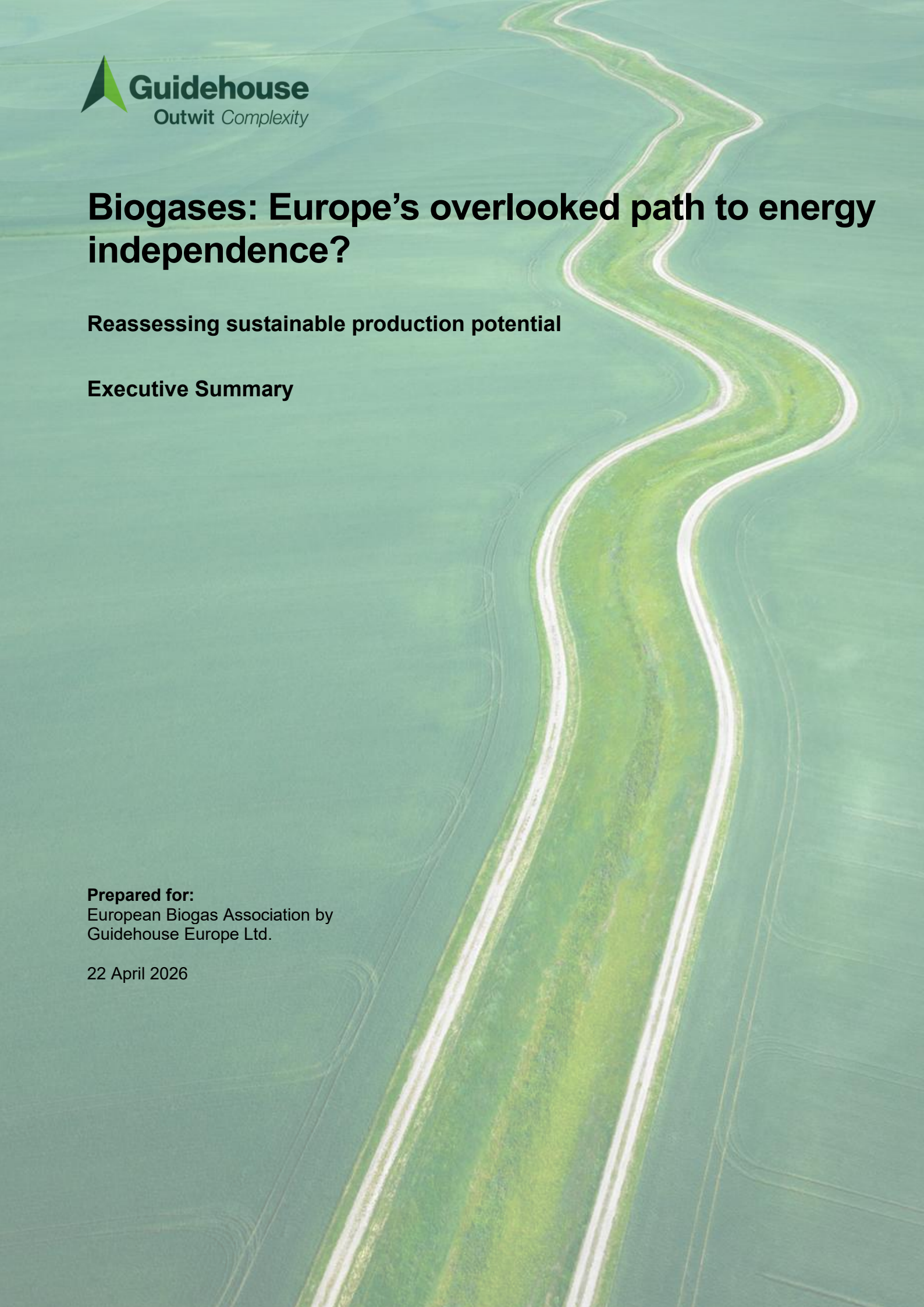

Biogases: Europe's overlooked path to energy independence?

Reassessing sustainable production potential

Executive Summary

Prepared for:
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Biogases are a scalable energy vector contributing to Europe's energy independence.

Biogases will play an important role in the European Union's (EU) ambition to be resilient, competitive and to achieve a net zero future by 2050. In 2022, the European Commission established a political target in the REPowerEU plan to produce 35 billion cubic metres (bcm) of biomethane annually by 2030 in the EU[1]. This objective aims to enhance energy security and support net zero goals by providing a renewable, domestically-produced source of gas that can directly substitute fossil natural gas across multiple sectors of the economy.

Despite progress since 2022, current developments show that the EU is not on track to meet this target. Although the underlying potential in Europe is sufficient to meet the target, further action is required to mobilise resources and scale this strategic domestic industry through 2030 and beyond, enabling it to reach its full potential by 2050.

In 2024, Europe produced 5 bcm of grid-quality biomethane and 17 bcm of biogas for combined heat and power.[2] Predecessor studies conducted in 2022[3] and 2024[4], assessed the biomethane production potential in in Europe (EU-27, plus Norway, Switzerland and the United Kingdom). This updated study revisits the 2024 Guidehouse assessment, incorporating the latest data as well as current market and regulatory insights. The underlying methodology remains consistent with the earlier studies.

The core potential assessment focuses on feedstocks that are ideally suited for anaerobic digestion, many of which are **wastes and residues** streams that already exist in significant volume across Europe. Additionally, this study quantifies the potential from feedstocks grown on **marginal and contaminated lands** and from biogenic carbon dioxide (CO_2). Marginal and contaminated lands can be used in an agroecologically responsible manner to restore and revitalise these under-utilised lands and unlock additional biogases potential. Furthermore, **biogenic CO_2** arising from either the production or use of biomethane provides a viable pathway for producing additional renewable gas through e-methane.

The **total potential of biomethane and e-methane** in 2030, assessed in this study, is **34-35 bcm/year (of which 31-32 bcm/year relates to the EU-27),** and almost exclusively based on biomethane from anaerobic digestion (with a minor share of e-methane)[5]. Thermal gasification is no longer considered to be close enough to commercialisation to make a material contribution towards the potential in 2030.

However, both thermal gasification and e-methane are set to become relevant in the 2040 timeframe and beyond (see Figure 1). A steep increase in the total potential is anticipated after 2030, with an assessed range of **116-132 bcm/year in 2040** and **181-205 bcm/year in 2050 (of which 105-119 bcm/year and 163-184 bcm/year relates to the EU-27 in 2040 and 2040 respectively)**.

Anaerobic digestion is still expected to be the dominant technology, representing ~61% of the total in 2040 and ~53% of the total in 2050, as these complementary technologies further commercialise towards 2050 (with thermal gasification representing ~25% and ~32% of the totals in 2040 and 2050 respectively).

[1] European Commission, REPowerEU Plan, 2022, https://commission.europa.eu/topics/energy/repowereu_en

[2] European Biogas Association, Statistical Report 2025, Tracking biogas and biomethane deployment across Europe, 2025.

[3] Gas for Climate, Biomethane production potentials in the EU, 2022. https://gasforclimate2050.eu/wp-content/uploads/2023/12/Guidehouse_GfC_report_design_final_v3.pdf

[4] Guidehouse, Biogases towards 2040 and beyond, 2024. https://www.europeanbiogas.eu/news/report-reveals-111-bcm-of-sustainable-biomethane-potential-for-2040/

[5] In contrast to the 2024 Guidehouse study, the potentials in this study are presented as a 'low' & 'high' range.

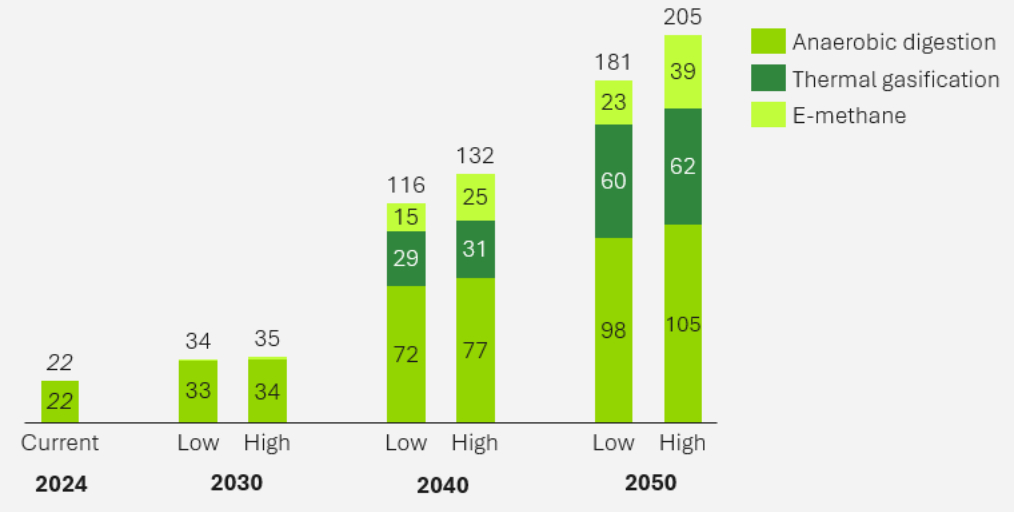

Figure 1. Actual 2024 biogases production in Europe and assessed biomethane & e-methane production potential in 2030, 2040 & 2050 per technology (low & high[6])

As highlighted in the 2024 study, **additional potential** could be unlocked from **novel feedstocks** such as seaweed and digestate, and **landfill gas** will further increase the potential in the short to medium term.

Faster feedstock mobilisation is critical to Europe meeting its biomethane potential.

This report presents an assessment of the realistic and sustainable potential for biogases production within Europe, reinforcing the conclusions of earlier assessments that biogases have an important role to play in the future defossilised energy system. However, the potential assessment for 2030 has been lowered compared to previous studies, which reflects not a change in the total sustainable potential, but a **lack of timely action to date to accelerate deployment of biogases and to mobilise available feedstocks.**

The results of this study reiterate the conclusions from earlier assessments that there is a significant potential. More coherent policy recognition of the system-wide benefits that biomethane can bring is needed to provide the boost that the sector needs. Scale up of the European biogas industry needs more coherence and harmonisation across different policy areas and Europe, as well as faster permitting and faster feedstock mobilisation. Mobilising the sustainable feedstock potentials in this study, in particular, requires clear definitions, targets and targeted outreach to the farming, forestry and waste communities to stimulate collection of wastes and residues, and plant sustainable crops for the production of biogases.

There is a crucial difference between **waste and residue** feedstocks that exist and need collecting and sustainable crops that need to be cultivated. Countries should quantify and map feedstock potentials and then develop actions and strategies targeted at their corresponding feedstock potential and to their specific agricultural or forestry sectors. As biogas plants become larger, structures will need to be put in place to either pool the sources of feedstock into one plant or otherwise have smaller capacity biogas plants but pool the biogas into a central biomethane upgrading facility.

[6] Note that the 'low' and 'high' potential ranges are specifically assessed for e-methane and biomethane from feedstocks cultivated on marginal and contaminated land.

For **sequential crops**, clear definitions are needed, including integration into current policy and putting in place national production targets to help to scale up this sustainable method of cropping. Definitions should be consistent across different areas of policy including energy and agriculture. Long-term predictable support to farmers can help to stimulate uptake. This could be via policy support or from offtake contracts with biogas producers. Furthermore, coordinated outreach and training from biogas project developers can help to mobilise cultivation of sequential crops centred around a specific biogas plant.

For **marginal and contaminated land**, income via biogas production could help to turn the fate of these lands around, bringing also broader benefits including to nature and biodiversity by halting further degradation and soil erosion, restoring land after industrial uses and more specifically restoring the soil through phytoremediation in cases of contamination. Depending on the reasons for the land being under-utilised, there can be a substantial upfront investment needed to start cultivation on the land, especially if it is degraded (for example with low soil organic matter) or contaminated. Mobilisation will therefore require incentives for farmers and landowners. Incentives could be provided via the Common Agricultural Policy or via the Renewable Energy Directive or by a contractual guaranteed feedstock price from a biomethane producer.

Furthermore, a clear classification of these lands via policy will help to provide certainty to those investing, and provide a framework upon which a system of policy incentives could be based. Government can play a role in mapping of such lands to make it easier for the market to identify lands that can be brought back into productive use. There is also a clear role for municipalities to facilitate land use planning. Combining such maps with consideration of logistical access for agricultural infrastructure and machinery and proximity to the gas grid can also inform those areas where it would make sense to focus efforts in the first instance. There is also a role for larger landowners, such as former mining or industrial sites, which may have suitable land and an obligation to rehabilitate the land after use.

Feedstock competition across the bioeconomy will tighten towards 2050, however the expected impact is limited for many conventional biogas feedstocks.

The large-scale deployment of biomethane in Europe depends not only on the technical availability of sustainable biomass, but also on how feedstocks are allocated across competing uses in an increasingly integrated bioeconomy. Wet organic waste feedstocks, such as animal manure, biowaste, industrial wastewater and sewage sludge, are very well suited to treatment via **anaerobic digestion**, and are not expected to face significant competition into the future as there are limited alternative options to utilise them for energy generation or across the wider bioeconomy. Additionally, the use of these feedstocks for anaerobic digestion delivers multiple environmental benefits, such as fugitive greenhouse gas emission avoidance, opportunities for nutrient recycling through the application of digestate and local pollution reduction. In contrast, significant competition for woody biomass feedstocks that are well suited for **thermal gasification** is expected over time, from continuing demand for conventional heat and power generation, as well as emerging demand for sustainable aviation fuels production, permanent carbon removals (carbon capture and storage and biochar), as well as demand as a bio-based material in sectors such as construction or bio-based chemicals.

This study is not a prediction of what will happen. Rather, it illustrates what is possible when concerted action is taken across Europe to mobilise sustainable feedstock streams towards producing biomethane. Realising the potentials assessed in this report will require coordinated efforts and a favourable and stable policy environment that gives certainty to stakeholders across the biomethane value chain. With the right conditions, Europe holds a significant sustainable potential to produce a domestic source of renewable energy that contributes significantly towards energy independence into the future.