Manual for National Biomethane Strategies

September 2022

GAS FOR CLIMATE
A path to 2050

Guidehouse

Table of contents

Imprint

Copyright:
© 2022 Guidehouse Netherlands B.V.

Authors:
Lucie Emprin, Gemma Toop, Silvia Yordanova, Sacha Alberici, Jan Cihlar

Date:
September 2022

Contact:
Guidehouse
Stadsplateau 15, 3521 AZ Utrecht
The Netherlands
+31 30 662 3300

www.guidehouse.com
Photo credits (title, page 34):
© Countrypixel / Adobe Stock

Design:
res d Design und Architektur GmbH, Chia-Yu Lin

The purpose of this manual

Following the Russian invasion of Ukraine, the European Commission published the REPowerEU Plan[1] to reduce the European Union's dependency on Russian energy imports. The REPowerEU Plan sets the ambition to replace 35 billion cubic meters (bcm)[2] of the 155 bcm of European natural gas currently imported from Russia with domestic production of biomethane across the EU-27 by 2030. This is equivalent to roughly ten times the current annual EU biomethane production. Today, 3 bcm of biomethane and 15 bcm of biogas are produced in the EU-27.[3]

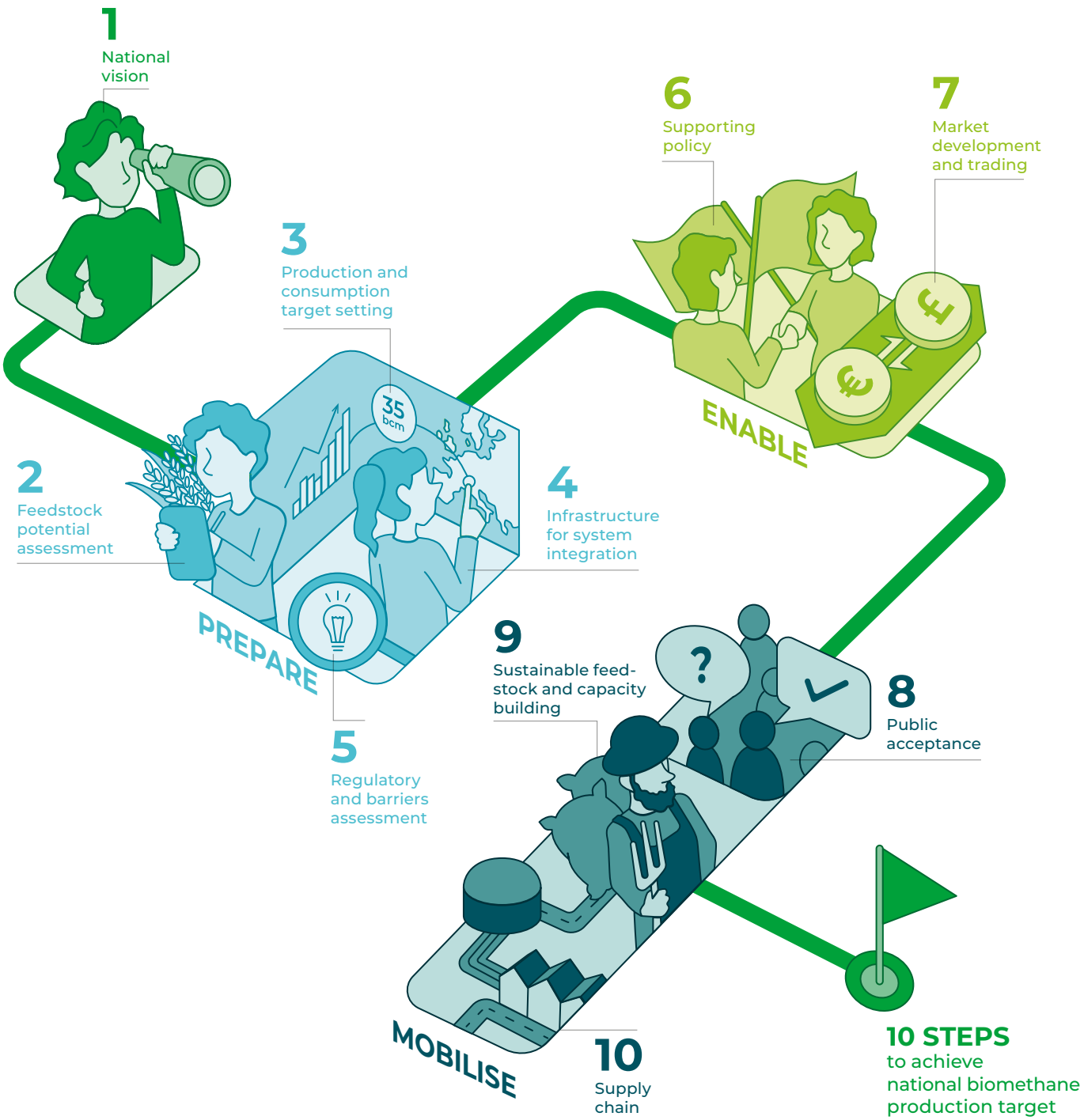
Gas for Climate recently assessed the potential for sustainable biomethane production[4] in the EU-27, estimating that the European Union has the potential to produce up to 41 bcm/year biomethane by 2030[5,6]. In 2030, the key feedstock potential for anaerobic digestion comes from manure, agricultural residues such as straw, sequential cropping[7] and industrial wastewater. Feedstocks for thermal gasification are mainly woody wastes and residues. The sustainable biomethane potential could increase to 151 bcm by 2050[8] by mobilising additional feedstock streams, especially sequential cropping, and increasing biomethane production capacity.[9] There is sufficient sustainable potential available, but concerted action is required to make the feedstock accessible and to mobilise and scale up biomethane supply chains.

The EU's 35 bcm biomethane target for 2030 has to be translated into individual contributions by all member states. To assist with the implementation of the REPowerEU Plan, the European Commission published a Biomethane Action Plan[10] setting out measures to be taken at both national and European levels to scale up biomethane production and consumption. The plan includes a recommendation to member states to develop a national biomethane strategy as soon as possible.[11]

1 European Commission (2022). REPowerEU, Link.
2 European Commission (2022), Commission Staff Working Document, SWD (2022) 230 final, Implementing the REPowerEU Action Plan: Investment needs, hydrogen accelerator, and achieving the bio-methane targets, Link
Biomethane Action Plan refers to the chapter 5 of this document: 5. *Achieving the biomethane targets*
3 Action plan for implementing REPowerEU, Gas for Climate, March 2022, Link
4 Biomethane can be produced in two main ways: anaerobic digestion and thermal gasification. Anaerobic digestion is a biological process in which microorganisms break down biodegradable material in the absence of oxygen. The process results in biogas and digestate. Biogas contains around 55% methane, the rest being mainly short carbon cycle CO_2. Biogas is already used directly in some EU member states to produce electricity and/or heat. By removing the CO_2, the biogas can be "upgraded" to become biomethane capable of being injected into the gas grid. Thermal gasification involves a complete thermal breakdown of woody biomass and consumer wastes, which takes place in a gasifier in the presence of a controlled amount of oxygen and steam. A mixture of carbon monoxide, hydrogen, and CO_2 is produced — called syngas or synthesis gas. After cleaning and purification, methanation of the syngas is performed in a catalytic reactor to obtain biomethane. A share of renewable methane demand is also envisioned to be met by power-to-methane, producing methane out of renewable hydrogen and biogenic CO_2, and by other processes including for example hydrothermal gasification.
5 The 2030 estimate increases to 45 bcm when the United Kingdom, Norway and Switzerland are included
6 Biomethane production potentials in the EU, Gas for Climate, July 2022, Link – this study does not include less mature feedstocks potential such as algae. Biomethane production from hydrothermal gasification was not explicitly included in this study given the potential overlap with anaerobic digestion, which is already commercially deployed. In addition, e-methane production from the power-to-methane route is not included. Although some feedstocks can be directed to both technologies, they have been directed towards one technology to avoid double-counting. A more elaborate feedstock repartition between technologies could lead to an increase of thermal gasification potential compared to anaerobic digestion.
7 Sequential cropping is the cultivation of a second crop before or after the harvest of the main food or feed crop on the same agricultural land during an otherwise fallow period, not triggering additional demand for land. Sequential cropping does not impact existing food or feed markets as no existing food or feed is used for biogas.
8 The 2050 estimate is 165 bcm when the United Kingdom, Norway and Switzerland are included.
9 Biomethane production potentials in the EU, Gas for Climate, July 2022, Link – this study does not include less mature feedstocks potential such as algae. Biomethane production from hydrothermal gasification was not explicitly included in this study given the potential overlap with anaerobic digestion, which is already commercially deployed. In addition, e-methane production from the power-to-methane route is not included.
10 Chapter 5 of European Commission (2022), Commission Staff Working Document, SWD (2022) 230 final, Implementing the REPowerEU Action Plan: Investment needs, hydrogen accelerator, and achieving the bio-methane targets, Link
11 Biomethane action plan, Action 1.2: Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs)

Gas for Climate has compiled this step-by-step manual to support member states in developing and implementing their national biomethane strategies. The ten steps, from developing a national vision on biomethane and setting initial targets to having a fully implemented national biomethane strategy, are shown below.

Figure 1: Ten steps to build a national biomethane strategy



The steps have a logical flow, but some can be done in parallel. For example, once a member state has a national vision on biomethane, they can already start to mobilise stakeholders and public acceptance to build a constructive and ongoing dialogue.

Member states are at different stages in their biomethane journeys. Some already have significant biomethane production, although often with a focus on one type of feedstock or segment of the potential market. In others, the industry is more nascent. Some member states will be able to make faster progress through the steps than others, depending on the current level of development of their biomethane sector. For all member states, the faster they can scale up their biomethane market, the better. **With this in mind, the core focus of this manual is to be as practical as possible – ideally, it serves as a "checklist" that key stakeholders in all member states can use in the development and implementation of their national strategies.**

The urgency to scale up biomethane production is high. Therefore, this manual emphasises actions that are immediately implementable and that build on research already done across the sector. The steps are complemented with some examples of best practices. These best practice examples aim to highlight different successful trajectories that have been taken to achieve each of the ten steps.

This manual is published in the context of the upcoming Biogas and Biomethane Industrial Partnership (BIP).[12] The BIP is recommended in the European Commission's Biomethane action plan and will launch at the end of September 2022. This manual is intended to feed directly into Task Force 1 of the BIP, which consists of EU member states, the European Commission and the biomethane value chain, and through which an active dialogue and recommendations will be made towards member state biomethane targets and their National Energy and Climate Plans (NECPs) to 2030.

Hence, a national biomethane strategy should be seen as a key element to kick start a biomethane market. The strategy should include ambitious targets which act as a 'north star' for the industry to develop towards, and should be embedded into a member state's short and long-term energy system roadmap. Any new national targets for biomethane production (and consumption) must be integrated into a member state's existing NECPs to ensure that the target sits within the heart of a member state's energy and climate planning. The long-term strategy should be sufficiently flexible to make room for new developments, such as new production technologies (waste-to-gas, gasification of plastics for instance).

When developing and implementing their national biomethane strategies, member states should ensure they engage the full spectrum of stakeholders who have a role to play in the biomethane industry. As biomethane is uniquely able to be made from a wide range of feedstocks arising from different sectors of the economy, and it can be used for different energy end uses, many different ministries, industry associations and different sectors are involved in the value chain. Relevant ministries will include those responsible for energy, transport, climate, environment, agriculture, forestry, waste and finance. Local authorities will be involved in local planning decisions and often have responsibility for feedstocks such as municipal wastes. Gas network operators are key stakeholders to be involved in the planning of biomethane integration into the gas grid. In addition, national biogas associations and relevant industry associations such as farmers industry associations should be involved. As well as national biogas associations, the European Biogas Association and the forthcoming BIP will have a wealth of resources available to help.

Successful scaling up of domestic biomethane production can present one of the key remedies to the currently highly volatile energy markets. Besides enhancing the EU's security of supply and contributing to rural development, biomethane – with its production cost well below the current natural gas market prices – can also help alleviate part of the economic pressure on households and companies. Ideally, this manual is then on the desk of policy officers responsible for the development of their national biomethane strategy and used as a key reference in this journey.

12 Biomethane Industrial Partnership, EBA, Link

10 steps to develop and implement national biomethane strategies

A practical, step-by-step guide to support stakeholders in the development of their national biomethane strategies.

1. National vision

Each member state should develop an overall vision for the role of biomethane in their energy system and economy for the time horizons 2030 and 2050, as mentioned in the Biomethane Action Plan. The vision should feed into the 10-year plan included in a member state's NECP.[13] The vision document should introduce a favourable environment for the biomethane market to start up by showing a clear direction and clear government support for the sector. It should set an overall roadmap with national objectives such as how much biomethane is to be produced, what it can be used for and the benefit it will bring. The vision can draw on the extensive body of work from Gas for Climate and REGATRACE[14] and on the forthcoming BIP.

Actions

1.1 Establish the current status of biomethane in the national context

Collect and compile any available data on the current national biogas and biomethane production and consumption to understand the status of the market. Compare any existing national roadmap for future biogas or biomethane production and consumption against the REPowerEU targets. Compare the forecasted domestic consumption of natural gas to high-level estimates for the national biomethane production potential[15] in 2030 and 2050 to understand the medium- and long-term share of the total gas demand that could be met by biomethane.

1.2 Understand economic, social and environmental benefits and risks

Make the case for biomethane including positive impacts, synergies and risks, based on available studies[16]. Investigate cost savings by comparing projected fossil fuels import costs to domestic biomethane production costs[17], potential greenhouse gas emission reductions[18], numbers of jobs created (especially in rural areas) and additional revenue streams for parties who supply plant operators with feedstock. Define a rationale specific to each member state to incentivise biomethane production in addition to clean energy production (for example energy independency, improved waste management, reducing agricultural greenhouse gas emissions etc.).

13 Biomethane Action Plan, **Action 1.2**: Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs), May 2022, Link

14 "D6.3 | Long-terms visions and roadmaps", REGATRACE, 2022, Link

15 Potential estimates per member state are, for example, available in a July 2022 Gas for Climate paper: Biomethane production potentials in the EU, Gas for Climate, July 2022, Link

16 The European Biogas Association has commissioned Guidehouse to quantify the positive impacts of a biomethane economy. Publication of the study report is foreseen for November 2022.

17 With the current natural gas price levels, biomethane is competitive. Natural gas on the EEX spot market reached 280 €/MWh in August 2022, while the levelized cost of biomethane is estimated to 50 to 90 €/MWh depending on the feedstock according to Gas for Climate, 2022

18 "[...] the overall lifecycle greenhouse gas emission reductions of biomethane ranges (produced in a closed anaerobic digester with off-gas combustion) compared to natural gas typically ranges from 68% with maize as feedstock, 86% with biowaste as feedstock and above 100% with manure as feedstock.", Gas for Climate, 2019

1.3
Take 'no regret actions' to kick start the market

REPowerEU sets an ambitious target of 35 bcm biomethane production across the EU by 2030. In member states where the biomethane market is not existing or nascent, launch first actions as soon as possible to kick start the market. 'No regret actions' mean developing biomethane production in the short term based on immediately accessible feedstock. Set initial short-term biomethane production targets as soon as possible, based on a conservative share of the available high-level estimates of national feedstock potential[19]. These short-term targets can then be ramped up following more detailed national level studies and priority setting. Facilitate the short-term targets by launching a call for tenders to install targeted production capacities, inspired by good practices observed in mature biomethane markets (e.g. contract for difference – CfD -, feed-in tariff – FiT -, feed-in premium – FiP -, subsidies, with many project types eligible for support.[20]).

Examples of best practice

Italy expressed its **national vision** for biomethane through the National Recovery and Resilience Plan (NRRP), approved by the European Commission in August 2022. The plan presents the vision and new directions for the future of the biomethane market. The plan includes €4.5 billion of funding to support biomethane production in Italy in line with a national target of 2.3 bcm by 2026. As part of its strategy, Italy seeks to improve the reconversion and efficiency of existing agricultural biogas plants towards partial or total biomethane production as well as the development of new plants. Accordingly, key end-use sectors include the industrial, residential heating and cooling, and transport sectors with encouragement to expand biomethane usage to other sectors ensuring demand aligns with 2026 production potentials.[21]

A forthcoming study by Guidehouse for the European Biogas Association (EBA) (due Q4 2022) aims to identify and quantify the **economic and societal benefits** of biomethane production beyond renewable energy provision. Such benefits include for example, reducing fugitive emissions in agriculture through better manure management, improving energy security, replacement of synthetic fertiliser with digestate and improving soil health. Typically, these aspects are not recognised in existing climate or energy policy at either the European or national level, while they provide real benefits to society.

Denmark started the promotion of biogas production based on clearly identified **positive benefits** such as decreasing nitrogenous gases from the agricultural sector (livestock), energy dependency and producing heat for neighbouring communities.[22] Today, biomethane is expected to cover ~28 % of the total Danish gas consumption. The Danish government has also set a **national vision** to achieve 100% biomethane consumption in its gas network by 2030.[23]

The French biogas and biomethane markets were boosted by the introduction of the **first FiT** system in 2011, along with a tax exemption for biogas and biomethane consumption. The number of installed production plants grew subsequently from 3 units in 2013 to 365 in 2021. With the maturity of the market, in 2015, the government started the process of revision of these measures and the modification of the FiT system.[24]

19 Potential estimates per Member State are, for example, available in a July 2022 Gas for Climate paper: Biomethane production potentials in the EU, Gas for Climate, July 2022, Link
20 Meaning different sizes of projects, types of feedstocks, technologies.
21 "Italia Domani, the National Recovery and Resilience Plan", Link
22 Interview with the Danish Biogas Association
23 "A brief overview of the growing green gas production in Denmark", Bech Bruun, March 2022, Link
24 Sia Partners Biomethane Observatory, 2018, 2019, 2022

1

Prepare

In this phase, member states gather the analysis needed to prepare and build a solid biomethane strategy. This includes an assessment of the physical characteristics of the country including the availability of sustainable feedstock and the state of the gas grid, together with a regulatory and barrier assessment and review that can all be combined to set robust yet ambitious biomethane targets.

2
Feedstock potential assessment

3
Production and consumption target setting

4
Infrastructure for system integration

5
Regulatory and barriers assessment

2. Feedstock potential assessment

Understand the feedstock potential available for biomethane production at the national level, identify which feedstocks offer the largest untapped potential and map the availability of those feedstocks to derive spatially explicit estimates of the potential for biomethane production at a regional or more local level.[25]

Actions

2.1 Assess the sustainable feedstock potential

Where possible, starting from existing national studies of feedstock potential[26], list and quantify the feedstocks available for biomethane production towards 2030 and 2050. For member states who do not have existing national feedstock potential estimates, Gas for Climate published a paper in July 2022[27] estimating feedstock potentials in 2030 and 2050 for each member state. In total, the paper estimates that 41 bcm biomethane could be produced in the EU-27 in 2030 and 151 bcm in 2050. As done in the Gas for Climate paper, estimates of sustainable feedstock potential should take into account both technical constraints (e.g. share of the total feedstock potential that can be mobilised by 2030 and 2050) and relevant environmental constraints (e.g. no competition with food and animal feed crops, and maximum removal rates for agricultural residues such as straw to maintain soil quality). The sustainable potential should also take into account existing and expected future (non-energy) uses of the feedstocks, to ensure biomethane production does not impact existing uses and result in indirect impacts.

2.2 Identify untapped feedstock potential that should be targeted

Based on the sustainable feedstock potential, identify the feedstocks that provide the most easily accessible untapped potential in a member state's national context in the short (2025), medium (2030-2040) and long-term (2050). This step provides the basis to better understand which sustainable sources of feedstock should be used, and therefore which sectors in the economy should be targeted through policy to develop biomethane production in the short term. This also enables member states to identify which actions might be needed to make feedstock available in the medium and long-term, such as further research, promotion of sequential cropping, or the introduction of separate collection of organic waste.

2.3 Map the target feedstock potential

Considering the above, map the available potentials of the feedstocks that will be targeted for biomethane production in the short, medium and long-term, to derive estimates of the potential for biomethane production at a local level. The volume of biomethane produced depends on the feedstock–technology combination used. To the extent possible, this should be taken into account in the mapping of biomethane production potential.

25 Biomethane Action Plan, **Action 3.1**: Carry out regional assessment of network development and matching it with the potential of sustainable biomethane production and **Action 4.1**: Further support the expansion of the sustainable biomass potential to ensure availability of resources for reaching the biomethane production target, May 2022, Link
26 Gas for Climate paper: Biomethane production potentials in the EU, Gas for Climate, July 2022, Link
27 Gas for Climate paper: Biomethane production potentials in the EU, Gas for Climate, July 2022, Link

Examples of best practice

Many member states have conducted their own domestic **biogas feedstock potential assessments** including Belgium, France, Denmark, Germany, Latvia, Ireland, Italy, Spain and more. For example, in Belgium, Fluxys together with the Flemish and Wallonian biogas associations, have conducted an in-depth study to assess the feedstock potential and availability at an intra-regional level dividing Wallonia and Flanders in 5 to 6 zones each. For each zone, feedstocks were assessed to identify potential volumes and associated greenhouse gas emission savings. The study is complemented by a feasibility study of 6 anaerobic digestion technology implementation solutions in each identified zone, together with their greenhouse gas emission savings. The study produced a map indicating the most beneficial feedstock–technology solution for each zone.[28] It also estimated a production potential of 8 TWh in Flanders and 7 TWh in Wallonia by 2030.

The United States has implemented a program mandated by the Environmental Protection Agency (EPA) and US Department of Agriculture (USDA) called AgSTAR, designed to enable the uptake of anaerobic digestion. The program **assesses the biogas feedstock** availability and emissions reduction potential on national, state and county levels combining USDA livestock data and EPA emissions inventory data. Through this, the top ten states for biogas recovery and methane reduction potential in the US are identified, and criteria for profitable biogas projects by waste management method, size of operation and energy costs defined.[29]

28 Interview with Fluxys, 07/13/2022
29 "Market Opportunities for Biogas Recovery Systems at U.S. Livestock Facilities", EPA, 2018, Link

3. Production and consumption target setting

Define biomethane production and consumption targets for 2030 (national target to contribute to the overall REPowerEU objective of 35 bcm), and also a long-term target for 2050. Integrate the 2030 targets into the NECP and any other relevant national policies and regulations.[30] Compared to 'no regret' targets introduced in the previous vision document (step 1), these long-term objectives aim to be more ambitious and provide security for the development of the market and the achievement of the REPowerEU target. Setting the targets is a crucial step for the development of the biomethane strategy and the definition of the multi action roadmap. This document will build on the vision document (step 1) and the feed-stock and technology assessment study (step 2).

Actions

3.1 Define targets for biomethane production and consumption

Define targets for biomethane production, ideally for both 2030 and 2050 based on the feedstock potential and production technology assessment. Production targets will directly contribute to the 35 bcm REPowerEU target and will not steer the market towards one end-use sector or another. Member states could also define consumption targets for particular sectors (power, transport, building, industry) based on the estimated benefits from biomethane use. The societal costs and benefits for each sector can be assessed and compared to the cost and greenhouse gas emission reduction criteria for instance.

3.2 Integrate the targets into the NECP and other relevant national policies and regulations[31]

Ensuring the coherence and the alignment of other policies is key to lift any regulatory barriers to biomethane development. Integrate any biomethane targets for 2030 into NECPs and coherent with other national policies and regulations, including the Recovery and Resilience Plan, the Common Agriculture Policy National Strategic plans, Waste policies and any other strategic planning documents.

30 Biomethane Action Plan, **Action 1.2**: Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs), May 2022, Link

31 Biomethane Action Plan, **Action 1.2**: Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs), May 2022, Link

Examples of best practice

Several countries have already introduced **production and/or consumption targets** for various timelines. As an example, in July 2022, Ireland committed to a new biomethane domestic **production target** of 5.7 TWh (~ 0.58 bcm) by 2030 to increase its greenhouse gas reduction ambitions. Their communication[32] mentions that this production target will address both agricultural decarbonisation as well as other consumer sectors'. Even though few details are given already, the communication is intended to provide confidence to the agricultural community on a future set up of a highly supportive system.

The Netherlands has set a biomethane **consumption target** of 2 bcm. Additionally, a 20% biomethane blending rate must be achieved by 2030 (1.6 bcm of the 2 bcm target). The biomethane will have to be produced domestically and be injected into the gas grid. A supplier obligation for small-scale consumers will be implemented, initially set at a 0.15 bcm for 2025. The exact instrument will be further specified in Q1 2023.[33]

Many European countries have assessed the benefits of using biomethane in the different sectors (industry, transport, building, power) to **target its consumption** towards highly beneficial use cases. For example, Denmark has chosen to prioritise the use of biomethane to be injected in the grid for decarbonising hard-to-abate sectors such as industry and transport.[34] On the other hand, Italy had initially supported the use of biomethane only in the transport sector (this has changed with the new policy measures adopted in July 2022).[35,36] The Netherlands prioritises the use of biomethane in the built environment.

32 "Government announces sectoral emissions ceilings, setting Ireland on a pathway to turn the tide on climate change", July 2022, Link
33 "Kamerbrief over bijmengverplichting groen gas", 01-07-2022, Link
34 "Biogas in Denmark, Danish Energy Agency, Link
35 Market state and trends in renewable and low-carbon gases in Europe, Gas for Climate, 2021, Link
36 "Italia Domani, the National Recovery and Resilience Plan", Link

4. Infrastructure for system integration

Assess the future infrastructure requirements for biomethane integration into the gas grid by comparing the current gas grid infrastructure to the mapping of biomethane production potential from step 2. Facilitate collaboration between local authorities, national Transmission System Operators (TSOs) and Distribution System Operators (DSOs), as well as with national energy regulatory agencies.

Actions

4.1 Engage with gas grid operators to update their spatial gas grid planning based on the mapping of biomethane production potential

Member states provide gas grid operators with the sustainable feedstock potential assessments and biomethane production mapping. Gas grid operators are then able to use the mapping for future planning by anticipating potential needs for grid updates and build an ongoing dialogue with member state authorities to plan a gas grid fit for future needs.

4.2 Develop a zoning approach according to infrastructure grid and assess future needs[37]

Member states request gas TSOs and DSOs to assess the current gas grid infrastructure together in the context of the defined biomethane production potential from step 2. This comparison should enable the identification of zones with abundant feedstock availability and developed gas grid infrastructure (injection will be technically and economically viable). These zones can be labelled as "renewable go-to areas" and be explicitly targeted as a priority for biomethane development. This should speed up permitting procedures[38] in these areas as the grid infrastructure check is already done. Areas with good feedstock availability but weaker grid infrastructure[39] (typically rural areas) should also be considered as important, as much of the sustainable feedstocks that should be mobilised in the short term are agricultural wastes and residues. For these zones, TSOs and DSOs will be able to anticipate the grid upgrades that might be necessary if biomethane projects are to be developed there. Member States could choose to mandate TSOs and DSOs to prepare for potential project connections (but not necessarily to already invest) so that biomethane can be integrated into the grid in case projects are developed. The overall grid infrastructure assessment should include the potential need for gas grid upgrades including capacities and injection points, but also regarding flows, pressure levels etc. Additional grid equipment installation (pipes and compression) and reverse flow capacities should be considered and planned for.[40]

37 Biomethane Action Plan, **Action 3.1**: Carry out regional assessment of network development and matching it with the potential of sustainable biomethane production and **Action 3.2**: Assess challenges, bottlenecks and other possible measures from the infrastructure perspective for cost-efficient deployment of biomethane, May 2022, Link

38 Biomethane Action Plan, **Action 1.5**: Reduce red tape and speeding up permitting, May 2022, Link

39 To get an idea of the poor coverage of rural areas by gas grid network, 40 million households in Europe are not connected to the gas grid, "FREE – Future of Rural Energy in Europe", FREE, 2020, Link

40 The optimal role for gas in a net-zero emissions energy system, Gas for Climate, March 2019, Link

4.3
Assess the need to cluster existing or new small-scale biogas plants to facilitate biomethane upgrading[41]

Gas grid operators should assess the domestic biogas landscape and map sites where clustering for biomethane upgrading is possible. In addition, they should be responsible for the planning and construction of the future raw biogas pipeline networks. It is cost-effective to aggregate the output of multiple neighbouring small-scale biogas digesters into larger centralised upgrading units. Promoting more centralised upgrading facilities lowers the number of grid connection points needed and leverages economies of scale. Clustering is particularly relevant in a rural context where many small farms producing relatively small volumes of agricultural wastes and residues means that anaerobic digestion units are often small-scale and spread across a large area, which typically often has a less developed gas grid infrastructure due to lower population density.[42] In an urban context or in an agricultural economy built on cooperatives, it can also make sense to transport feedstock to larger-scale integrated biogas production and upgrading sites.

Examples of best practice

Following the adoption of the French EGALIM Act, gas system operators (TSOs and DSOs) have assessed the optimum socio-economic solution to connect biomethane production plants to the gas grid. As a result, a **zoning approach** has been developed and delivered as a map with the most favourable areas to connect a biomethane plant to the French gas network. This map is available publicly and developers can rely on it to assess the feasibility of projects.

Following **gas infrastructure planning**, the network has been upgraded or is planned to better match the rising decentralised biomethane production. In this context, gas grid improvements are required to accommodate the injection of biomethane at various sites different from the top-down structure most national gas grids are built today. As a solution, certain member states have adopted reverse flow facilities to allow the bidirectional flow from the transmission to the distribution grid and vice versa. In 2021, 15 reverse flow facilities are operational today in Denmark, France, Germany, and the Netherlands, with 25 under construction in Denmark, France, and Belgium and 16 feasibility studies announced in France and Italy. It is important to consider that reverse flows facilities are not always necessary depending on the degree of interconnection in a country's gas grid, which can reduce the need for compression.[43]

In the Netherlands, Gasunie (TSO) and Cogas (DSO) have implemented a network for raw biogas transport from a pig farm to a centralised biomethane upgrading facility in the Twente region. 7.5 km of pipeline have been laid between 2016 and 2018.[44] This **clustering** infrastructure (pipeline + upgrading plant) needed an investment of €2.2 million and was funded via the Energiefonds Overijssel, a regional fund that supports sustainability projects with loans, financial partaking, and guarantees.[45]

41 Biomethane Action Plan, **Action 2**: Provide incentives for biogas upgrading into biomethane and, May 2022, Link
42 The pipelines that carry biogas to upgrading plants can be made of inexpensive PVC. At a cost of €200,000 per kilometre, with a small diameter at low pressure (below 8 bar). The cost of steel piping is about 2.5 times higher than PVC pipes. (Gas for Climate 2019)
43 Market state and trends in renewable and low-carbon gases in Europe, Gas for Climate, 2021, Link
44 Success Stories, EBA, 2018, Link
45 Energie Fonds Overijssel, Link

5. Regulatory and barriers assessment

Identify the main economic, technical and regulatory barriers that biomethane producers and consumers are currently facing.[46] It will feed into the next step (6) in which measures are implemented to alleviate the barriers. Examples of the most common barriers are listed below[47].

Examples of barrier

5.1 Absence of long-term regulatory and legal framework

A long-term stable regulatory framework, covering the overall value chain of biomethane (from production to end uses and by-products), is needed to give certainty, security and direction for investors in the market. To support the objectives of REPowerEU, a regulatory and legal framework should include support for the production and use of biomethane (rather than support aimed at producing electricity from biogas), the possibility to inject biomethane into the gas grid, support to project developers including financial support measures (subsidies, feed-in-tariffs etc), allowing the use of digestate as an organic fertiliser and the integration of this specific biomethane framework into the existing climate and renewable energy regulatory frameworks.

5.2 Lack of incentives for biogas upgrading and difficulties to inject biomethane

Some member states have existing regulations such as feed-in tariffs that incentivise the production and direct use of biogas. Regulations should encourage upgrading to biomethane and injection into the gas grid as to offer the highest overall energy system benefit[48]. The concept of "right to inject" guarantees access to the gas grid for the output of a biomethane plant and as such, a more secure revenue guarantee to the plant operator, increasing the bankability of the project. The lack of a regulatory framework granting the right to inject to all biomethane plant developers is considered as a major barrier for project developers. Without this in place, project developers are likely to prioritise investments in countries that have already introduced such a measure.

5.3 The length of the permitting process

Decreasing the length of the permitting process is crucial to encourage investors and ensure sufficient biomethane can be produced in time to meet the REPowerEU targets. Across Europe, the administrative work and permissions required to develop a biogas or biomethane production project can involve several different authorities, and the time required to receive the relevant permits can typically range from 2 to 7 years. As well as delaying production of biomethane, this increases project development expenditure and increases the risk of projects not reaching a final investment decision.

46 Biomethane Action Plan, **Action 1.2**: Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs), May 2022, Link

47 "D6.3 | Long-terms visions and roadmaps", REGATRACE, 2022, Link

48 Biomethane has several advantages over biogas: more uses and trade possible with biomethane through the use of the existing gas grid, less air quality issues (biogas emits more than 3 times more NOx than biomethane during combustion, and more carbon monoxide V. Paolini, 2018), biomethane has the exact same physical characteristics as natural gas, ...

5.4 Absence of national biomethane registry and guarantee of origin system

Member states may not yet have in place a system to record biogas and biomethane production within their territory (because current Renewable Energy Directive (RED) targets relate to renewable energy consumption). Such a system will be needed to track progress towards the REPowerEU target. Also more broadly, a robust system is needed to track biomethane injection into the grid and consumption from the gas grid. These objectives can be achieved by implementing a national biomethane registry. A biomethane registry, facilitated by a clear guarantee of origin system and in line with the European Commission's forthcoming Union database for renewable liquid and gaseous fuels, ensures that targets can be robustly accounted and that any volume of biomethane put into the grid can only be claimed once, regardless of which end-use sector it is used in. This also gives end users certainty on how much biomethane they can claim (even if what they withdraw from the grid is physically not biomethane) and enables the market to develop mechanisms to ensure robust claims of biomethane use and the associated greenhouse gas saving.[49]

5.5 Inconsistent application of European gas quality standard

Today, inconsistent application of existing European CEN standard for gas quality across borders (e.g., different accepted levels of oxygen content at interconnection points) hinders cross-border trade of biomethane between member states.[50] Harmonised and updated quality standards will enable physical trade of biomethane within the EU and even outside[51], with partner countries, which helps to build the scale of the market. The European Commission, through the Biomethane Action Plan and Hydrogen and Gas Markets Decarbonisation Package from December 2021, supports an update of the CEN gas quality standard to ensure the cross-border flow of biomethane. The standard must support a significant and cost-effective green transition of the gas system. In the meantime, member states should assess their existing gas quality standards and work with neighbouring countries in the short term to ensure that different gas quality standards are not creating a barrier to grid injection of biomethane.

5.6 Accessibility of waste and residue feedstock

Different feedstocks offer different challenges in terms of accessibility. Based on the feedstock potentials identified in step 2, it is important for member states to identify the barriers to access feedstock streams for biomethane production. For instance, waste feedstocks (e.g., municipal biowaste) might currently go for incineration or landfilling, either of which does not offer the best benefits to society. The switch to biomethane production may however not be easy if existing long-term waste collection and management contracts make it hard for biomethane project developers to access feedstock. Manure is often currently used directly as a fertiliser although its storage produces high amount of greenhouse gas emissions (including methane and nitrous oxide gases)[52].

49 This would also apply to "partial biomethane" such as biomethane produced from waste that is a mixture of waste fossil and biogenic material. The system needs to ensure that the biogenic part can be robustly accounted to ensure these techniques can be used.
50 Biomethane Action Plan, **Action 3.3**: Address gas quality standardisation issues, May 2022, Link
51 The Biomethane Action Plan incudes for example the extensive possibility of involving Ukraine in such biomethane cross-border trading systems.
52 The optimal role for gas in a net-zero emissions energy system, Gas for Climate, March 2019, Link - A less emitting way of valuing manure would be to produce biomethane and use the digestate as a fertilizer. When manure is treated in anaerobic digester to produce biogas, a credit of 45 gCO_{2eq} is allocated per MJ of manure treated.

5.7 Lack of support for sequential cropping

For sequential cropping, a lack of experience knowledge and therefore also a lack of incentives for the agricultural sector to cultivate sequential crops for biomethane will often represent a barrier to activate this type of raw material. The Gas for Climate biomethane potential study[53] estimates significant untapped potential from sequential cropping, especially in the 2050 timeframe. This feedstock needs farmers to see the potential benefits and to commit to growing sequential crops. When implemented in a sustainable way[54] with digestate being returned to the land as an organic fertiliser, sequential cropping can bring additional benefits for farmers such as reduced erosion as the land is not left fallow, as well as soil quality and biodiversity benefits.

5.8 Farmer awareness

To 2030 especially, the majority of biomethane production is expected to come via anaerobic digestion of agricultural wastes and residues and sequential cropping. A lack of awareness in the farming sector of their potential contribution to biomethane production (low knowledge of biomethane production process, low involvement in the biomethane supply chain, etc.), can be a limiting factor for biomethane development.[55] This relates both to feedstock availability and to the appetite from farmers to invest in on-farm anaerobic digestion plants.

Example of best practice

REGATRACE is a Horizon 2020 funded project working to improve the uptake and reduce **barriers** of biomethane development. With funding from the EU's Horizon 2020 Framework, a project developing biomethane roadmaps for participating countries (Belgium, Czech Republic, Estonia, Finland, Greece, Ireland, Italy, Latvia, Lithuania, Poland, Slovenia, Spain, Ukraine) was launched. Within the project, working groups collaborated to identify key regulatory, economic, and legislative barriers to biomethane development and actions to overcome them. A comparative analysis between nations was performed to determine common challenge areas and serve as a model for other countries.[56] Regarding, the absence of long-term regulatory and legal framework, the project observed that 4 countries out of the surveyed ones appear to have this issue. The lack of incentives for biogas upgrading and 'right to inject' has also been observed in 4 countries. The length of the permitting process is considered as a major barrier for 5 member states, and 5 European countries consider the absence of a national biomethane registry and guarantee of origin system as a major barrier. Inconsistent application of European gas quality standard is seen as a barrier in 5 of the surveyed countries.

53 Gas for Climate paper: Biomethane production potentials in the EU, Gas for Climate, July 2022, Link
54 For example, Consorzio Italiano Biogas (CIB), Biogasdoneright. Anaerobic digestion and soil carbon sequestration. A sustainable, low carbon and win-win BECCS solution (2017), Link
55 "D6.3 | Long-terms visions and roadmaps", REGATRACE, 2022, Link
56 "D6.3 | Long-terms visions and roadmaps", REGATRACE, 2022, Link

2
Enable

In this phase, member states define the supporting policies and build the market framework that will allow for an accelerated development of the biomethane market. This includes the definition of financial and regulatory measures and tools to encourage biomethane project development and the mechanisms to enable robust trade of biomethane as an energy commodity.

6
Supporting policy

7
Market development and trading

6. Supporting policy

Based on the barriers identified as being relevant in step 5, introduce policies and regulatory measures to address those barriers and enable a smooth and robust development of biomethane production and uptake.

Actions

6.1 Define and adopt financial support measures for biomethane

Introduce long-term support schemes to stimulate biomethane market development and guarantee long-term investment security. Consider starting with feed-in tariffs for projects developed in the initial years, eventually evolving into a contract for difference[57] type support scheme. By doing so, a stable support is offered to project developers while ensuring that projects are not over subsidised in the longer-term as the biomethane market matures. Other supporting measures could include other grants, loans, tax exemptions or loan guarantees. Financial support should be offered for biogas production, and also for biomethane upgrading that can be injected into the grid.[58] Also consider the option of introducing fiscal incentives to agricultural cooperatives. This would incentivise farmers to pool their financial resources and obtain the necessary funding to build larger biomethane production plants, thus promoting a centralised production model that can leverage economies of scale.

6.2 Introduce a 'right to inject' policy[59, 60]

Introduce a regulatory framework granting all biomethane plant operators the right to connect to the gas infrastructure and inject their production directly into the grid. This measure guarantees that biomethane produced can be injected into the grid thereby providing secure offtake for plant operators. It also mandates the local gas system operator to connect the biomethane plant in the most cost-efficient way (e.g., pipeline, trucks).

6.3 Define how to speed up the permitting process for new constructions as well as for the upgrading of existing plants[61]

Minimise the permitting process timeline. To achieve this, streamline the process into a 'one stop shop' where the project developer only needs to approach one administrative desk (including planning permission, grid access, environmental impact assessment etc.) and the process should be digitalised. The process should be coordinated locally while following the overall strategy from the national level. The introduction of a maximum reviewing period for the involved authorities could also help to avoid delayed procedures. Identification of renewable go-to areas (step 4) should also facilitate the permitting process. As biomethane projects are technical in nature, training should be provided for the staff involved in permitting. Lastly, the appeal procedure to oppose the development of new projects should have clearly defined deadlines or a maximum number of instances, to ensure project developers can have more clarity in the process.

57 A Contract for difference is a financial support measure similar to a feed-in tariff, but it guarantees the level of revenue whilst preventing over incentivising the renewable energy in case of high natural gas prices as we currently see. In that case the operator would need to give back if market prices are higher than their bidding price.
58 Biomethane Action Plan, **Action 5.1**: Provide access to grants and loans, May 2022, Link
59 Biomethane Action Plan, **Action 2**: Provide incentives for biogas upgrading into biomethane, May 2022, Link
60 Chapter IV, Section I: "Member States shall enable the access of renewable and low carbon gases to the market and infrastructure regardless whether the renewable and low carbon gases production facilities are connected to distribution or transmission networks.", *DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules for the internal markets in renewable and natural gases and in hydrogen*, EC, Dec. 2021, Link
61 Biomethane Action Plan, **Action 1.5**: Reduce red tape and speeding up permitting and **Action 2**: Provide incentives for biogas upgrading into biomethane, May 2022, Link

6.4 Define cost sharing process for integration to the gas grid

In collaboration with DSOs, TSOs, and the regulator, member states should define a clear and transparent cost sharing framework for the grid connection between project developers and gas grid operators.[62] The lifting of injection costs for biomethane producers is proposed as part of the hydrogen and gas markets decarbonisation package. A possible solution for the regulator is to acknowledge these additional costs in the regulated asset base of gas grid operators. As such, these costs could be directly reflected in the tariffs for end users and spread across the whole customer base. In addition, for transparency, the cost sharing process and criteria to be met for connection and injection should be published on the TSOs, DSOs and regulator's websites.

6.5 Ensure measures to stimulate feedstocks are coherent with broader energy, agricultural, waste and environmental policies[63]

Align relevant national policies to enable feedstock to be mobilised towards the newly set biomethane targets. This includes, for example, coherence with waste management policies, agricultural and land development policies. For example, waste policy should ensure organic waste can be diverted to biomethane production, the Common Agricultural Policy should support the use of manure and agricultural residues for biomethane and allow digestate to be returned to the land as fertiliser. In addition, member states' Common Agricultural Policy strategic plans should channel funding to biomethane produced from sustainable biomass sources, including agricultural wastes and residues. Member states should also set out a clear and sustainable approach for the use of crops for biomethane. This approach should include implementing any European guidance and appropriate definitions for the use of sequential cropping as part of sustainable farming practices. Providing this certainty to farmers and the energy market on a sustainable approach to crop use for biomethane will enable the sector to develop more rapidly and in a more harmonised way.

Examples of best practice

In the Netherlands, **financial support measures** include a feed-in-premium system that is linked to the biomethane's reported greenhouse gas emission reduction. The feed-in-premium varied from 30 €/MWh for sewage-based biomethane to 79 €/MWh for biomass gasification in 2020 for example. This system incentivises the use of sustainable feedstocks in addition to providing sufficient support to biomethane plant operators.[64]

After the introduction of the first feed-in tariff system in the early 2010's, which was considered to be relatively generous, the French government has recently modified its **financial support measures** depending on the size and type of plant with a premium for favourable feedstocks used such as manure.

62 Biomethane Action Plan, **Action 2.1**: Reduce the costs for economic operators, which currently prevent biogas upgrading into biomethane, May 2022, Link
63 Biomethane Action Plan, **Action 1.2**: Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs), May 2022, Link
64 Market state and trends in renewable and low-carbon gases in Europe, Gas for Climate, 2021, Link

Recently, Denmark has seen a shift in their **financial support scheme** for biomethane. At the end of 2020, the country ended new access to the existing support system due to the high popularity of the scheme, suggesting a risk of the scheme being too generous. The feed-in tariff for existing plants is calculated based on a fixed amount, supplemented by a premium that is dependent on the natural gas price observed the year before. This system works well as long as natural gas prices do not experience a long period of very low or very high prices. The low natural gas price in 2020 led to a high premium for 2021, which when combined with the high natural gas prices experienced in 2021 meant that the total tariff received by biomethane producers in 2021 was deemed to be too high. Hence, the natural gas price dependent premium in 2022 will be zero, and there will probably be a repayment of part of the support going forward. The support system has been re-designed for new plants and expansions of existing plants and from 2024, the Danish government plans to launch a new auction-based feed-in premium with seven auction rounds between 2024 and 2030 with a total budget of €1.8 billion (€87 million per year for 20 years). At each auction round, the biomethane production projects with the lowest bid requests will win.

Beginning in early 2022, the Austrian government passed the Renewables Expansion Act which affirmed **financial support measures** for converting biogas-CHP plants into biomethane production plants. Austria's vision for biomethane includes a direct incentive scheme for the injection of biomethane into the grid succeeding to a feed-in tariff system for electricity produced from biogas that has been implemented since 2012. In addition, Austria is looking to implement a Green-Gas-Quota for gas suppliers, which would require renewable gases such as biomethane to obtain a "Green-Gas-Seal" confirming the sustainability and Austrian production of the gas to qualify under the quota.

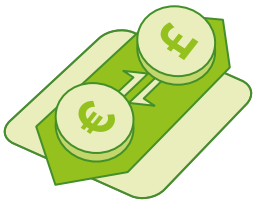
The European Commission's Biomethane action plan recommends reducing the **permitting** time for biogas plants and biomethane upgrading facilities. This can be done by through various actions. In Europe, Denmark has the shortest permitting period of between 18 and 24 months for biomethane projects.[65, 66] France has identified two main processes that could reduce permitting timeline. The first process is the application evaluation which could be improved by increasing the staff in charge of the analysis of the dossier but also by conducting trainings to improve their competences. The second process concerns the appeal for the projects and the reduction of the number of authorities to be involved.

The French EGALIM Act implements a **cost sharing** process to avoid that one biogas or biomethane operator takes on his expense all grid upgrade costs (typically the first biomethane operator to commission). Since this law enforcement, 457 biomethane production sites are currently injecting into the gas grid.[67]

Germany has set a cap on the connection costs for biomethane plant operators that allow a balanced **cost sharing** scheme. For biomethane plants located at less than 1 km from the gas grid, operators pay a maximum of 250,000 euros to connect. The remaining costs are covered by the system operator. This has the triple advantage of incentivising grid connection (and thus providing a secure offtake for the operator), encouraging plant operators to locate their assets closer to the grid and reducing plant operators' expenses.[68]

65 Biomethane Action Plan, May 2022, Link
66 Short, mid-, and long-term strategies to speed up biomethane deployment in Europe, EBA, 2022, Link
67 Chiffres cles, Act 4 Gaz, GRDF, Aug. 2022, Link
68 Interview with the German Biogas association, 07/12/2022

7. Market development and trading



Biomethane trade should be enabled as with any typical energy commodity. To ensure biomethane market liquidity, additional features need to be introduced in the gas market to ensure biomethane volumes and their associated greenhouse gas and sustainability benefits can be transparently and robustly claimed, thereby stimulating biomethane's competitiveness. A functioning biomethane market will rely on having a robust national biomethane registry that works in line with the European Commission's forthcoming Union database, combined with a guarantee of origin system, a robust cross-border trading system and a system which allows biomethane valuation under the European Emission Trading System (EU ETS).

Actions

7.1 Set up a robust system to monitor biomethane production

Set up a reporting system for plant operators to report their production and sales volumes. The collected data would include production and sale volumes, grid-injected volumes, auto-consumption volumes if relevant, and the sustainability and greenhouse gas emissions related to the produced biomethane according to the Renewable Energy Directive criteria. Such a system is essential to monitor progress and compliance with the REPowerEU biomethane production target.

7.2 Set up national biomethane registry with guarantees of origin (GOs)

Enable robust and transparent traceability and accounting of biomethane production and consumption via a national biomethane registry. The European Renewable Gas Registry (ERGaR)[69] is an initiative of biomethane registries from different member states which can offer best practice for how to set up a national biomethane registry. The European Commission is developing a Union database to ensure transparency and traceability of renewable fuels. Originally conceived to only be used to track fuels used in transport, an extension to cover broader renewable fuel use – including biomethane – is being developed. Member states should follow the progress of the Union database and ensure they set up a national biomethane registry in line with it and supported by a national system of gas GOs that become the main instrument to carry information about the renewable gas, including sustainability and greenhouse gas characteristics. The Union database and GOs (as a preferred way to trace sustainability information, enable trade and provide robust accounting mechanism) will have a critical role in the development of the biomethane market.

69 ERGaR, Link

7.3 Enable cross-border biomethane trade[70]

To build scale in the biomethane market, cooperate towards building a European biomethane trading market. To enable physical trading of biomethane between different country gas grids, engage in or start discussions on European CEN gas quality standard harmonisation and especially with their direct neighbours to seek to solve any immediately conflicting standards while the harmonisation process concludes at the European level (e.g. harmonising the maximum oxygen content in the gas grid to allow for the unhindered cross-border flow of biomethane). From a traceability, accounting and market liquidity perspective, member states should engage with the European Commission on the development of the Union database and encourage their national biomethane registries to engage with ERGaR which aims to facilitate cross-border trade of biomethane certificates between national registries.

7.4 Promote the use of Renewable Gas Purchase Agreements (GPA)

Similar to Power Purchase Agreements (PPAs) in the power market, enable and promote GPAs between producers and fuel suppliers. GPAs can provide revenue certainty to biomethane producers and ultimately result in lower government spending. Moreover, GPAs between producers and fuel suppliers will facilitate the certification of the renewable origin of the gas consumed.

Examples of best practice

Many member states currently operate pilot or fully implemented **national biomethane registries** including Ireland, Italy, Portugal, France, Switzerland, Germany, Austria, Czech Republic, Slovakia, Poland, Denmark, Estonia, Latvia, and Lithuania. In addition, there are initiatives aiming to expand the implementation and functionality of these registries. One such example is the ERGaR, which is establishing a documentation and **certificate of origin scheme** to facilitate cross-border trade of biomethane and other renewable gases. To obtain a national biomethane certificate, from production to gas grid injection, the gas within the exporting country must undergo certification to ensure it complies with the established RED sustainability and greenhouse gas saving requirements. From the point of injection to withdrawal in the importing country, the so-called "ERGaR RED Mass Balance scheme" applies a mass balancing methodology. This requires documentation about the input and output biomethane volumes, to ensure that the gas consignments entering the grid are legitimately transferred to end users and robustly accounted towards (one country's) renewable energy consumption targets. The mass balancing system allows for biomethane injected into the gas grid to be withdrawn flexibly in another location, as long as the input and output registries are included in the scheme and the gas grid is interconnected. The ERGaR RED Mass Balance scheme and Transfer Hub serve as a database for recording transactions and administering proof-of-origin certificates upon compliance.[71]

70 Biomethane Action Plan, **Action 1.6**: Promote sustainable biogas and biomethane co-operation with neighbouring and enlargement countries and: Address gas quality standardisation issues and **Action 3.3**: Address gas quality standardisation issues, May 2022, Link

71 "ERGAR RED MB SCHEME", ERGAR, Link

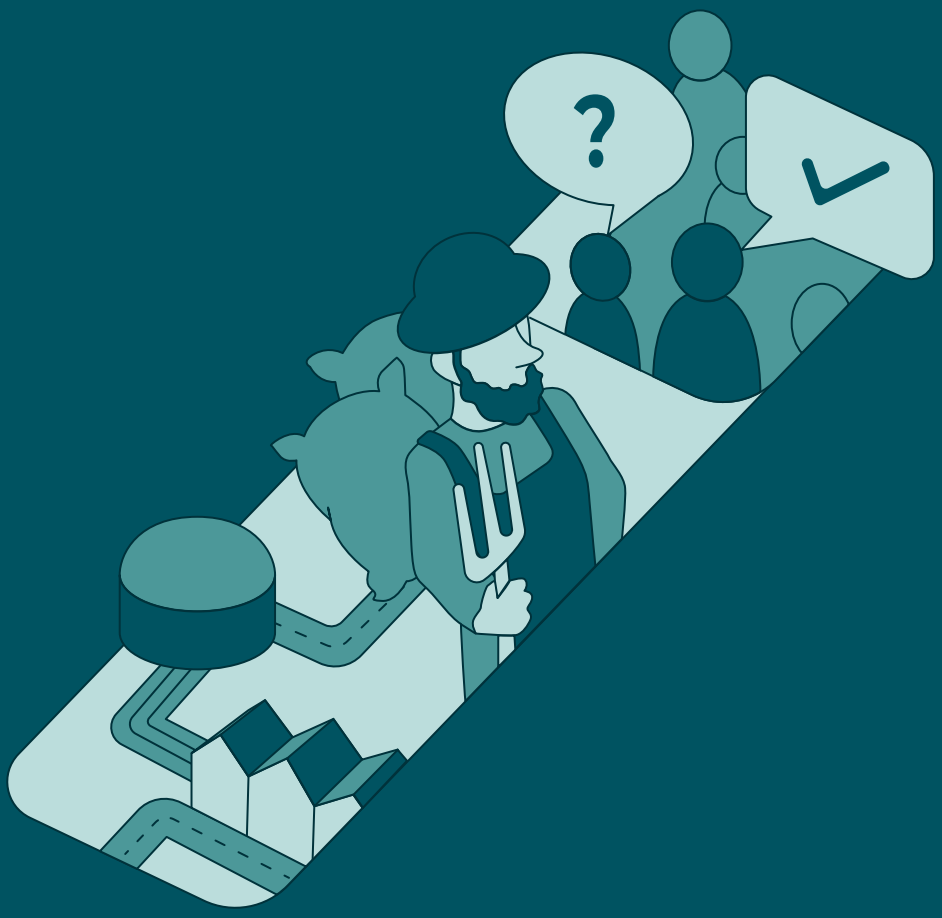
3
Mobilise

This phase can begin as soon as possible as it is vital to engage all stakeholders to build a thriving market. This includes information and engagement to ensure public acceptance, facilitate access to sustainable feedstock and ensure an operational supply chain able to follow the targeted pace of development.

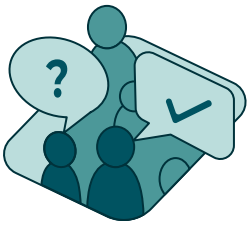
8
Public acceptance

9
Sustainable feedstock and capacity building

10
Supply chain



8. Public acceptance



Engage stakeholders throughout the process of developing and implementing the national biomethane strategy to secure acceptance for the development of the biomethane market. Involve a wide range of stakeholders from an early stage, throughout the 10 steps, including civil society, non-governmental organisations, agricultural cooperatives, labour unions, industrial associations, among others. Organise communication campaigns, public presentations, and discussions to build understanding and support from the public towards biomethane and minimise local opposition to project development.

Actions

8.1 Involve professional associations and unions when developing new biomethane policies

Engage and consult with relevant stakeholders (e.g., agricultural cooperatives, industry associations) to foster a constructive dialogue on biomethane market development. The uptake of biomethane at the national level is likely to impact some industries and sectors: if organic waste is, for example, used to produce biomethane, then employment in the waste incineration sector would decrease. In this context, a smooth dialogue with labour unions from early stage is important.

8.2 Engage local communities around the biomethane industry[72]

Inform properly local authorities on which benefits biomethane production can bring to their region and help them understand the planning and permitting procedures. In addition, involve the local communities at an early stage of the development of biogas and biomethane projects and inform them on the benefits and drawbacks such projects could have. Civil society is often reluctant to the installation of biogas and biomethane plants due to the fear of a heavy traffic (for feedstock supply), a bad management of fertiliser (risk of food and feed contamination) or potential public health risks due to air and soil pollution. Conducting information campaigns and developing a framework to receive public concerns, in cooperation with the local authorities, are key to mitigate the opposition of the public. Member States can receive more information via the Rural Energy Community Advisory Hub.[73]

8.3 Mitigate negative impacts of biomethane

Reduce negative impacts (e.g., smell and methane leakage) by defining a set of guidelines for quality excellence of the biogas and biomethane production industry and ensure a better development of the industry by giving more confidence to investors and steering public acceptance up.

72 Biomethane Action Plan, **Action 1.4**: Promote participatory multi-stakeholder engagement, May 2022, Link
73 Launch of the Rural Energy Community Advisory Hub, European Commission, June 2022, Link

Examples of best practice

Nature Energy, a Danish biomethane project developer, has a structured approach to address **public acceptance**. In early phases of the project, the company engages with local community leaders to present the project and the associated benefits. Nature Energy organises visits to existing facilities to show the functioning of a biogas plant and the limited negative externalities (smell, noise, etc.). During the meetings with local communities, the plant operator focuses on logistics highlighting the limited traffic with transports conducted during specific hours of the day far from schools or other facilities visited by children.[74]

To second the practice described above, biomethane is being recognised by EU member states and associations such as the EBA as a key tool in reducing energy and heating bills by decreasing energy dependence. Demonstrating to customers the savings potential between falling costs of biomethane and increasing energy import costs is a key strategy to improving **public acceptance** and demand. The provision of cheap heat though the combustion of biogas has been proven to be the first lever of public acceptance in Denmark.[75]

The EU-funded ISAAC project (Increasing Social Awareness and Acceptance of biogas and biomethane) conducted between 2015 and 2018 in Italy was implemented to lift **the social acceptance** barrier to biomethane and biogas production. It addressed the issue by creating a participatory framework where citizens' and stakeholders' suspicions and doubts are overcome through information campaigns, trainings, discussions and the possibility to make suggestion to improve the biogas and biomethane production projects. In parallel, the project also focused on facilitating the collaboration between farmers, foresters, among others to better optimize the scale and efficiency of plants operations.[76, 77]

The Consortio Italiano Biogas initiative of **Future of Farming** happening in Italy regularly includes visits in the agricultural areas during which the CIB organises meeting with citizens around the topic of biomethane.[78, 79]

Bus2025 is a project managed by RATP (public transport company in Ile-de-France, France) and financed by Ile-de-France Mobilités and the European Commission. It aims to switch the whole bus fleet in Paris to biomethane or electric buses by 2025. To engage and **inform stakeholders**, GRDF (French gas DSO) invited Ile-de-France Mobilités, Bus2025 and RATP, to visit a large biomethane production site in Seine-et-Marne to showcase how biomethane is produced and understand the extensive benefit of biomethane.[80]

74 Interview with Nature Energy, 06/27/2022
75 Interview with the Danish Biogas Association, 08/03/2022
76 ISAAC project, Link
77 Biogas and Biomethane in Europe Lessons from Denmark, Germany and Italy, IFRI, 2019, Link
78 Interview with the EBA, 07/13/2022
79 Farming Tour, Consortio Italiano Biogas, Link
80 « Visite d'un site d'injection de biométhane avec Île-de-France Mobilités et la RATP Bus2025 », GRDF, Aug. 2022, Link

9. Sustainable feedstock and capacity building

Mobilise sustainable feedstock supplies to reach biomethane production potentials estimated for 2030 and beyond. Facilitate access to sustainable feedstock for biomethane producers by coordinating and incentivising initiatives to increase awareness across key potential feedstock supply sectors. Prioritise mobilisation of the available volumes of waste and residue feedstocks including manure, agricultural residues, food waste, and industrial wastewater in the short-term. These feedstocks are the cheapest and offer the highest greenhouse gas emission savings. Incentivise sequential cropping.

Actions

9.1 Raise awareness and launch training and information sessions for agricultural stakeholders to unlock agricultural waste and residue production potential[81]

Prepare and launch information campaigns on biomethane for the agricultural communities to highlight the economic, environmental and energy security benefits which biomethane can bring to farmers and society in general. This should aim to encourage farmers to divert their existing agricultural wastes and residues to anaerobic digestion, thus unlocking the untapped feedstock potential. Introduce biomethane production in the programs to train future agricultural workers at relevant vocational training centres.

9.2 Research into a sustainable approach for sequential cropping to enable new sources of feedstock to be cultivated

In accordance with the Biomethane Action Plan[82]; unlock fundings for agricultural research to provide guidelines on sustainable approaches to sequential cropping for different regions. This will enable clarity for farmers to set up new cultivation practices to leverage more feedstock potential.

9.3 Leverage industrial sources of waste organic feedstock, including biowaste and wastewater

Run information campaigns via the ministry for industry together with industry associations and local authorities, targeted at industrial players in sectors with high shares of biowaste[83] or wastewater. This will create understanding of how industrial waste can be best valorised for biomethane production. Information dissemination regarding the available support for biomethane, its benefits and examples of best practice can create interest from this sector to develop projects. This step can also encourage coordination and collaboration between industrial players or match industrial sources of feedstock with potential biomethane project developers to unlock additional untapped feedstock potential.

81 Biomethane Action Plan, **Action 1.4**: Promote participatory multi-stakeholder engagement, May 2022, Link
82 Biomethane Action Plan, **Action 4**: Address RND&I gaps, May 2022, Link
83 Gas for Climate paper: Biomethane production potentials in the EU, Gas for Climate, July 2022, Link considered biowaste potential from 21 diverse industries producing wastewater, ranging from beer and wine production to veg oil processing

9.4
Leverage waste-based feedstock

Unlock additional feedstock with the Revised Waste Framework Directive which requires a separate biowaste collection or recycling at the source by 31 December 2023 (Directive 2018/851/EU,§10). All municipalities must plan and implement separate biowaste collection schemes. Municipalities should anticipate where new sources of organic waste will become available and approach potential biomethane project developers to ensure new biomethane projects are developed.

Examples of best practice

Italy set up the **"BiogasDoneRight"** model encouraging the use of sequential crops, crop rotation, minimum tillage, and integration of crop residues with livestock effluents sub-products and organic waste instead of primary energy crops in order to limit the competition between food and energy for land occupation. To date, over 1 bcm of biomethane is produced via sequential cropping in Italy.[84] The CIB teams organises visits in different Italian agricultural areas to meet, discuss, and train local farming communities and engage citizens around biogas production. The main activities include demonstration of machinery targeted at more sustainable farming solutions, as well as discussions around feedstock sustainability and biomethane market opportunities. The initiative's objective is to steer agricultural communities' interests and knowledge and raise awareness among citizens.[85,86]

The city of Milan conducts **awareness campaigns to its inhabitants** to enable the collection of high-purity organic municipal waste for biogas production. They achieved an 85% waste recycling rate with only 4.5% contamination level.[87] Also, the Food Policy di Milano project was awarded the Earthshot prize in 2021 for developing a scalable and adoptable model for food waste reduction. As such, Milan has demonstrated that an integrated approach to food waste redistribution and waste-energy production can be achieved.[88]

French government agency ADEME is funding the 'RECITAL' research project, led by Arvalis Institut du Végétal. The objective is to provide **guidelines on sequential cropping** for farmers in France in order to optimize its application in the different regions and with different crop rotations. The project started in 2020 and will continue until 2023. Alongside Arvalis, the Association of Biogas Farmers of France (AAMF) and the Chambers of Agriculture and other French economic operators are involved in the project.

In Ireland, a private initiative Project Clover[89], launched by dairy product manufacturers aims to promote biomethane production in partner with breeding farms to implement a fully **integrated biomethane supply chain**. Anaerobic digestion units produce biogas upgraded to biomethane from animal manure which is then directly used as a fuel in the dairy product manufacturing processes. These local and circular economy projects can help scaling up the biomethane industry while accelerating the industrial and agricultural decarbonisation. Member States can initiate these kinds of partnerships, involving their local governments too.

84 "BiogasDoneRight", EBA, Link
85 Interview with the EBA, 07/13/2022
86 Farming Tour, Consortio Italiano Biogas, Link
87 Residential food waste collection in a densely populated European city: the case study of Milan", EBA, Link
88 The city of Milan food waste hubs, The Earthshot Prize, Link
89 "PROJECT CLOVER", Renewable Gas Forum Ireland, Link

Lithuania plans on **incentivising non-hazardous waste for biogas production** by increasing fees to landfill these waste up to 50 - 70 €/ton in their 2022-2025 roadmap and to extend them further in their 2026-2030 roadmap. The ultimate goal is to reduce the share of waste disposed in landfills to 5%.[90]

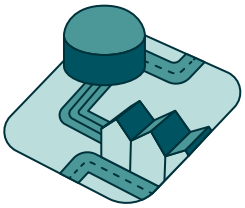
The USDA administers the **Biomass Crop Assistance Program (BCAP)** providing financial assistance to owners and operators of agricultural and non-industrial private forest land who establish, produce, and deliver biomass feedstocks. Algae is now included as an eligible feedstock under the program. BCAP provides two categories of assistance: payments for establishment and production of biomass feedstocks and payments for collection, harvest, storage, and transportation of biomass feedstocks to qualified conversion facilities. Annual appropriations of up to $25 million (~25.1 M€) are authorized for fiscal years 2019-2023 under the following plans:

- Establishment payments: For growing new biomass crops, BCAP can cover up to 50% of the cost of establishing a new, perennial energy crop or biomass crop.
- Maintenance payments (annual payments): To maintain the new biomass crop as it matures until harvest, BCAP can provide up to 5 years of assistance for an herbaceous crop, or up to 15 years for a woody crop.

Retrieval payments (matching payments): To collect existing biomass residues that are not economically retrievable, BCAP can help with the cost of sustainably harvesting and transporting agricultural or forest residues to an energy facility (biomass conversion facility).[91]

90 "D6.3 | Long-terms visions and roadmaps", REGATRACE, 2022, Link
91 "Biomass Crop Assistance Program for Fiscal Year 2017", USDA, 2016, Link

10. Supply chain



Rapidly scale up biomethane project development by developing a reliable supply chain (equipment, installation, project development). The supply chain needs to be able to foster the development of a skilled and qualified workforce that can support high quality installation, operation and maintenance of anaerobic digestion plants and biomethane upgrading sites.

Actions

10.1 Stimulate a reliable and competitive equipment supply chain

Assess the current equipment supply chain's hurdles in the member state's context in collaboration with industrial associations. Stimulate the development of a competitive, high quality, and reliable pool of equipment suppliers that can support the rapid development of the market. Inform equipment manufacturers on the expected scale of biomethane industry so they can prepare their supply chains to prevent shortages and mitigate long equipment delivery and lead times. In the context of the European Industrial Strategy, member states should push their participation in the development of a European centre of excellence in the delivery of biomethane production units.

10.2 Provide training to ensure quality in the development, installation, operation and maintenance of biomethane plants

Develop and coordinate training programs to create a skilled workforce and allow current and future workers to improve competencies in installing, operating and maintaining biomethane plants. A quality label for construction companies can be set up and public funding for biomethane projects should be linked to quality criteria. This will benefit the industry by decreasing the number of accidents, mitigating the risks and negative impacts and will favour social acceptance and investors' confidence. In addition, this will contribute to qualified job creation across the whole national territory. Member States should coordinate their training programs and have a common ground for the required skills for biomethane constructors and operators.

10.3 Define a legal framework for digestate valuation

Allow digestate from anaerobic digestion plants to be sold as a fertiliser. Nowadays, digestate is not legally considered in various member states as a fertiliser that can be used by other parties. Defining a legal framework for its use will allow for additional revenues for farmers and favour circular economy development.

10.4
Provide guidance how to integrate biogenic CO_2 sales in the business case

The upgrading step from biogas to biomethane produces biogenic CO_2, which can be a valuable by-product. Having a clear approach for how to valorise the CO_2 can be an important part of the business case for plant operators. The CO_2 could be valorised by producing renewable methane or for other uses such as the production of biogenic hydrocarbons that can be further valued for decarbonisation purpose in the transport sector or industry.

10.5
Consider outlining research and development priorities to unlock additional production capacities and drive costs down

In accordance with the Biomethane Action Plan Action[92], select and launch R&D programmes. This could include the exploration of new biogas production and biomethane upgrading routes, feedstock pre-treatment, technology efficiency improvements or process modification. Research and development could also be targeted at feedstock pre-treatment technologies that allow a broader range of feedstocks to be used in anaerobic digestion and gasification.

Examples of best practice

The Qualimetha certification in France was developed by ATEE Club Biogaz and now endorsed by the public administration and acknowledged by Afnor (the French standard organisation). Its goal is to ensure the **quality of biogas and biomethane installations** and to address the need for professionalisation of the sector, raised during a consultation led by the Energy Transition Ministry in 2018. It allows the actors engaged in the installation of qualitative production sites to value their quality process and share their good practices. The good practices and criteria are available on ATEE's website and are revised every 3 years to adapt to new practices and innovation.[93, 94]

Sweden has been incentivising the **use of digestate** as a biogenic fertiliser since 1999, allowing for additional revenue stream for the biogas plant operators. To achieve this, Swedish government launched a fertiliser quality assurance program ("Certifierad återvinning", i.e. "Certified recycling") and has engaged the fertiliser consumers to build trust around the use of organic fertilisers. 99% of digestate's volume is now used as an organic fertiliser for agricultural lands.[95] According to the Italian NRRP approved by the European Commission in August 2022[96], farmers should be allowed in the near future to **use digestate as a fertiliser** as it will be recognised as equally qualitative as a chemical fertiliser.[97]

92 Biomethane Action Plan, **Action 4**: Address RND&I gaps, May 2022, Link
93 Qualimetha, ATEE Club Biogaz, Link, Interview with France Biomethane, 07/27/2022
94 Label Qualimetha, Afnor, Link
95 "Open market for digestate from anaerobic digestion, Uppsala, Sweden", EBA, Link
96 Article 21, Decreto Legge 21, 2022, Link
97 Biogas Informa n38, Consorzio Italiano Biogas, Link

Several projects that are being developed across member states aim to **utilise captured CO_2** from biogas upgrading plants:

– In Denmark, biomethane producer Nature Energy is capturing 16.25 kt CO_2/year at its Korskro plant. The captured CO_2 is equal to 25% of the annual demand for CO_2 in Denmark and is primarily used in the food and beverage industry.[98]

– In the United Kingdom, Future Biogas is cooperating with Pentair to install 25 CCS units to capture 200 kt CO_2/year from 2024. This CO_2 will be supplied to the Northern Lights Project, a project that is planning to store CO_2 permanently under the North Sea.[99, 100]

– In Italy, Biogas Wipptal is capturing the biogenic CO_2 in its biomethane plant in Vipiteno. Here, the CO_2 is used in the beverage industry and dry ice is produced.[101] Revis Bioenergy is planning a biomethane facility in Cloppenburg, Germany where 87 kt CO_2/year are captured and liquified. This facility is planned to be operational by 2023.[102]

98 IEA Bioenergy (2020): Production of food grade sustainable CO_2 from a large biogas facility, Link
99 Pentair and Future Biogas join forces to help reduce the UK's CO_2 footprint, 2021, Link
100 "Future Biogas to build 25 new plants with CCS", Bioenergy Insight, June 2021, Link
101 Biogas Wipptal, Link
102 Revis Bioenergy, 2021, Link

Disclaimer

This deliverable was prepared by Guidehouse Netherlands B.V. for Gas for Climate. The work presented in this deliverable represents Guidehouse's professional judgement based on the information available at the time this report was prepared. Guidehouse is not responsible for a third party's use of, or reliance upon, the deliverable, nor any decisions based on the report. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

GAS FOR CLIMATE
A path to 2050

Guidehouse