under the scheme, the aid will be granted in the form of two-way contracts for difference, concluded for a duration of 15 years.

The European Commission considers that the French scheme is necessary and adequate to accelerate the green transition process, while facilitating the development of certain economic activities, which are key for the implementation of the REPowerEU Plan and the Green Deal Industrial Plan.

### The Mourenx plant

In January 2023, the BioBéarn biogas production unit in Mourenx was commissioned, with an annual production capacity of 160 GWh.<sup>13</sup> The plant has been built on a 7-hectare former brownfield site in the centre of the Lacq basin. The unit will be capable of converting 220,000 tonnes of organic waste every year from local farming activities and agri-food industry.

In the Mourenx plant, the anaerobic digestion process turns feedstock into biogas. Once purified, biogas becomes biomethane, with the production being certified as sustainable by the *International Sustainability & Carbon Certification* under the highest sustainability criteria set in the Red II Directive. Since January 2023, the unit has been feeding its biomethane into the natural gas transmission network operated by the Spanish firm Teréga.

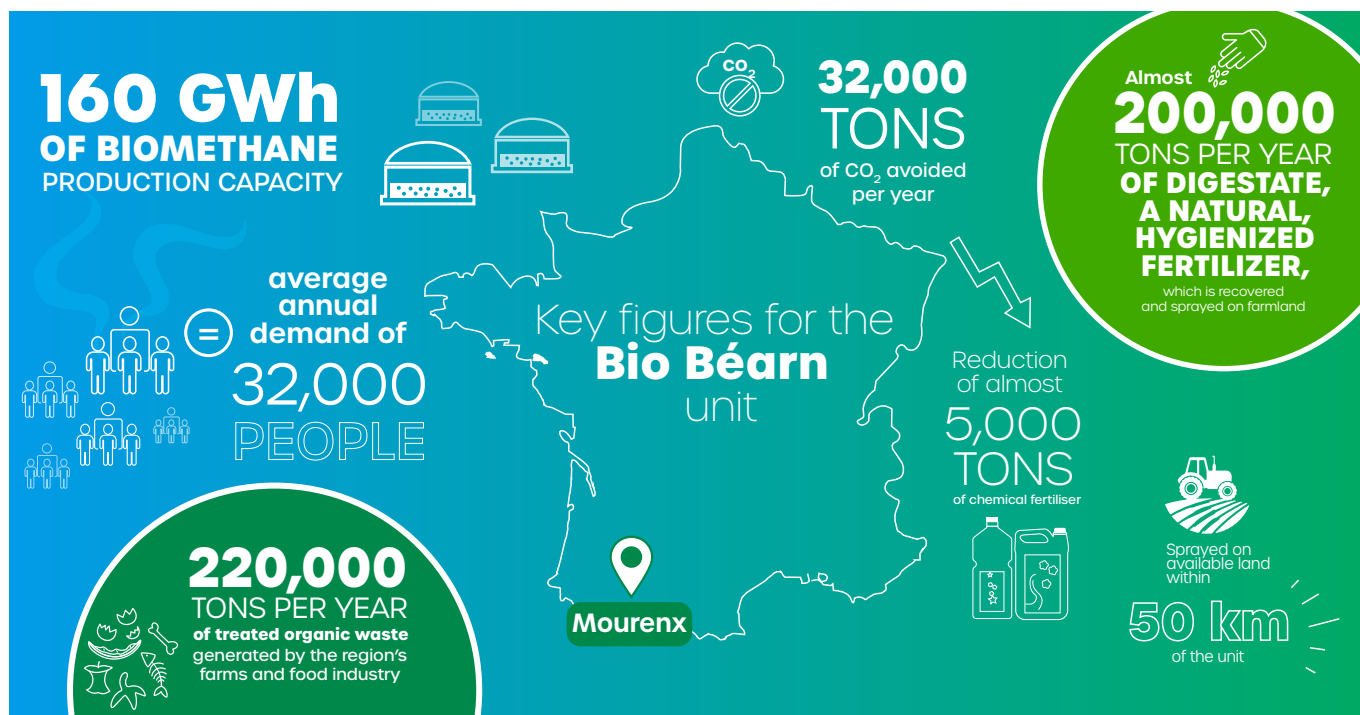
The project will gradually be scaled up to produce up to 160 GWh at 100% capacity, which is equivalent to the average general consumption of 32,000 inhabitants. The initiative contributes to avoiding the emission of 32,000 tonnes of CO<sub>2</sub> per year. Furthermore, as part of a Biomethane Purchase Agreement concluded in June 2023, the installation will supply Saint-Gobain France with 100 GWh of biomethane over a three-year period starting in 2024.

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11-IP\_24\_3986\_EN.pdf.

12-[https://competition-policy.ec.europa.eu/state-aid/ukraine\\_en](https://competition-policy.ec.europa.eu/state-aid/ukraine_en).

13-BioBéarn, TotalEnergies' largest anaerobic digestion unit in France | TotalEnergies.com.



Source: BioBéarn, TotalEnergies' largest anaerobic digestion unit in France | TotalEnergies.com

The project is an example of cooperation with local farmers, with the initiative including so far more than 200 farmers and agri-food producers.<sup>14</sup> The unit is supplied with **organic waste from 90 local suppliers**. Additionally, the plant's integration into the landscape has been designed in association with the Lacq joint local authority. The nearly 200,000 tonnes of digestate (residues from the anaerobic digestion process) produced each year will be sprayed on crops located within a 50-kilometre radius of the unit. An additional benefit is that the use of natural fertilisers is expected to reduce the need for chemical fertilisers by almost 5000 tonnes.

## Czech Republic

### Legislation issues

In terms of legislation enabling the operation of such installations, the Czech National Plan<sup>15</sup>, which is soon to come into effect, is significantly linked to the update of the Czech Climate Protection Policy and the draft of the State Energy Concept. The National Plan includes more specific references to biogas and biomethane production and use<sup>16</sup>, while the language used in other policy documents remains rather vague.

The greatest potential for production is offered by biogas plants, with more than five hundred of them. Most of them now produce heat and electricity using cogeneration units, but the Plan expects that the vast majority will also start producing biomethane. This can be achieved by treating biogas and then supplying it directly to the gas grid. However, currently, only a few stations are producing it.

The potential for the development of high efficiency "CHP" was identified in the national plan, particularly for smaller sources with electrical outputs on the level of a few MWe. It is likely to consist in increasing the number of micro-CHP units (capacity below 50 kWe), small (capacity below 1 MWe) and medium-sized natural gas-based CHP sources.

In the transport sector, fuel suppliers will have to comply with a **mandatory sectoral target of 5.5% of final consumption of biofuels, including biomethane (BioCNG)**.

Conversion is expected to be particularly important for biogas plants with lower utilization of useful heat

<sup>14</sup>-BioBéarn, TotalEnergies' largest anaerobic digestion unit in France | TotalEnergies.com.

<sup>15</sup>-Czech National Plan.

<sup>16</sup>-CZECH NATIONAL PLAN 2030: BIOGAS AND BIOMETHANE.

and close to high-pressure gas pipelines, which should have a positive impact on increasing the use of primary energy sources. By adjusting legislation and standards, it will then be possible to **implement bi-directional pressure reduction stations and thus use them to connect low-pressure distribution networks**.<sup>17</sup> This should also lead to a reduction in both operating and investment costs and increase the connectivity of production plants.<sup>18</sup>

Furthermore, in January 2022, the **Renewable Energy Sources Promotion Act** was introduced, providing support schemes for biogas and biomethane production. Until 2025, a support scheme is in place to support the production of sustainable biomethane to be injected into the gas grid or delivered to a filling station/distribution unit and used for transportation or heating.

The aid will take the form of a bonus granted to biomethane producers for each MWh of biomethane produced over a period of 20 years. The amount of the bonus is set annually by the Czech Energy Regulatory Authority, with the scheme being specifically targeted at SMEs or energy communities with capacities up to 6 MW.

A key issue for the development of renewable gases is related to the existence of public support, which should cover both the transformation of existing biogas plants to biomethane production and the construction of new biomethane installations. This should help with the costs for the production, transport, distribution and storage of biomethane.

### The Litomyšl plant

In the Czech Republic, Hutira plyn built the biomethane plant ZDCHP Litomyšl<sup>19</sup>, currently using biogas for cogeneration of electricity and heat (CHP). The project deals with the modification of biogas – upgrading, to the quality of natural gas or biomethane, and its injection into the high-pressure gas distribution system and use in a CNG filling station.

Biogas used in this installation<sup>20</sup> is produced by processing cow manure and agricultural crops. The biogas is then adjusted to natural gas quality with special technology.

With respect to the technology used in this case, raw biogas undergoes pre-treatment in a dedicated unit with a capacity of up to 550 Nm<sup>3</sup>/hour. The volume and quality of biomethane is measured in a dedicated unit, being prepared for supply to the high-pressure network with an overpressure of 2.3 – 2.5 MPa.

In terms of technical parameters of the technology used, the biogas upgrading project is a follow-up to the existing BPS facility, where biogas is used for quote generation of electricity and heat. In the final stage, biomethane is injected into a high-pressure gas distribution system (Gas2Grid).

### Italy

Italy has supported LNG/Bio-CNG through **state support and tax incentives**, by introducing a tax credit mechanism for the purchase of LNG in road transportation, covering 20% of expenses (Decree-Law No. 17 of 2022).

Also, a **Guarantees of Origin (GO) mechanism** was introduced for biomethane, validating the origin of energy from renewable sources. A GO is valid for 12 months and can be traded on a specialised platform.

With respect to subsidies for the purchase of green trucks, Italy's Transport Ministry has set a budget of €25 million for transporters using green vehicles powered by LNG or other sustainable fuels. The subsidies range from €2,000 to €24,000, depending on vehicle size.

Facilities for the construction of LNG liquefaction stations and production of Bio-LNG: Funds have been allocated for the construction of new stations – €12 million for a biomethane liquefaction plant and €6 million for a gas station for the sale of liquefied biomethane.

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17-Czech National Plan.

18-CZECH NATIONAL PLAN 2030: BIOGAS AND BIOMETHANE.

19-Biomethane plant ZDCHP Litomyšl – HUTIRA.

20-Another Milestone in the History of the Czech Gas Industry – a New Biomethane Plant Will Be Built in Litomyšl. – HUTIRA green gas

In 2021, Air Liquide Italia built two biomethane<sup>21</sup> production units in Lombardy with a total production capacity of 3200 tons per year. The two plants, located in Truccazzano, in the province of Milan, and Fontanella, Bergamo, started operating the same year. The installations, built in collaboration with the local partner Dentro il Sole, recycle organic material (livestock wastewater and agricultural waste) from local agricultural and livestock activities and convert it into **biomethane for transport and fertiliser production**.

Air Liquide has also set up a temporary association of companies to develop a further important project for the construction of a distributor of alternative fuels, including liquefied biomethane (BIO-LNG) from the two new above-mentioned plants.

The proximity of the production plants to the distributor (1.5 kilometers in the case of Truccazzano and 35 km for Fontanella) and the agricultural origin of Bio-LNG were fundamental points that led to the award of the tender. The proximity of supply means that transport trucks will travel short distances, with a reduced environmental impact.

## 3. Implementation opportunities in Romania

### 3.1. Romania's potential

Romania ranks 6<sup>th</sup> in the EU-27 in biomethane production potential by 2030 (2 bcm), and 7<sup>th</sup> out of the EU-27 by 2050 (8 bcm), according to the European Biogas Association.<sup>22</sup>

According to the EC, industry estimates Romania's sustainable biomethane potential as 2.0 bcm (1.9 bcm from AD and 0.1 from gasification) by 2030. Considering the sustainable potential, Romania could become one of the top biomethane markets in the EU27. Romania consumes 469 kt and 82 kt of nitrogen and phosphorus fertiliser<sup>23</sup> that could be partially replaced by digestate.

Manufacture and agriculture, forestry & fisheries sectors are the main GHG emission sources by economic activity with 51% (50.6 MtCO<sub>2</sub>eq)<sup>24</sup> in Romania. This can be tackled both by manure management in anaerobic digestion and application of digestate on soil (land management).

However, currently, Romania represents one of the least developed biogas markets in EU. Romania has the potential to replace around a quarter of current natural gas imports with biomethane. This fact would be beneficial both from an energy security perspective and for GHG emission reduction from the energy sector.

### 3.2. Technological potential

Natural gas accounts for 29% of Romania's total energy supply. 96% of the natural gas is used for energy purposes and 4% for non-energy purposes (synthetic fertilisers). The main natural gas consumption sectors in Romania are represented by households (33%) and industry (25%) from final energy consumption and electricity production, either in electricity only or CHP plants.

Romania could reduce its natural gas import dependency by including the synthetic fertiliser production capacities to improve and market digestate, or extract micronutrients for bio-fertilisers.

To achieve and maximise to the fullest biomethane production in Romania, the production process should be linked with agri-food industry, which currently is the largest employer in the national economy as well as the generator of most of the feedstock necessary for biomethane production. Short supply chains are needed to reduce transportation costs, as well as bringing production close to the end user or to natural gas pipelines, with digestate use as a local source of nutrients.

Based on public information, in October 2024, a large integrated livestock farm in Romania, and an

21-Fontanella: Air Liquide Italia and the "biomethane revolution" - Martesana first.

22-<https://www.europeanbiogas.eu/eba-statistical-report-2023/>.

23-[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental\\_indicator\\_-\\_mineral\\_fertiliser\\_consumption#Analysis\\_at\\_country\\_level](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_mineral_fertiliser_consumption#Analysis_at_country_level).

24-[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Greenhouse\\_gas\\_emissions\\_by\\_economic\\_activity,\\_2021\\_\(thousand\\_tonnes\\_of\\_CO2\\_equivalents\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Greenhouse_gas_emissions_by_economic_activity,_2021_(thousand_tonnes_of_CO2_equivalents).png).

energy producing company agreed to cooperate to develop a large biomethane production facility in Romania, with a total capacity of up to 15 MW. The mentioned livestock farm will supply the raw material for biomethane production through a long-term contract to ensure sustainability and the energy producer will develop the facility.

Based on further public information, the project represents the first of its kind in Romania, being expected to be able to expand from 15MW to over 20MW by sourcing additional feedstock. The overall investment in the facility is estimated to exceed EUR 30 million. EBRD supports the financing.

### 3.3. Relevant areas for biomethane technology implementation

Its multiple applications include heat and power supply for buildings and industry, and renewable fuel production for the transportation sector.

In Romania, biomethane can be used in the following activity fields, given the geographic, human capital and technological characteristics in place, as well as the country's significant agricultural sector:

- Alternative to natural gas: Biomethane can be injected into the gas network to replace natural gas and distributed for both residential and industrial use. This makes it possible to use the existing infrastructure.
- Generate electricity and heat: Biomethane's combustion can also serve to generate electricity and heat.
- Power Vehicles: In this case, the use of biomethane as an advanced renewable biofuel allows improvement in air quality. Also, the use of compressed natural gas (CNG) can support urban bus fleets.
- Raw material: Biomethane can be used as a raw material for the production of renewable hydrogen.
- Stimulate Job creation: Biomethane production can generate further development across Romania's extensive rural areas, by increasing the number of new jobs linked to agricultural and livestock sectors. Furthermore, this also contributes to the sustainability of agro-livestock sector as its self-consumption supports the decarbonisation process in this sector.
- Encourage circular economy: Biomethane production encourages efficient organic waste management, as the digestates obtained are returned to the field as fertilisers.
- Waste use: Using waste to produce local energy helps plans to reduce energy dependency across Romania and in the region.

## 4. The need to implement biomethane

In terms of Romanian national policy documents and targets, the National Energy Strategy envisages a target of achieving a **5% share of biomethane in the natural gas grid by 2030 and 10% by 2050**.

This initiative will further strengthen the role of biomethane in Romania's energy mix and support long-term sustainability objectives.

This target is also mentioned in the revised version of the new National Integrated Energy and Climate Change Plan (PNIESC), published on 16 September 2024 and sent to the European Commission in late October.

The document also points out that improvements in waste management and biofuels, including biomethane production and use, are needed. PNIESC also refers to the need to blend biomethane into the natural gas pipeline, where technical conditions allow it. The plan mentions a target value of 368 ktoe for biomethane consumption for 2030.

However, PNIESC does not include a description of the technical specifications required for the quality of biomethane to be injected into the national transmission network and to be taken up in the national network.

The plan also mentions a biomethane-related study conducted by the EBRD, which found that waste

and manure recovery and plant residues play a significant role for biomethane production in Romania. The study estimates that around 501 ktoe of biomethane can be produced by 2050 from waste and agriculture sectors.

However, the document also notes that, between 2021 up to 2025, Romania will need to increase the share of renewable energy in its industry sector by at least 0.8 percentage points every year on average. The Renewable Energy Directive (2009/28/EC) sets out specific rules for achieving this target, while in Romania's case, electricity from renewable energy sources should be counted.

Furthermore, the revised Renewable Energy Directive broadens the scope of the fuel supply obligation to cover all uses of biomethane and the Commission's recommendation on permitting for renewable energy projects should also **accelerate new biogas and biomethane investments**.

The Biomethane Industrial Partnership (BIP) was launched on 28 September 2022 and aims to support the achievement of the EU's 2030 target of 35 bcm annual production and use of sustainable biomethane and to create the conditions for a further ramp-up of its potential by 2050. It will promote active engagement between the Commission, EU countries, industry representatives, feedstock producers, academics and NGOs. The Commission will work closely with EU countries to support them in their development of national strategies on biomethane production and to promote cooperation on biomethane with neighbouring countries, including Ukraine.

Additionally, by 2024, under the Waste Framework Directive (2008/98/EC), EU countries will have to collect organic waste separately. This offers an opportunity to scale-up the production of sustainable biomethane and create income opportunities for farmers and foresters.

## 5. Missing elements and Recommendations to update the legislation

Several changes need to be made in the Romanian primary legislation, with respect to **traceability and certification processes**, as well as the **injection of biomethane in the national natural gas transmission system**, to encourage large scale investments in biomethane technological uptake and production.

Concerning **GOs**, there is a need to establish a legal framework providing for the introduction and trading of GOs, both for locally produced biomethane and for any volumes imported for domestic consumption.

It is also necessary to implement a **national biomethane register**, aiming to monitor any biomethane quantities produced and traded, to remove any double selling and double counting possibilities. Additionally, it is necessary to link the future national biomethane register with the Union Database for Biofuels (UDB). The UDB technically covers gaseous fuels since 21 November 2024, however there are still no clear deadlines for mandatory use and implementation within the Member States.

The legislative framework should primarily foresee:

- Notices and deadlines for connecting biomethane installations;
- Provisions allowing biomethane from producers to be injected into the natural gas distribution and transmission systems;
- With respect to the connecting procedures involved for linking biomethane production units, new provisions should cover the manner in which these units are connected to natural gas transmission and distribution systems;
- Amendment of the current regulation relating to a single licence being required for the activity of supplying natural gas and biomethane;
- Adoption of the National Energy Regulatory Authority's (NERA) regulation establishing the licensing framework for biomethane traders;
- Clarifications regarding the application of legal obligations for producers' natural gas and biomethane.

The new legislative framework should also include provisions allowing biomethane from producers to be

injected into the natural gas distribution grids as well as the transmission grid, to stimulate investments from producers in this sector.

Furthermore, provisions should be included to clarify the transmission system operator's (TSO) and distribution system operators (DSO) to allow biomethane injection into the national grids.

One of the first steps needed to allow the injection of biomethane in the national natural gas distribution and transmission systems is the amendment of the current **definition of biomethane** included in the Electricity and Natural Gas Law no. 123/2012. Specifically, it is necessary to amend Article 100, paragraph 12, so that biomethane is defined as *"biogas brought to the quality parameters laid down in secondary legislation in a non-discriminatory manner, so that it can be injected into natural gas transmission and distribution networks and upstream pipelines."*

Furthermore, new legislative provisions should include specifications relating to the **quality of biomethane in order to avoid restrictions on cross-border flows** due to differences in gas quality at interconnection points.

With respect to this point, Art. 21 of Regulation (EU) 2024/1789 of the European Parliament and of the Council of June 13, 2024 on the internal markets in 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 (EC) No 715/2009 provides that: *"Transmission system operators shall cooperate to avoid restricting cross-border flows due to differences in gas quality at interconnection points between Member States. When so cooperating, transmission system operators shall consider the characteristics of the final customers' natural gas consuming facilities."*

The provision underlines the importance of harmonising the quality of natural gas, biomethane included, to facilitate uninterrupted cross-border flows among different countries.

Furthermore, **biogas and biomethane technologies should be explicitly classified as green gases**, since the policy and strategy documents adopted so far failed to classify it as such. Art. 4 of Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024, establishing a framework of measures to strengthen the European zero net technology ecosystem and amending Regulation (EU) 2018/1724 states that: "The zero net technologies falling within the scope of this Regulation are: [...] (f) sustainable biogas and biomethane technologies".

## Conclusions

Biomethane has the potential to become price-competitive on the Romanian market, provided that adequate legislative changes are made to encourage large scale biomethane adoption, and fiscal incentives are introduced to support investments in this sector.

Especially during the early stages of its development, financial support is essential to encourage investors to enter this market.

Funding sources currently used for the renewable energy sector, as well as those for agriculture, sustainable development, and waste management, can be adapted to address this technology. Specifically, the following types of funds could be used to stimulate biomethane production:

Support schemes can encourage both the production sector (through feed-in-tariff or investment support schemes) and to make biomethane a more attractive energy source for consumers (e.g. through tax incentives or quotas/certifications).

To encourage large-scale adoption of this technology in Romania, we propose associating two of the most widely used measures at European level, **the feed-in-tariff to encourage the production and injection into natural gas networks, and the introduction of a register and guarantees of origin** also for green gas.

