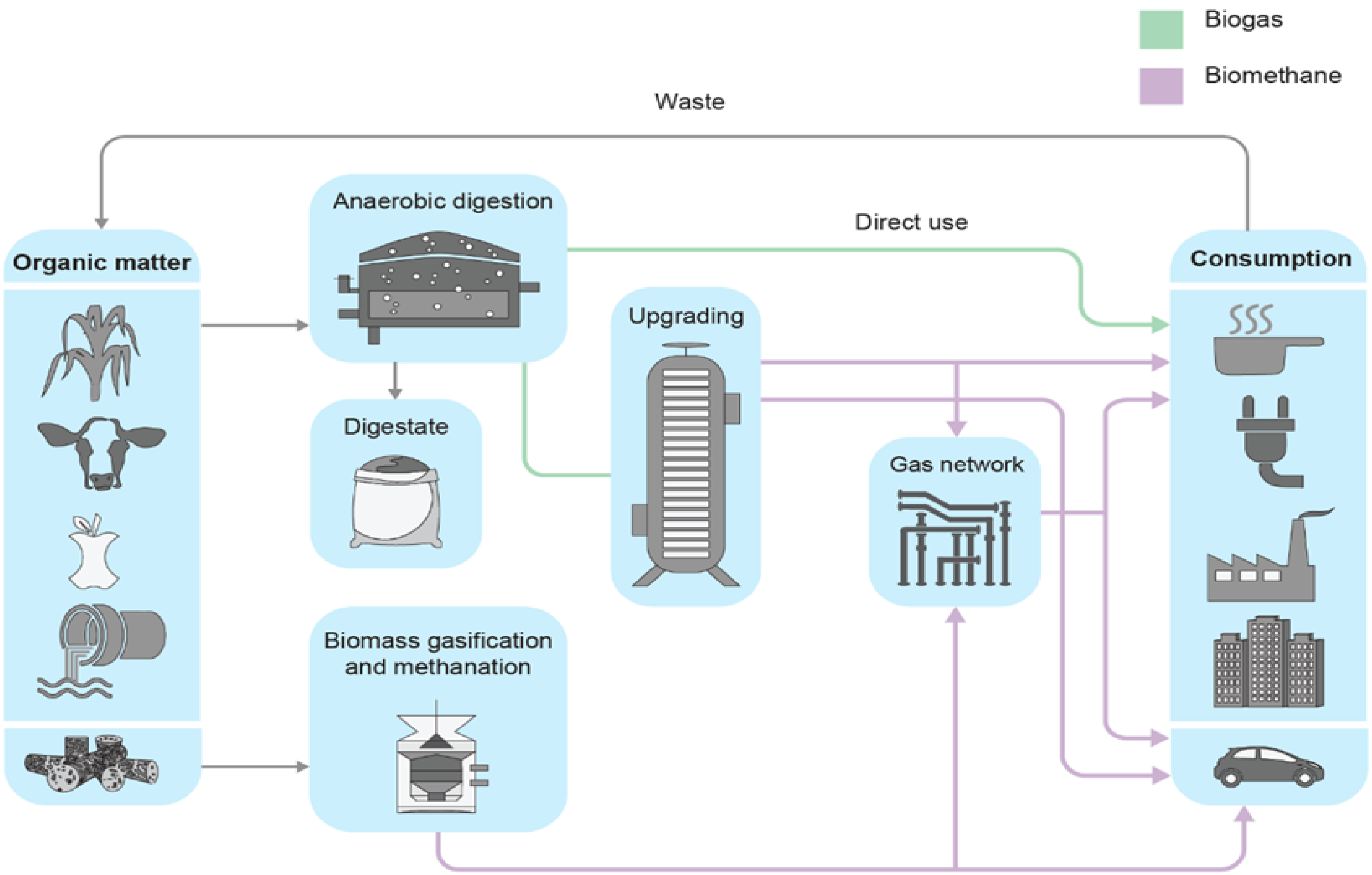
Scaling up biomethane in the European Union: Background paper

This Biomethane background paper, part of the IEA support to reduce EU dependence on Russian fossil fuels – Output 2 'Support for biomethane production'/Activity 2.1 'Workshop on support schemes for biomethane' –, has been produced with the financial assistance of the European Union. It reflects the views of the International Energy Agency (IEA) Secretariat but does not necessarily reflect those of individual IEA member countries or the European Union. The IEA makes no representation or warranty, express or implied, in respect to the Workshop on support schemes for biomethane's contents (including its completeness or accuracy) and shall not be responsible for any use of, or reliance on, it.

Biogas and biomethane producers take organic residues and wastes and turn them into a valuable modern source of clean energy

Biogas and biomethane production pathways



What are biogas and biomethane and why are they important?

Biogas is a mixture of methane, CO_2 and small quantities of other gases produced by anaerobic digestion of organic matter in an oxygen-free environment. The precise composition of biogas depends on the type of feedstock and the production pathway.

Biomethane (also known as “renewable natural gas”) is a near-pure source of methane produced either by “upgrading” biogas (a process that removes any CO_2 and other contaminants present in the biogas) or through the gasification of solid biomass followed by methanation. Solid biomass can undergo gasification at high-temperatures whereby it is thermally decomposed into a gaseous product (syngas) and a solid product (biochar). Biomethane is largely indistinguishable from natural gas and so can be injected into gas grids, or compressed or liquefied for use as a transport fuel in natural gas vehicles.

A wide variety of feedstocks can be used to produce biogas including:

• **Crop residues:** Residues from the harvest of wheat, maize, rice, other coarse grains, sugar beet, sugar cane, soybean and other oilseeds. on log felling residues (or forest slash), i.e. small branches or tree stump, and wood processing residues, such as sawmill residue or pulp waste.

• **Animal manure**: From livestock including cattle, pigs, poultry and sheep.

• Organic fraction of **municipal solid waste** (MSW): Food and green waste (e.g. leaves and grass), paper and cardboard and wood that is not otherwise utilised (e.g. for composting or recycling). MSW also includes some industrial waste from the food-processing industry.

• **Wastewater sludge**: Semi-solid organic matter recovered in the form of sewage gas from municipal wastewater treatment plants.

Biogas from the above sources can in turn be upgraded into biomethane. Additionally, **forestry** and **wood processing residues** offer a direct pathway to biomethane production via gasification.

Specific **energy crops**, i.e. 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. However, they have also generated a vigorous debate about potential land-use impacts and competition with food production.

The main characteristics of feedstocks that determine how suitable they are for biogas or biomethane production are the biochemical methane potential of the volatile solids, the water content, and the nutrient content of the solids to help support efficient digestion. Biogas energy content is directly related to the amount of carbon in the feedstock while nutrients, such as nitrogen and phosphorous, can improve feedstock digestability. Feedstocks with lower moisture content have been shown to lead to lower conversion to biomethane.

Biogas can be used to generate power and heat or used for clean cooking. Almost 75% of global biogas production in 2021 was used to generate electricity and heat (approximately 70% of which are co-generation plants, or CHP). Around 10% 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 a transport fuel.

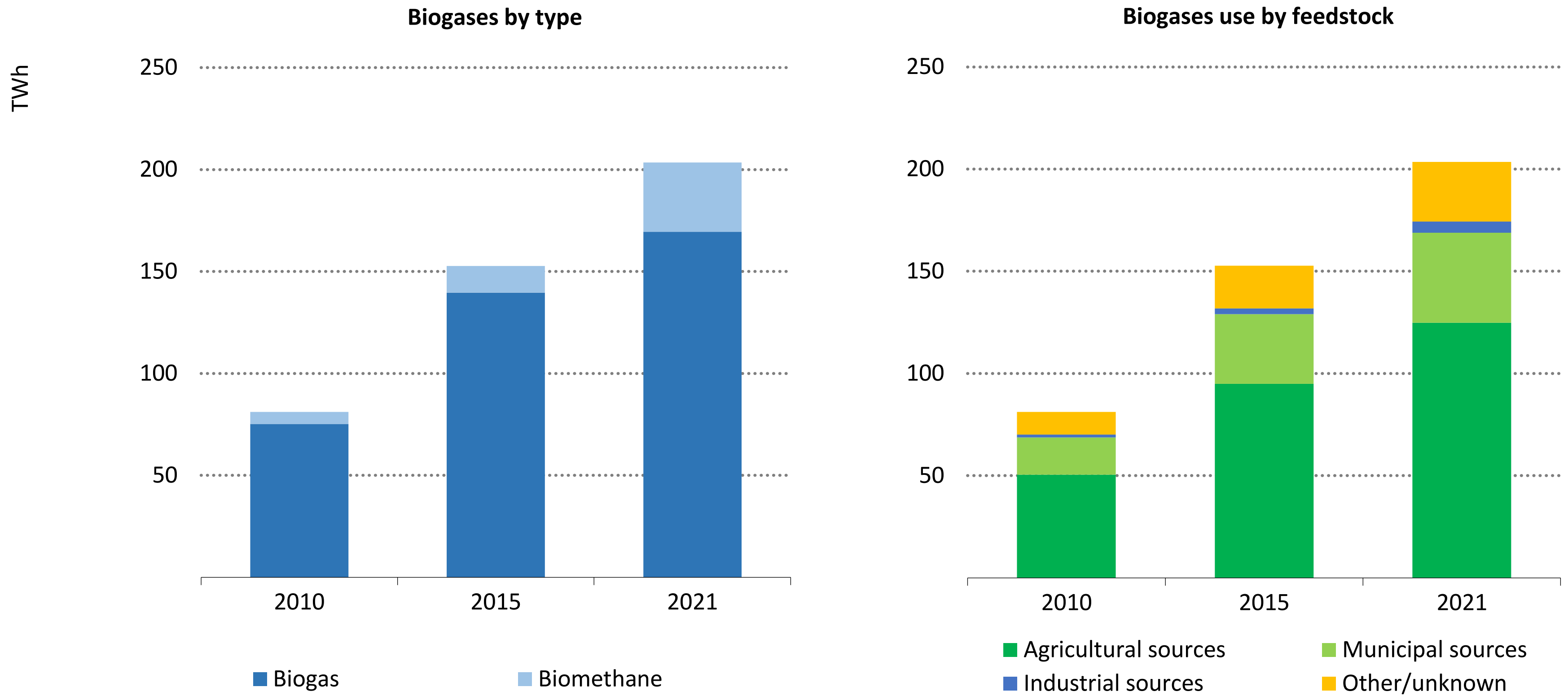
If produced sustainably, biogas and biomethane embody the idea of a more circular economy, bringing benefits from reduced emissions, improved waste management and greater resource efficiency. Biogas and biomethane also provide a way to give rural communities and industries a stake in the transformation of the energy sector.

Biomethane, since it is indistinguishable from the regular natural gas stream, can be transported and used wherever gas is consumed, but without adding to emissions. It can make use of existing gas infrastructure thereby improving the cost-effectiveness and security of energy transitions, and can be used as a low-carbon fuel in sectors such as heavy industry and freight transport where emissions are hard to abate using electricity. For example, several cities in the EU including Berlin, Paris and Amsterdam have transferred a portion of their bus fleet to biomethane.

Full utilisation of the sustainable potential of biomethane could, in the IEA’s view, cover some 35% of the EU’s current natural gas demand in buildings, transport and industry, and therefore make an important contribution to meeting both climate and energy security goals, including a reduction in reliance on Russian gas.

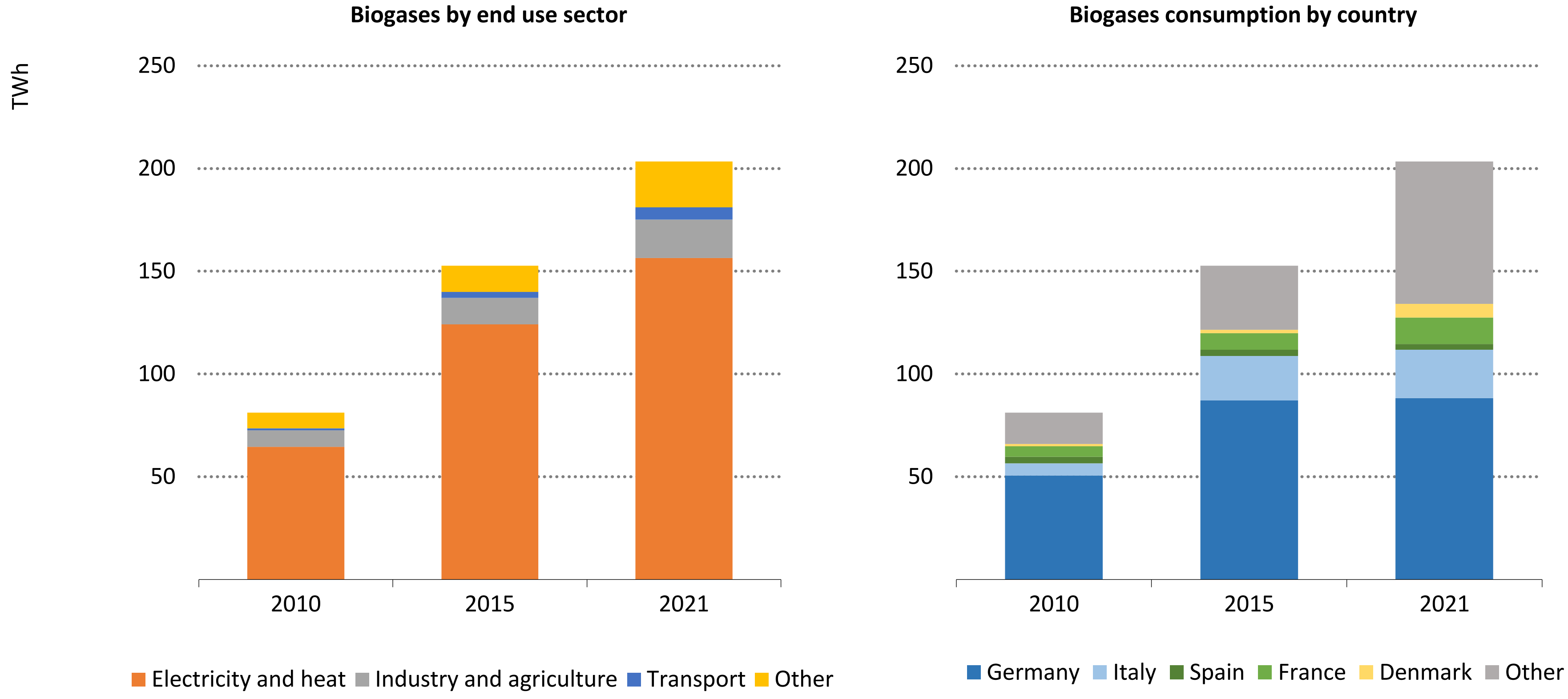
Biomethane is driving growth in total biogases in the European Union, with most of the production today coming from agricultural sources (mainly energy crops)

Key indicators of biogases production in the European Union (1/2)



Most biogases are currently used in EU to produce electricity and heat, although future growth is often earmarked for the transport sector; Germany is the largest EU producer and consumer

Key indicators of biogases production in the European Union (2/2)



The EU’s biogas and biomethane industry is growing, and has been given a large boost by the RePowerEU plan

Europe is the largest producer of biogases today, at around 170 TWh of biogas, and around 35 TWh of biomethane. Most of the biogas production is in Germany, which has around 9 000 individual biogas installations. Energy crops were the primary choice of feedstock that underpinned the growth of Germany’s biogas industry, but policy has recently shifted more towards the use of crop residues, sequential crops, livestock waste and the capture of methane from landfill sites. Other countries such as Denmark, France, Italy and the Netherlands have actively promoted biogas production.

About 75% of the biogas produced in the EU today is used as a source of local electricity generation and heat and almost 20% of biogas is converted to biomethane. The REPowerEU plan aims to achieve a target of at least 35 bcm (350 TWh) annual biomethane production by 2030. To achieve this, much more biogas must be produced and more, in turn, converted to biomethane.

REPowerEU proposes several near-term actions aimed to support and grow the development of a biogas and biomethane EU market. An industy partnership has been proposed that would serve as a platform for public-private engagement and the sharing of best practices around permitting, financing, incentives and environmental regulations. The EU plan encourages national biomethane strategies to evaluate potential and identify barriers to production as well as enabling conditions at the local and national levels. It also suggests an integration of biomethane into an EU-wide strategy for rural development and local job creation, including the use of energy communities and farmers cooperatives. There are many EU policies already in place (see next page) that support biogas and biomethane.

The growth in biomethane production envisioned in the RePowerEU plan would imply a 40% CAGR from 2023-30 compared to 17% between 2015-2021. Factors that could accelerate growth include streamlined permitting procedures, factory-style fabrication of standardised biodigesters and related equipment, dedicated biogas financing facilities, and robust support schemes such as quotas, feed-in tariffs, contracts for difference (discussed below).

Early work by national authorites, transmission, and distribution system operators is needed to assess the challenges and solutions for timely and cost-efficient injection of biomethane in pipelines, and to consider the potential for standardisation – in equipment value chains and gas quality considerations.

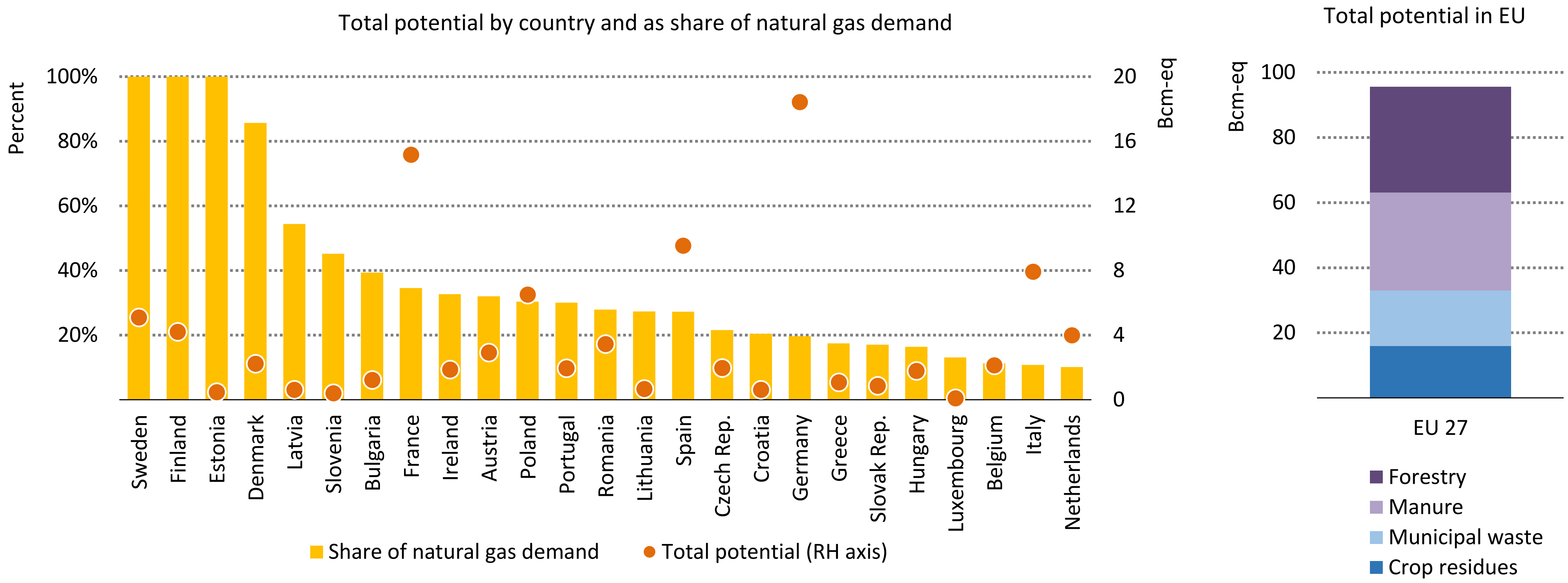
Integrated business models that protect developers from downside volatility, such as using fixed feed-in tariffs or other forms of subsidy, typically yield a lower risk for securing finance. REPowerEU points to examples such as the lifting of injection costs. Farming co-operatives or other models that aggregate feedstock sources are also viable routes to scale up production. Additionally, both biogas and biomethane projects might also benefit from the growing accessibility of financial instruments focused on renewable projects, such as sustainability-linked bonds or targeted institutional investor funds.

Accelerating deployment also depends on good data, including local and national assessments of the availability of sustainable biogas and biomethane feedstocks, biogas and biomethane consumption and biogas and biomethane supply.

Key EU policies in support of biogas and biomethane
The EU emission trading system covers near 45% of the EU's greenhouse gas emissions, including from natural gas. Permits have ranged from 17 EUR/tonne in 2019 and stand near 85 Euro/tonne in June 2022. An 85 EUR/tonne price is equivalent to 4.5 Euro/MBtu of natural gas.
The Renewable Energy Directive II covers biomethane as a transport fuel (which the RePowerEU plan recommends expanding to cover all uses). RED II provides guidance on GHG requirements for biogas and biomethane projects. Other policy tools include feed-in-tariffs, quotas, contracts for difference, fuel standards, tradeable certificates of origin and GHG intensity requirements.
Directive 2009/73/EC, recommends that biogas producers be granted non-discriminatory access to the gas grid when meeting technical and safety standards in member states.
Several policies across the EU provided co-ordinated support for biogas and biomethane including the EU ETS, the renewable energy directive, the inclusion of biogas in the EU taxonomy, rural development funds, common rules for natural gas markets and fertilizer rules for the application of digestate. Never the less, biogas and biomethane supply and demand is primarily driven at the member country level, since the EU rules and regulations don't specifically require biogas and biomethane. The level and type of co-ordination varies by member state.

EU member states have significant potential to meet their gas needs with biomethane

Biomethane potential by country in the European Union, and as a share of total natural gas demand in 2021



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There are sufficient sustainable feedstocks to support 95 bcm of biomethane output today in the EU, and this potential rises to 130 bcm by 2050

In 2020, the IEA conducted a bottom-up assessment of the availability of sustainable feedstocks for biogas and biomethane. The global potential of biomethane was assessed at around 850 bcm-equivalent, or around 20% of total global natural gas demand. The total potential in the EU is around 95 bcm, or just over 10% of the global total.

Every country in the EU has scope to produce biogas and/or biomethane, and the availability of sustainable feedstocks for these purposes is set to grow 35% over the period to 2050, to reach around 130 bcm.

In support of the RePowerEU, we have produced country-level estimates of the feedstock potential within the European Union, using Eurostat, FAO and World Bank data. The largest potential lies in Germany, France, Spain and Italy, owing to their size, population and realtively large gross agricultural output. Comparing potential to the size of the gas market, the Nordic and Baltic States have significant quantities of available feedstock that can be converted to biomethane, in some cases exceeding annual natural gas demand requirements.

Other studies exist that provide different estimates of the feedstock potential, over different time frames and with different assumptions relating to feedstock quantities, cost factors, production pathways and other technical parameters.

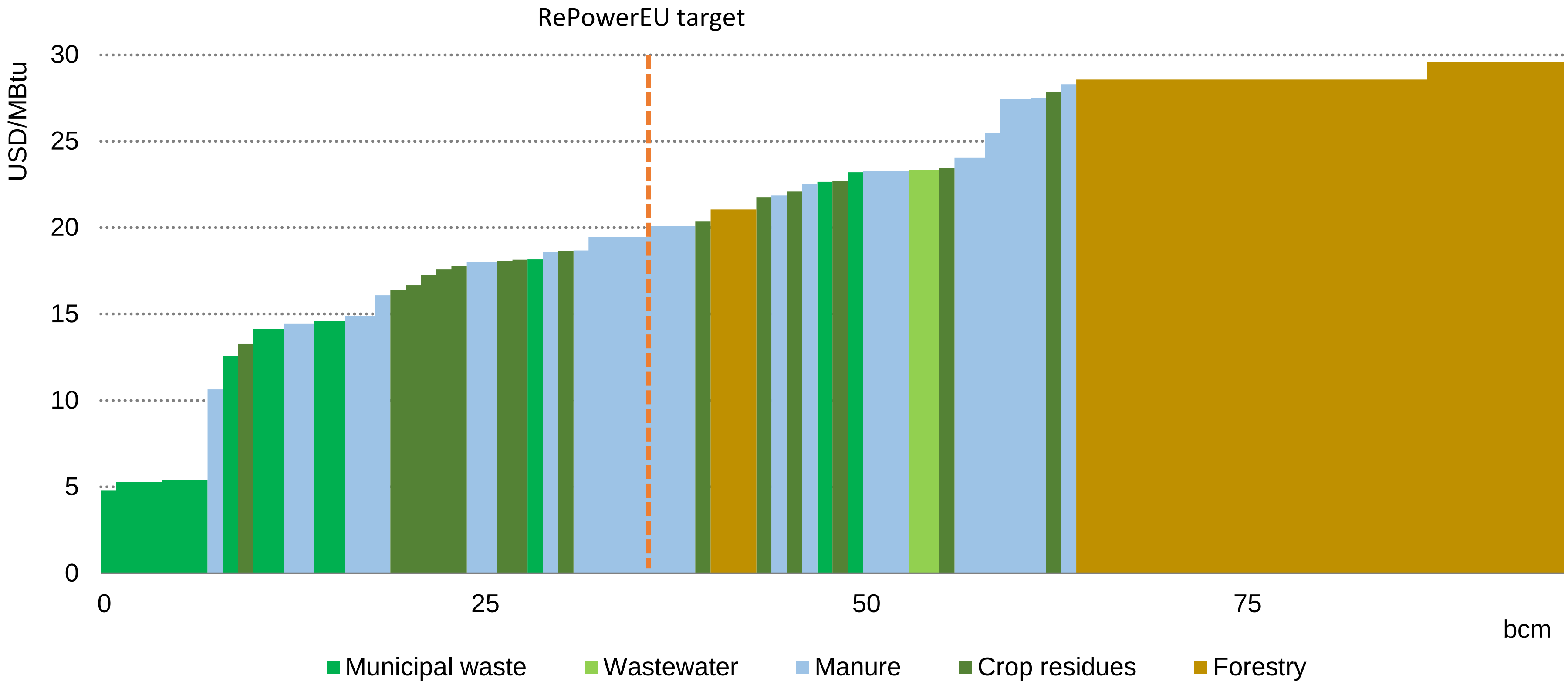
Contrary to the global picture, animal manure is the first feedstock biogas potential in the European Union, before crop residues. This potential grows over time as livestock increases, and reaches almost 40 bcm-eq in 2050. By a sound management of farm waste, anaerobic digestion of animal manure would also help avoid nitrate pollution, such as water contamination and green tide.

The technical potential of biogas production from crop residues in the European Union is relatively small (around 20 bcm-eq) despite its strong agricultural sector. The reasons of this low availability of crop residues for biogas production are two-fold. Wheat is the most cultivated crop and does not produce a significant amount of residues per tonne of grains. Livestock is huge proportionally to the land available: a tenth of global cattle livestock is European and a fifth for pigs, which means that an important portion of the crop residues is directed to animal feed.

Certain industrial subsectors, such as the food and drink and chemicals, produce wet waste with a high organic content, which is a suitable feedstock for anaerobic digestion. In such industries, biogas production can also have the co-benefit of providing treatment for waste while also supplying on-site heat and electricity.

The estimated costs of developing biogases in Europe vary widely, depending on technologies and feedstocks

Cost of producing biomethane in the EU by feedstock source



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There are three main cost components to a biogas or biomethane project

IEA analysis suggests that 35 bcm of biomethane can be produced in the EU for less than USD 20/MBtu, at an average near USD 15/MBtu. This is below the prices seen since July 2021, but well above the average of the past decade. It also does not include injection costs into pipelines or compression/liquefaction costs if transporting the gas in this way. These overall estimates depend on three main cost elements: feedstock, biodigesters and gasification units and grid connection costs.

Feedstock: Feedstock prices can vary considerably as feedstocks can be zero-cost or even negative in cases where producers of waste are obliged to pay to dispose of their waste, whereas in other cases "gate fees" for certain agricultural feedstocks may be as high as USD 100/tonne. In the assessment above manure is zero cost, while agricultural residues in the EU can be around EUR 50/tonne. Food and green, and paper and cardboard wastes are assumed available at no cost as we assume that the collecting costs are supported by the municipality and are therefore outside the scope of the biogas project.

Biodigesters/gasification units: The technologies for biogas production and upgrading are relatively mature although there may be potential to bring down the cost of biomass gasification. Larger facilities could also provide some economies of scale for both production routes. Gasification is currently the more expensive method of production in all regions with average costs around USD 25/MBtu globally. The potential is also limited by the availability of cost-effective feedstock such as forestry management and wood processing residues. Other possible feedstock sources for biomass gasification would be MSWs and agricultural residues.

Grid connection costs: Grid connection represents a potential additional cost (if the biomethane is to be injected into gas networks rather than used locally). Proximity to the gas network is a significant cost factor, and to be cost-effective plants must generally be located very near to gas grids, up to 10-15 km. Typical network connection costs are around USD 3/MBtu, split roughly equally between pipeline infrastructure and grid injection and connection costs, although this will vary significantly depending on the length of the pipeline.

Key issues for scaling up biomethane production

There are several feedstock, cost, policy and technical issues that will need to addressed in order to accelerate biomethane production and use in the EU.

1. Feedstock management

Manure: Open storage of cattle slurry leads to significant levels of fugitive methane emissions, which can be abated by biogas facilities. However, a very significant barrier to collection of cattle manure is an animal husbandry system whereby cattle are pasture grazed for the majority of the year.

Crop residues: Crop residues are used for animal feed and a significant portion is kept in the soil to maintain a sustainable amount of nutrients, such as nitrogen, phosphorus and potassium and avoid soil erosion. Therefore, reserving crop residues for use in biogas production must be carried out as one part of a wider agricultural and land management plan. Additionally, harvest cycles could affect the seasonal availability of biogas production when facilities are tied to a single feedstock type. Although not included in the IEA assessment of feedstock potential, there are prospects for the use of sequential crops for biogases production, grown between two harvested crops as a soil management solution that helps to preserve the fertility of soil, retain soil carbon and avoid erosion. Sequential cropping has been tested at scale in Italy through the BiogasDoneRight concept.

Municipal solid wastes are a fundamental feedstock for the future development of biogas and biomethane because it is huge reservoir and it has limited competitive uses. The bulk of it is biogas from food and green wastes today, although there is considerable potential from paper and cardboard. A crucial variable determining the potential is how these wastes are managed, e.g. whether they are put in an open dump, recycled, composted or incinerated. MSW collection rates differ strongly in urban and rural area within the same country.

To date, 80% of **wastewater** (municipal and industrial combined) is not collected or treated. Initial capital costs of may be high unless there are existing wastewater treatment facilities and effective downstream management of sludge.

Landfill gas. The EU's landfill reduction targets and the prohibition of landfilling separately collected bio-waste means municipal and food waste is mostly composted and so avoids ending up in landfill. Nonetheless, there is significant residual organic waste that ends up in landfill, and adding anaerobic digestion equipment is one of the cheaper options to produce biogas.

Every cubic metre of biogas or biomethane produced is accompanied by anywhere between 10-200 kg of digestate. Digestate is an easy product to handle and apply and can be used successfully as a substitute for mineral fertilisers. The fertiliser value of digestate depends on the nutrients present in the feedstock. However, there needs to be an identification of suitable areas to apply digestate, and the processing to digestate to produce fertiliser replacement materials; processing of digestate to minimise the mass to be transported to land for use as a fertiliser. Disposal of digestate could be an added cost.

Given their relatively low energy density, feedstocks must generally be close (within 50 km) to biodigesters in order to achieve economical returns. These feedstocks may be trucked or, in some cases, there is potential to develop pipeline infrastructure if there are feedstocks in a closer proximity.

2. Sustainability issues

The potential to realise CO_2 emissions reduction from using biogas or biomethane depends on how these gases are produced and where they are used in the value chain. From a policy perspective, it is essential that the production of biogases (and all other forms of bioenergy) actually deliver net life-cycle CO_2 emissions reduction. For example, a 10% volume blend of biomethane in a natural gas pipeline would in theory reduce CO_2 emissions in the gas consumed by 10%. However, there are emissions from the collection, processing and transport of the biogas feedstock that need to be weighed against the CO_2 emissions that arise during the production, processing and transport of natural gas (GRDF, 2018) (Giuntoli et al., 2015). These indirect emissions can vary considerably between sources of biomethane and natural gas and, unless minimised, they could reduce the CO_2 emissions savings from the use of biomethane.

Potential factors to take into account include direct and indirect land use change, methane leaks in biogas production facilities and transport, (accounting for the) displacement of alternative fuels (e.g. oil in transport, natural gas or coal in power, natural gas in industry vs. buildings), and the resulting avoided emissions from fossil fuel production and use, avoiding alternative waste treatment, avoiding fossil fertiliser production, increasing soil carbon accumulation and capturing carbon dioxide.

Several studies have measured the GHG emissions from biogas and biomethane facilities, noting the importance of of different feedstocks and production pathways. The issue of methane emissions is particularly important, with one study noting that methane losses from the biogas plants are the most significant parameter affecting the GHG emissions of biogas plants running on energy crops or biowaste. Another recent study has contended that methane emissions from the sector have been under-estimated, noting in particular the relatively high potential for methane leaks in the process of storing and handling digestate.

Some of the feedstocks that are used to produce biomethane would decompose and produce methane emissions naturally if not carefully managed. This applies in particular to animal manure and the organic fraction of MSW at landfill sites. In both cases, anaerobic digestion can happen spontaneously, generating methane emissions. All other potential biomethane feedstock types, such as crop residues, generally degrade in the presence of oxygen (not under anaerobic conditions) and so do not commonly result in methane emissions.

Clear, consistent and broadly used sustainability requirements can also reduce development risks and facilitate trade. Biomass supplies are fundamentally limited, connect with multiple sectors and its colleciton and use is receiving increased scrutiny. The sustainability of biogas and biomethane feedstocks, production and use must be officially monitored and certified through a consistent mechanism. The EU's Renewable Energy Directive provides such a framework including minimum greenhouse gas intensity requirements, feedstocks use and landuse change. The EU's sustainable finance taxonomy likewise contains recommendations on ensuring that investments in anaerobic digestion can be considered sustainable.

3. Costs and competitiveness

The primary barrier to the expansion of biomethane is cost. While natural gas prices are currently higher than biomethane, they have historically been lower, especially when natural gas is not covered by a carbon price. Between January and May 2022 natural gas prices in Europe averaged 33 USD/MBtu, but average prices between 2017 and 2020 were just over 5 USD/MBtu. Both prices exclude carbon prices. There are limited prospects for major reductions in the cost of producing biomethane, while the cost reductions in wind and solar mean that biogas has become steadily less competitive as a source of electricity generation (even though tight supply chains for solar and wind have reversed their cost declines since 2020).

Biogas and biomethane processing, despite their reliance on steel and other raw materials, rely on local sourcing and noted fewer disruption in supply chains in the aftermath of the Covid-19 pandemic than other industries such as solar, wind and oil and natural gas.

Notwithstanding current record high gas prices, the production and utilisation of biomethane requires supportive access to financing and incentives to become competitive. A large-scale biogas project (with a capacity of around 500 m^3/hr can cost approximately EUR 1.5 to 2 million. Financing support is therefore necessary for many project sponsors. Moreover, banks often lack technical expertise in this area and there are few benchmarks to assess the unique risk/return profile for biogas and biomethane projects (e.g. securing reliable feedstock or process capability to consistently meet gas quality specifications).

These gaps can increase the perception of risk, raising the cost of capital or reducing the loan tenures. Consolidation of financial and risk assessment resources could be effective to encourage projects move from concept to development.

When used for electricity generation, biogas offers unique value compared to other renewable electricity generation technologies because it is dispatchable (though actual deliverability would depend on seasonal variability of biomethane and the presence or absence of gas storage infrastructure). Valuing dispatchability can also improve biogas competiveness. Financially rewarding biogas fired electricity generation facilities for this value can help expand demand for biogas used in this way.

4. Policy support

Policy intervention will be needed to close the cost gap and provide a clear and predictable business case for investors. Policy options include carbon pricing, sector GHG regulations, biogas regulations and incentives.

If CO_2 prices are applied to the combustion of natural gas, then biomethane becomes a more attractive proposition. Between 2017 and 2020 natural gas prices averaged 5.7 Euro/MBtu. An 80 Euro per tonne CO_2 carbon price, equivalent to current market prices in Europe, raises natural gas prices to nearly 10 Euro/MBtu, partially closing the cost gap with natural gas.

Policies that regulate sector GHG reductions or otherwise value biomethane such as the EU's Renewable Energy Directive, can also make biomethane a competitive fuel. In Sweden more than 95% of gas used in natural gas vehicles comes from biomethane because there value in using biomethane tosupport transportation greenhouse gas objectives (Swedish Biogas Research Center, 2020). If policy recognises the value of avoided methane emissions that would otherwise take place from the decomposition of feedstocks, then an even larger quantity of biomethane would be cost-competitive.

While carbon pricing and sector regulations can support biomethane, countries have generally relied on feed in tariffs, fiscal incentives and investment support to directly close the cost gap with natural gas or quotas to mandate the use of biomethane.

Other environmental benefits such as waste management and fertilizer provision can also improve biomethane competitiveness by providing additional revenue streams. In certain locations and applications, digestate can be sold as a natural fertiliser, helping to offset a part of the production cost. European regulations have recently recognised the role organic materials play in the production of digestate. Biogas production can also help avoid waste management costs for municipal and industrial organic wastes, agricultural residues and manure, and sewage sludge. Countries often include support mechanisms specifically for these biogas feestocks and landfill restrictions can make biogas a more competitive choice (IEA Bioenergy, 2021).

5. Trade

Biomethane is already traded amongst EU countries, but trade across borders is happening only on a bilateral basis and expanding trade will require more sophisticated trading platforms and certifications. Expanding trade can help expand biomethane by expanding the market for producers, allow for management of national market disruptions and facilitate large consumers to acquire biomethane resources (IEA Bioenergy, 2021). Establishing a market for tradeable certificates of origin, such as proposed by the European Renewable Gas Registry, will be essential part of scaling up cross-border trade of biomethane.

6. Connecting to natural gas networks

There are a number of technical, cost and policy barriers to connecting to gas grids. Locating biogas facilities can be limited to the local availability of substrates. This can make connections to gas grids difficult if the available substrate is far from the gas network, or the facility is too small to make upgrading gas and connecting to the gas network cost effective. Combining biogas production from a number of facilities to one upgrade facility and one gas network connection can help reduce costs. Jurisdictions must also provide clear injection quality standards for biomethane producers to follow. Different standards across jurisdictions can also act as a barrier to trade and so slow deployment.

Permission to access the gas network must also be provided, which is not always guaranteed. Who pays for the connection to the grid can also act as a barrier. These costs are sometimes shared between the network operator, biomethane plant owner and grid operator or sometimes paid solely by the biomethane plant owner (IEA Bioenergy, 2021).

Recommendations for scaling up to 35 bcm by 2030

Expanding biomethane production to 35 bcm will require a 12-fold increase in biomethane production across EU in less than 8 years. Below we suggest a 7-point set of recommendations for meeting this ambitious target.

1. **Close the competitiveness gap.** Notwithstanding current record high prices for natural gas, **t**here remains a signficant cost gap between producing biomethane and natural gas even with carbon prices at 80 euro/tCO_2. In order to support investments, further incentives are needed that give biomethane a value linked to its GHG performance, alongside multiple co-benefits (rural development, dispatchable generation, avoided methane emissions, value of digestate as biofertiliser, etc).

2. **Create a harmonised trading network:** Trade can help expand the pace and scale of biomethane growth by connecting production and demand centres. This requires consistent biomethane standards, trading platforms for physical and greenhouse attribute trading and shared sustainability certification.

3. **Increase facility sizes:** Most biomethane units in the EU have a capacity to produce around 50-250 m^3/h, whereas a typical shale gas well in the United States will produce 2 000 m^3/hr. There are some larger biomethane facilities that can produce up to 1 000 m^3/h, however these make around 5% of existing plants. To meet the RePowerEU target plant sizes are likely to increase, potentially requiring the pooling of multiple feedstock sources and development of centralised upgrading facilities, in order to achieve economies of scale and reduce integration costs.

4. **Improve feedstock management** The majority of the EU biogas production comes from landfills, wastewater treatment, energy crops and some agricultural wastes like manure. Biogas producers will need to scale supply chains for these wastes and construct many efficient facilities to use these feedstocks. Standards should be put in place to ensure that employing feedstocks for biogas production avoids negative impacts on soil and nutrient cycles, farm management practices, biodiversity, or animal husbandry.

5. **Facilitate investment:** Meeting the 35 bcm target will require EUR 70 billion of new investment, according to the RePowerEU plan. Reducing the risk of biogas and biomethane investment by extending public financing or loan guarantees, or by securing long-term offtake agreements with creditworthy buyers, can help finance larger projects and therefore attract larger private sources of capital.

6. **Measure, report and verify emisssions** There remains considerable uncertainty around the lifecycle emissions of biogas and biomethane plants. Operators should be obliged to measure and report their emissions at each stage of the production process.

7. **Prepare gas networks for biomethane injection:** Natural gas network operators will need to accomodate higher rates of biomethane injection, that comes with different supply profiles, while maintaining reliable supplies.

Annex: Further information and resources

Repower EU plan

IEA Outlook for Biogas and Biomethane

IEA Bioenergy Task 37

Biomethane map (European Biogas Association)

Swedish Biogas research centre

German bioenergy research centre

Biogas Platform

European Renewable Gas Registry

ENTSOG Biogas projects platform

Biogas technical terms