Guidehouse

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Biogases: Europe’s overlooked path to energy independence?

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outwit complexity™

The aim of this study

- A refresh of 2024 Guidehouse study for the EBA
- An update of 2030, 2040 and 2050 potential assessment based on the latest data and insights
- Quantified biogases potential from marginal and contaminated land, and biogenic CO_2
- Additional focus on feedstock mobilisation and competition for other energy uses
- Contribute to policy discussion on the future role of biogases in Europe

Our research scope

Scope

Time horizon:
2030, 2040 and 2050

Countries:
EU-27 + Norway, Switzerland and UK

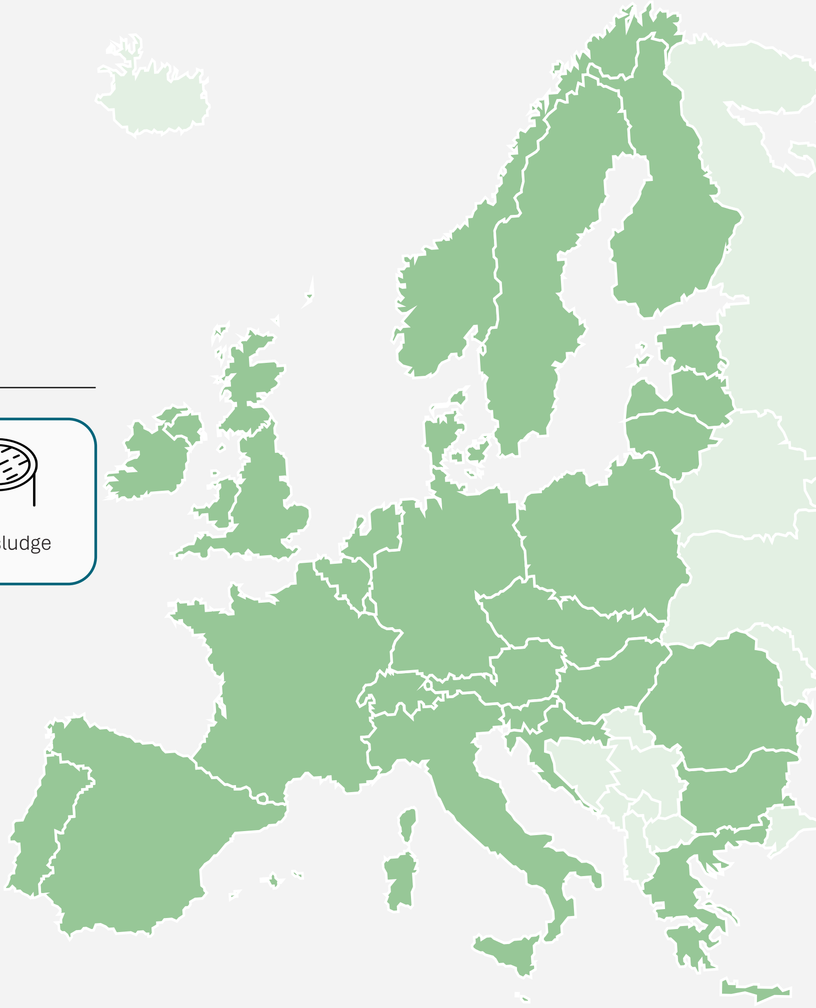
Technology & feedstocks

Anaerobic Digestion
- Agricultural residues
- Animal manure
- Biowaste
- Industrial wastewater
- Marginal land
- Permanent grassland
- Roadside verge grass
- Sequential crops
- Sewage sludge

Thermal Gasification
- Contaminated land
- Forestry residues
- Landscape care wood
- Municipal solid waste
- Pruning
- Wood waste

E-methane *(Newly added)*
- CO_2

■ = Newly added technology / feedstocks



Methodology for biomethane

Step 1

Identify feedstocks and conversion technology option per feedstock

Step 2

Update potentials per feedstock per country in 2030/40/50

Step 3

Convert feedstock potentials to biomethane potentials in 2030/40/50

Published reports covering 2030–2050 time horizon or **current statistical data** (including Eurostat, FAOstat), and expert interviews

Methodology for e-methane

Step 1

Assess total biogenic CO_2 availability from biomethane production and use

Step 2

Allocate share of biogenic CO_2 available for CCU

Step 3

Allocate share of biogenic CO_2 available for e-methane production (low/high)

Step 4

Calculate e-methane potential based on biogenic CO_2 volume (low/high)

Published reports covering biogenic CO_2 supply and demand, e-methane conversion technologies and policy environment

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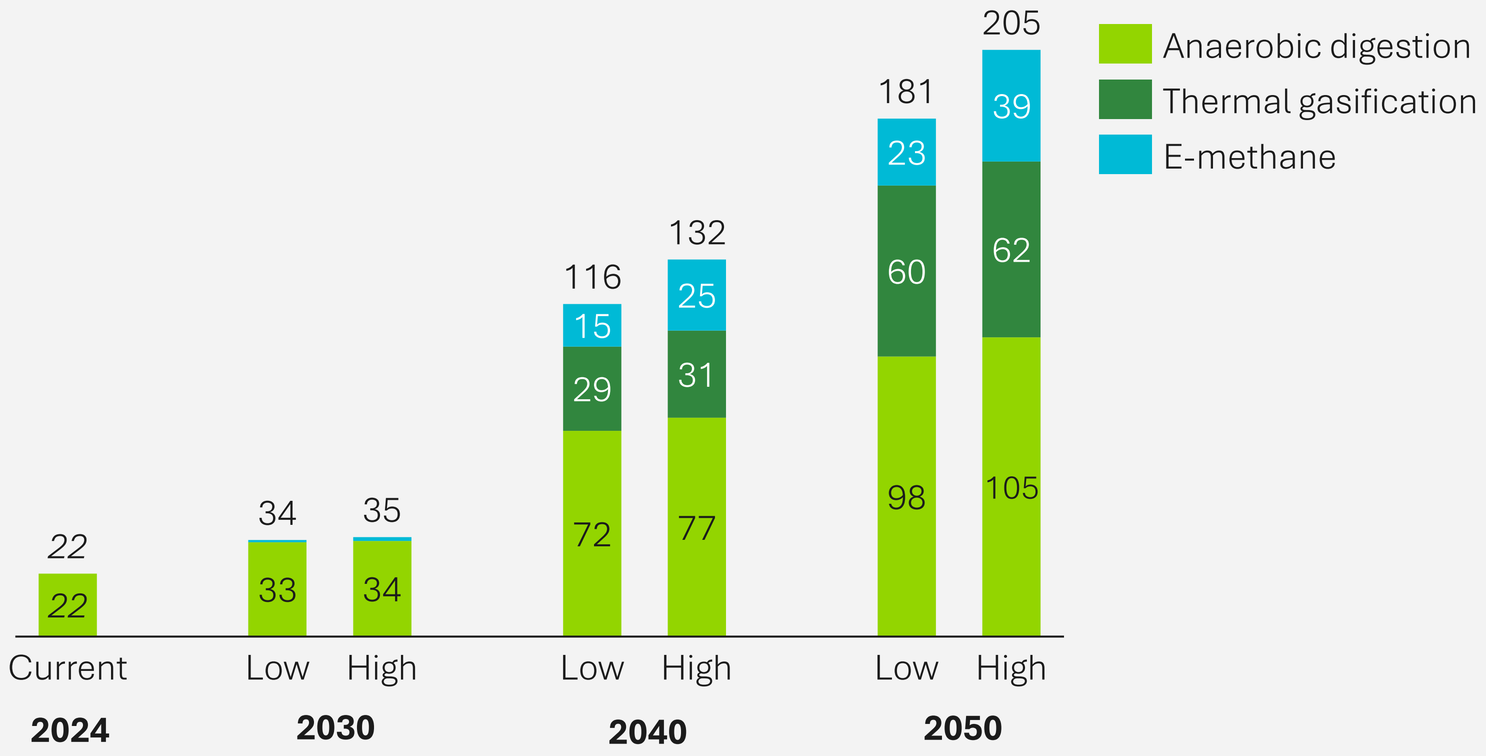
There is a significant opportunity to scale-up sustainable production potential from today to 2050

Production potentials in 2030, 2040 and 2050 (EU-27+3)

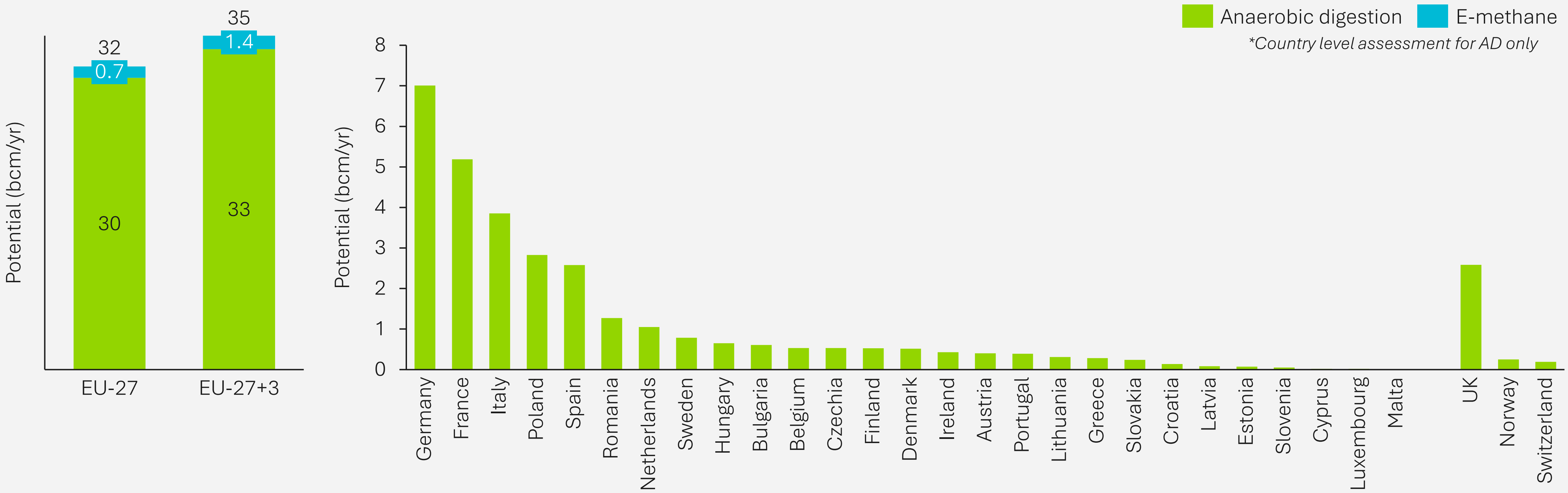


Key insights

- Up to 2030 almost exclusively based on anaerobic digestion
- 2030 potential lower than previously assessed due to lack of timely action to scale up production and mobilise sustainable feedstocks
- Steep increase towards 2050 – all production technologies play an important role
- Thermal gasification and e-methane become relevant by 2040 as these technologies commercialise
- EU-27 potential 31-32 bcm in 2030, increasing to 163-184 bcm by 2050

In 2030, production potential in Europe is 35 bcm/yr, almost exclusively from anaerobic digestion

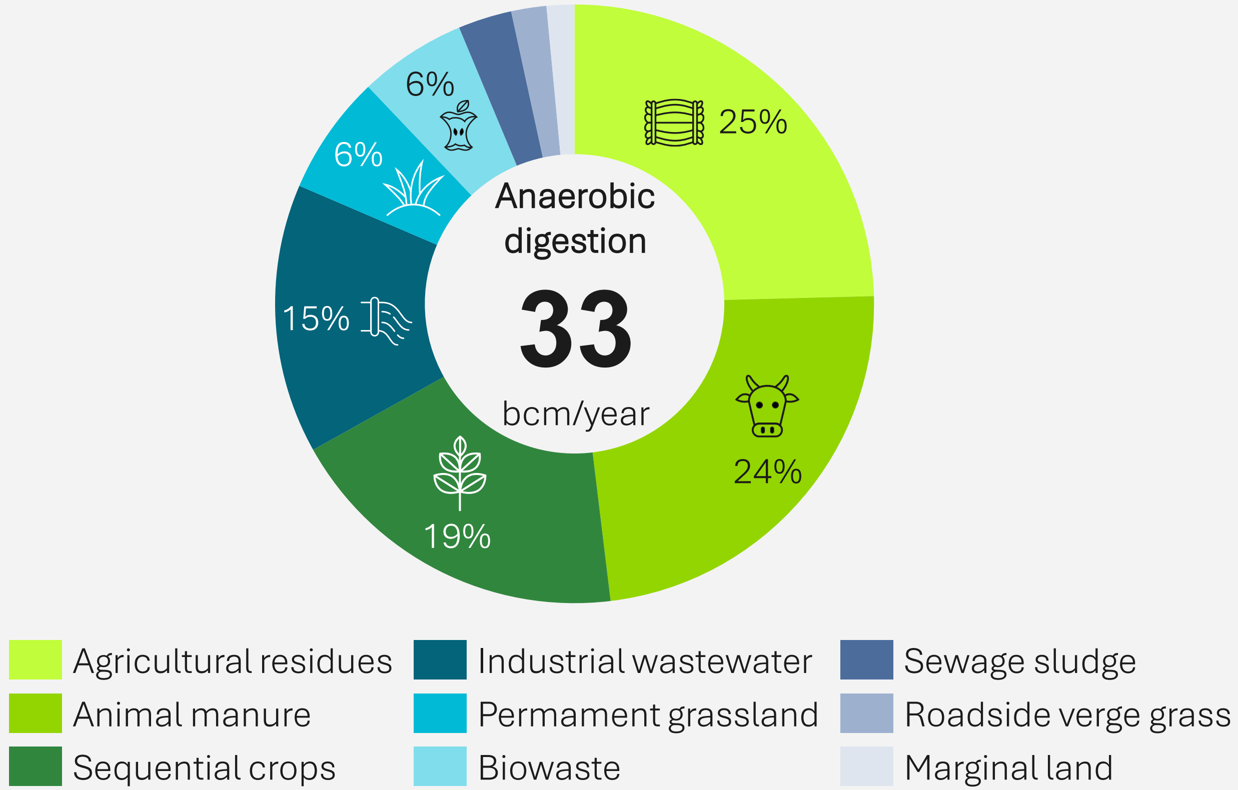
Total production potential by country and technology (bcm/yr)



Note: Estimates may deviate from nationally specific studies assessing feedstock availability for sustainable biomethane production.

2030 Anaerobic digestion feedstock mix: led by agricultural residues and animal manure

2030 anaerobic digestion feedstock mix

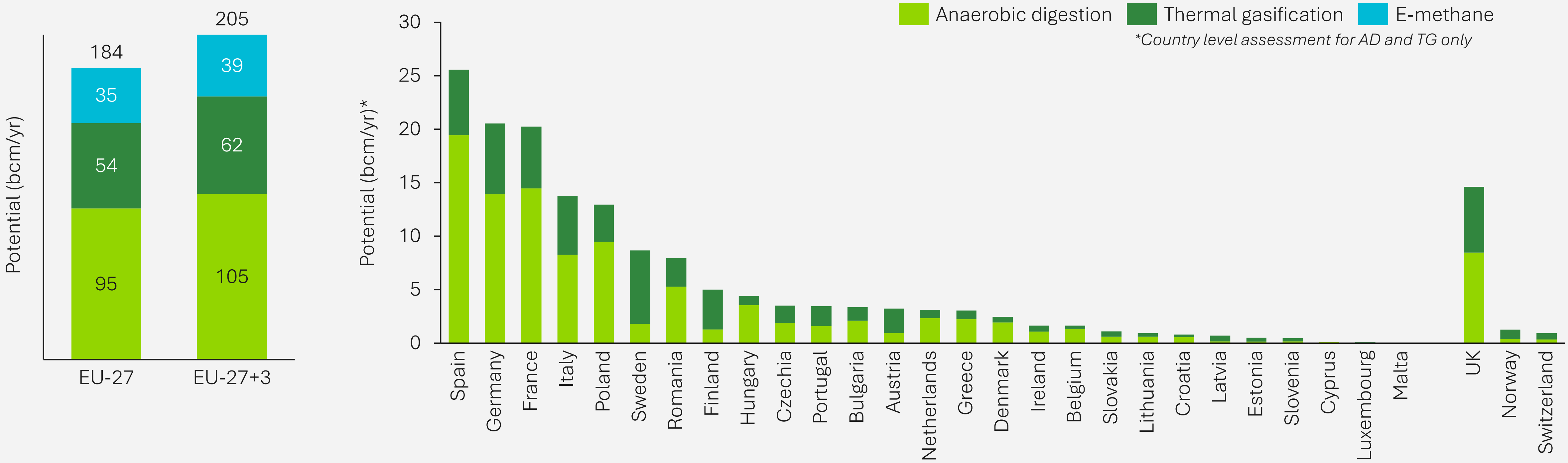


Key insights

- Potential of 33 bcm/yr estimated for Europe (down ~8 bcm/yr compared to 2024 study)
- Top 5 countries: Germany, France, Italy, Poland, United Kingdom (64% of total)
- Animal manure and agricultural residues make up 49% collectively
- Sequential crops (19%) and Industrial wastewater (15%) both provide a material contribution
- Newly added marginal land makes up 1.5%

In 2050, production potential in Europe is 205 bcm/yr, and still largely anaerobic digestion based

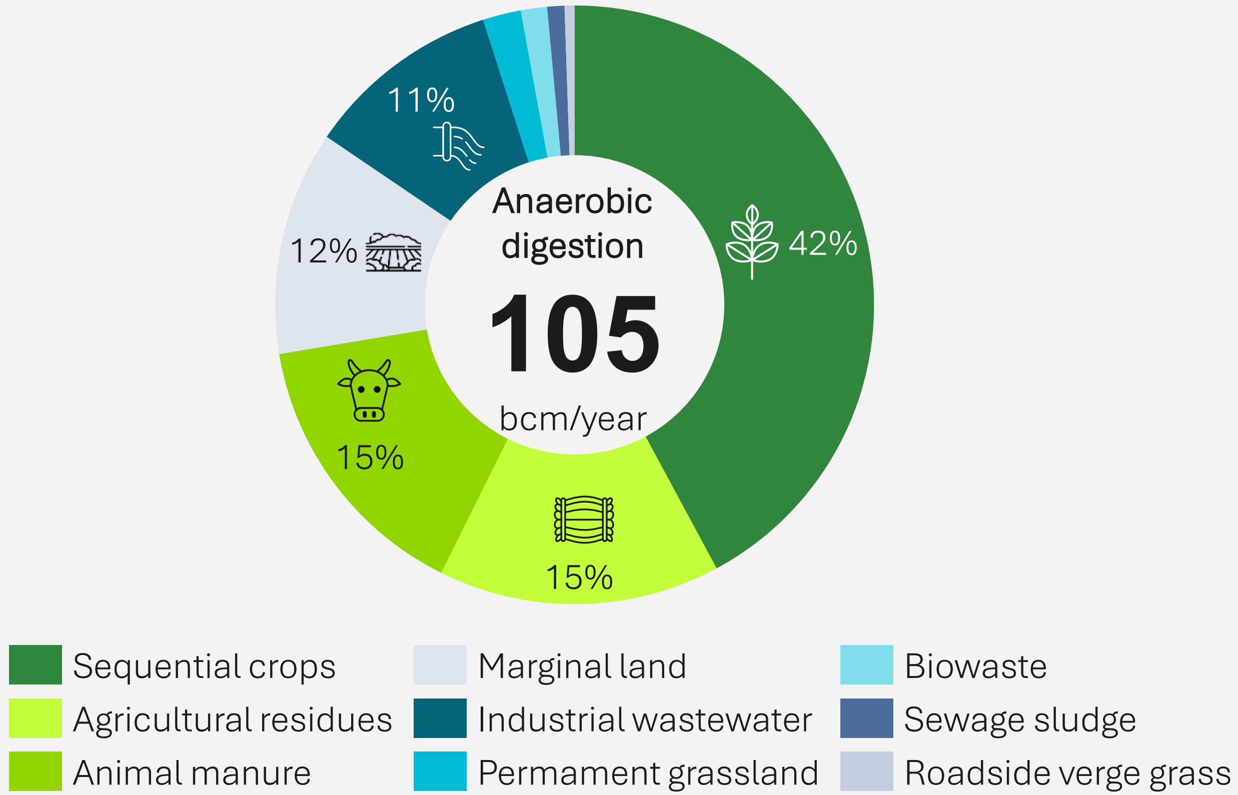
Total production potential by country and technology (bcm/yr)



Note: Estimates may deviate from nationally specific studies assessing feedstock availability for sustainable biomethane production.

2050 Anaerobic digestion feedstock mix: led by sequential crops, agricultural residues and manure

2050 anaerobic digestion feedstock mix

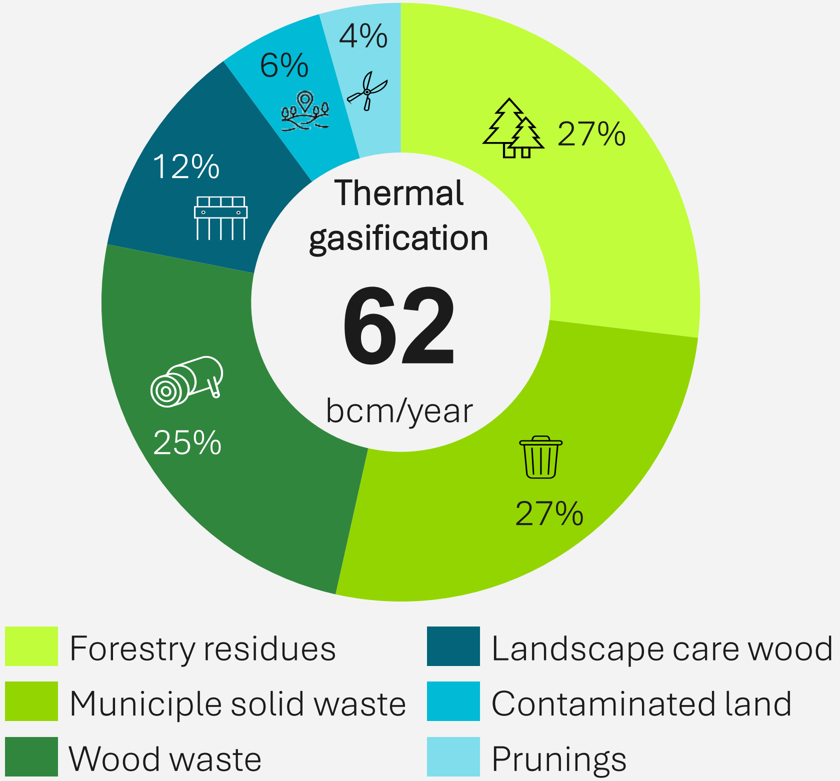


Key insights

- Potential of 105 bcm/yr estimated for Europe (up ~12 bcm/yr compared to 2024 study)
- Top 5 countries: Spain, France, Germany, Poland, United Kingdom (63% of total)
- Sequential crops share has increased significantly from 19% (in 2030) to 42%
- Marginal land has increased significantly from 1.5% to 12% (largely relating to Spain)

2050 Thermal gasification feedstock mix: led by forestry residues, municipal solid waste and wood waste

2050 thermal gasification feedstock mix

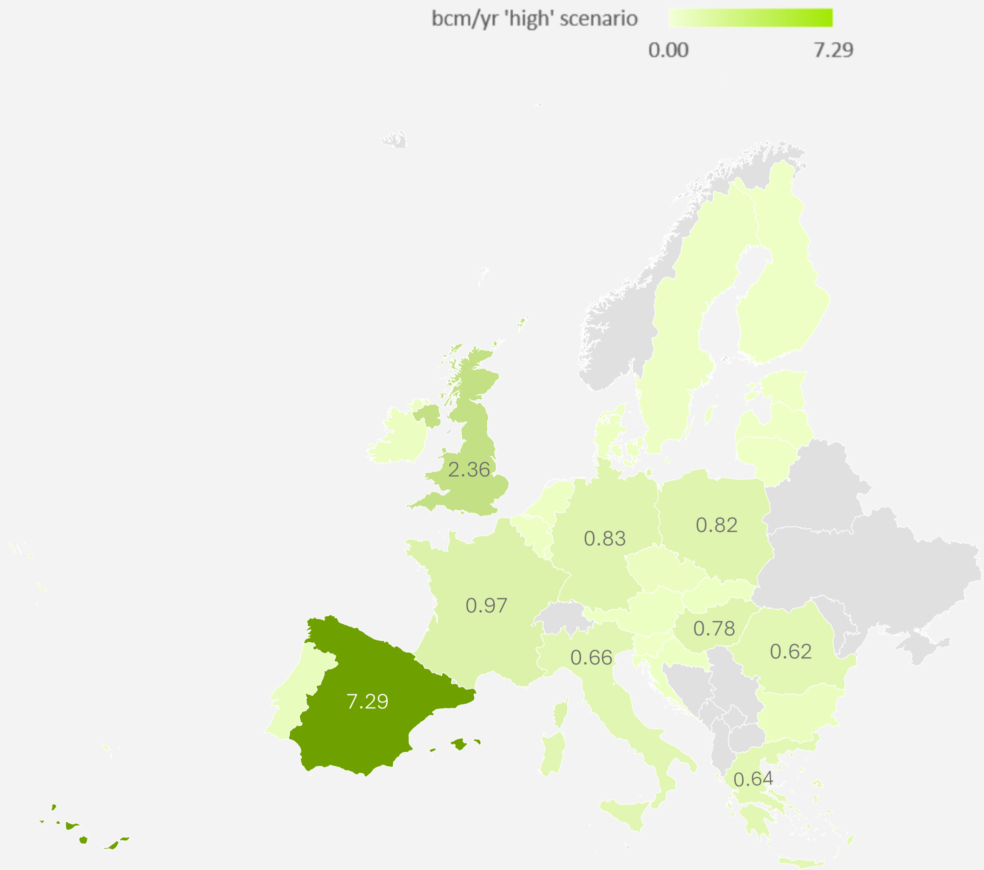


Key insights

- Potential of 62 bcm/yr estimated for Europe (down ~5 bcm/yr compared to 2024 study)
- Top 5 countries: Sweden, Germany, United Kingdom, Spain, France (51% of total)
- 68% of the feedstocks are woody biomass based - but these feedstocks may face significant competition
- Municipal solid waste accounts for the remainder (27%)
- Newly introduced contaminated land makes up 6%

Marginal and contaminated land production potential

Total biomethane production potential 2050 (bcm/yr)



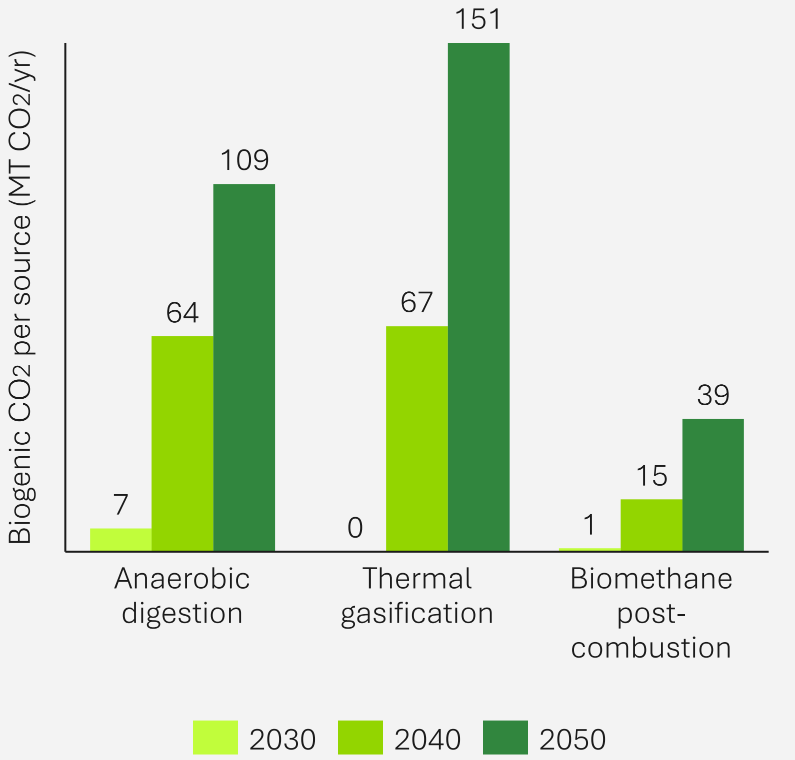
Key insights

- Over **70 Mha** agricultural **marginal land** in Europe in 2050
- **~18 Mha** with **low soil fertility** or **adverse chemical composition** – selected to align more closely with RED definition of severely degraded land (52% in Spain)
- Biomethane potential of **6-13 bcm/yr in 2050** if this land is brought back into productive use (51-55% of potential in Spain)
- Production potential based on 26%-50% utilisation of marginal land as default. Lower utilisation of 15-25% applied for Spain and Sweden due to very significant areas of marginal land available*
- **2 Mha contaminated land** in Europe. Share of this land could produce **1.8-3.5 bcm/yr** in 2050

* Either in absolute terms (Spain) or as a share of the current total arable land area (Sweden).

E-methane production potential from biogenic CO_2

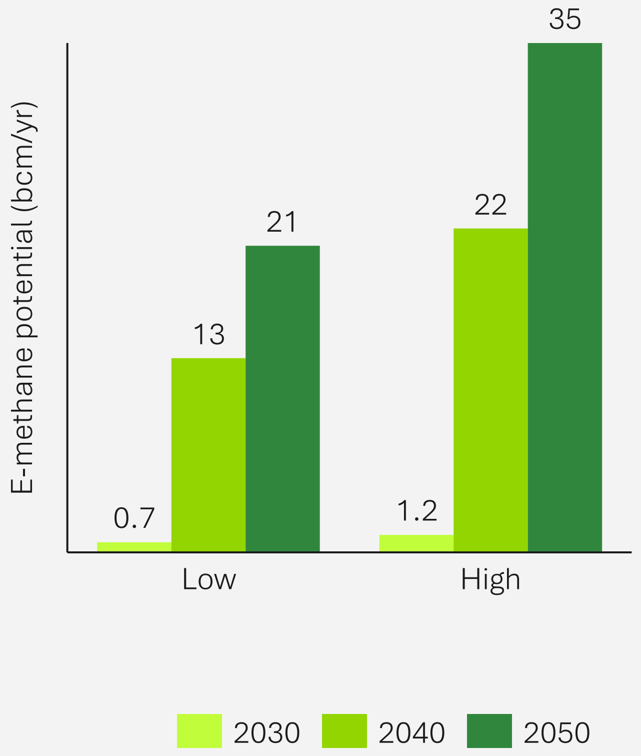
Biogenic CO2 per source in EU-27



Methodology

1. Share of the total biogenic CO_2 allocated to CCU (decreasing from 95% in 2030 to 50% in 2050)
2. 20-35% of this biogenic CO_2 is allocated to e-methane production in 2030, increasing to 30-50% in 2040 and 2050
3. Conversion of this biogenic CO_2 to e-methane (low/high range)

E-methane potential in EU-27



Faster mobilisation is critical to Europe meeting its biomethane potential

Key insights

Assessed 2030 potential has been lowered due to **insufficient action** to accelerate deployment of biogases and mobilise available feedstocks

Effective feedstock mobilisation requires:
i) **coordinated mapping** of resources and infrastructure planning ii) **clear definitions** and national targets iii) **predictable long-term incentives** for farmers and targeted engagement with stakeholders in the supply chain

Different strategies are needed for existing wastes and residues that need to be **collected** versus sustainable crops that need to be **cultivated**

Sequential crops require **clear, practical and supportive definitions** and **coordinated outreach** from biogas project developers – centred around a specific biogas plant – to mobilise the cultivation of sequential crops

Marginal and contaminated land offers untapped potential for biogas feedstocks, but requires **policy clarity, mapping, financial incentives**, and **coordination** between governments, municipalities, landowners, and biogas developers to become viable

Key takeaways

1

Biomethane and **e-methane** production potential is **34-35 bcm** for Europe in **2030** (31-32 bcm for EU-27) and **181-205 bcm** in **2050** (163-184 bcm for EU-27)

2

Anaerobic digestion leads scale-up to 2050, with potential of **~33 bcm** for Europe in **2030** (~30 bcm for EU-27) increasing to **98-105 bcm** in **2050** (90-95 bcm for EU-27)

3

Thermal gasification and e-methane are set to become relevant in Europe after 2030 – with **60-62 bcm** assessed for **thermal gasification** and **23-39 bcm** for **e-methane** in **2050**

4

Biogas scale-up is constrained less by sustainable potential and more by lack of timely action to accelerate biomethane deployment and **mobilise biomass feedstocks**

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Thank You

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