

Scaling-up Biogases Production

Shared recommendations for the design of future EU research and innovation investments

Research and innovation are at the forefront of a more sustainable future and the basis of the transition to a renewable energy mix. The signatories of this shared recommendations, a coalition of universities, highly valued research institutes and associations believe in the constant evolution of the biogases sector towards greater sustainability and process efficiency, better management practices and circularity. Research and development are key to unlocking new potential in biogases and safeguarding European strategic autonomy in biogases technologies. The EU research and innovation policy, underlying the funding programmes such as Horizon Europe, are of strategic importance to sustainably increase biogases production, integrate biogases production with other technologies, develop innovative production routes and untap specific end-use applications.

To further develop the sector and innovate, funding must be channelled into innovation and demonstration projects in the biogas field, such as:

1. Feedstock mobilisation

- a. Biomass production from contaminated, marginal, and degraded lands
- b. Novel waste valorisation routes suitable for biogases production
- c. Long-term field trials for novel agricultural systems

2. New technologies

- a. Gasification and methanation technologies
- b. Digestate application and digestate upgrading technologies
- c. Small-scale synthetic methane production, directly from the power grid
- d. Biogenic CO₂ storage and use

3. Optimisation and increasing efficiencies

- a. Pre-treatment technologies to increase biomass conversion efficiency.
- b. Biogas upgrading technologies
- c. Optimisation of existing digestion assets

The funding programs Horizon Europe, LIFE, Innovation Fund, InvestEU, are key in contributing to innovations in biogases production. Numerous promising technologies can contribute to the further scale-up of biogases. Some are close to commercialisation, while others require more work to grow from pilot to full scale. The signatories identifies the following research fields ensuring the further scale-up of biogases production.

1. Feedstock mobilisation

➤ Biomass production from contaminated, marginal, and degraded lands

Biomass production on degraded lands can increase soil carbon stocks and offers a sustainable non-food feedstock suitable for biogases production. While dedicated research at demo-scale has been

already executed in several EU projects, open issues such as biomass supply potential, biogas productivity, digestate characteristics and system economics remain.¹

➤ **Novel waste valorisation routes suitable for biogases production**

Biogases production potential will further increase by investigating in novel waste types such as seaweeds, digestate and bioplastic recycling currently not yet considered. There is an interest in using 'cast' seaweed as a sustainable feedstock for biogases production, while also delivering multiple co-benefits. Digestate can be used to produce additional biogases using either hydrothermal gasification or pyrolysis. Both technologies yield several co-products which can be valorised, including nutrients and biochar. Novel technological paths will additionally enable the use of difficult to degrade low grade biomass and waste types.

➤ **Long-term field trials for novel agricultural systems**

Novel agricultural practices, such as the Biogas Done Right (BDR) concept in Italy and grass silage cultivation in Ireland, have already proven to be successful. Long-term field trials in the different climate zones in Europe will strengthen knowledge and trust by farmers across Europe in these innovative sustainable practices to ensure further uptake.

2. New technologies

➤ **Gasification and methanation technologies**

Gasification and methanation technologies are an opportunity to diversify the technology basis for biomethane production in Europe and increase the overall biogases potential. Biomethane from gasification represents an important share of the potential by 2050, and a considerable 3 bcm by 2030², while biomethane from methanation increases Europe's biomethane potential by 66%. Increased knowledge of the technologies, assessing the coherence with the current policy frameworks and investigating synergies (such as the production of biochar and Carbon Dioxide Removal (CDR) potentials) are necessary to ensure a smooth and sustainable scale-up.

➤ **Digestate application and digestate upgrading technologies**

The 2022 fertilizer crisis showed EU vulnerability towards food security. Closing the nutrient cycle is part of the circular bioeconomy concept and contributes to achieving a climate-neutral Europe. Now, nutrients are lost along the entire food chain and polluting while energy intensive chemical fertilizers are produced and used instead. Further research directed towards digestate application and digestate upgrading technologies will support closing the nutrient cycle and facilitate an increase in digestate use, among others, on land, vertical farming, hydroponics and algae growth.

➤ **Small-scale synthetic methane production, directly from the power grid, for balancing purposes and grid services**

To mitigate grid congestion, stronger connections between the electricity and gas systems are required. As a congestion management strategy, small-scale synthetic methane stations can convert excess power to methane. Introduction of this method requires however demonstration projects, including process management strategies, variable operation, integration and delivery of grid services, strategic locations, CO₂ and CH₄ logistics and economic and environmental analysis.

➤ **Biogenic CO₂ storage and use**

During the biomethane upgrading process, highly concentrated biogenic carbon dioxide becomes available as a by-product. It can be re-used, for example in industrial processes or to produce e-fuels,

¹ BIP TF3.2 Feedstock production on marginal and contaminated land – an EU-wide potential assessment

² <https://www.europeanbiogas.eu/biomethane-production-potentials-in-the-eu/>

or it can be stored and thus permanently removed from the atmosphere. New developments and demonstration projects can unlock this easy-to-access source of biogenic CO₂.

➤ **Biogas utilisation technologies**

While biogas and biomethane are end-products of the anaerobic digestion and gasification processes with a broad range of applications, the development of innovative end-products such as biohydrogen and biomethanol can further increase the flexibility and versatility of biogas plants.

3. Increasing efficiency

➤ **Pre-treatment technologies to increase biomass conversion efficiency**

The introduction of advanced feedstock pretreatment technologies will both increase biogas yields (more biogas from the same amount of feedstock) and unlock new feedstock types. For example, steam explosion pretreatment of lignocellulosic feedstocks allows their treatment in an anaerobic digestion plant. These materials need to undergo pretreatment to be biodegradable in a biogas production facility.

➤ **Biogas upgrading technologies**

Development and optimisation of biogas upgrading technologies to convert biogas into biomethane are key to enable biogas plants to make a significant contribution to renewable energy production, fostering energy independence and supporting local economies.

➤ **Optimisation of existing digestion assets**

Apart from the introduction of new technologies and new feedstocks, the optimisation and intensification of existing digestion assets leads to increased productivity. This is for example, analysing the reasons behind unused or underused capacity from existing digesters, reducing the amount of self-consumption of biogas facilities, but also for example, real-time monitoring and control systems and the coupling of biogas plants with gasification and pyrolysis of digestates.




Recommendations for EU's strategic research and innovation investments

To safeguard Europe's strategic autonomy in biogas technologies, consolidate current biogas production potentials and ensure technical, economic and political efficiencies, innovation and demonstration projects are necessary. Furthermore, coordinated research facilitates cross-sectoral integration and collaborations.

The EBA encourages in particular the funding programmes Horizon Europe, LIFE, Innovation Fund, InvestEU to incorporate the above-mentioned topics and in particular:

- Stimulate the establishment of pilots and demonstration plants for novel technologies, which are close to commercialisation.
 - Assess the coherence of new technologies with current policy frameworks and integration of project results at policy level
 - Integrate biogas production with other technologies, such as the use of biogenic CO₂ from biogas upgrading.
 - Ensure environmental, economic, and social aspects are part of EU research and innovation projects.
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The signatories – subject matter experts³

Organisation logo	Co-signer	Description of the organisation
	Mieke Decorte, Technical Director at European Biogas Association	EBA believes in the potential of renewable gases in Europe. Founded in 2009, the association is committed to the expansion of sustainable biogases production and use across the continent. EBA counts on a well-established network of over 300 national associations and other organisations covering the whole biogas and biomethane value chain throughout Europe and further afield.
	Johan Andersson, Researcher at RISE Environmental Engineering	RISE is an independent, state-owned research institute. As an innovation partner for every part of society, we help develop technologies, products, services, and processes that contribute to a sustainable world and a competitive business community. We do this in collaboration with and on behalf of companies, academia, and the public sector. We also have a special focus on supporting small and medium-sized enterprises in their innovation processes.
	Erik Meers, Professor, Coordinator of the various Bioresource Recovery Platforms of the Ghent University Association	Ghent university is an internationally renowned, open, and socially engaged university in Belgium, with the credo “Dare to Think”. The university ranks in the top 100 university worldwide, has 11 faculties, 50,000 students and 15,000 employees.
	Lars Brüll, Research manager at TNO	TNO is an independent research organisation. A safer, healthier and more sustainable life. That's what we're going for. We are the flywheel for innovation. We make knowledge serve the public interest.
	Stefano Proietti, senior researcher at ISINNOVA	ISINNOVA is a research and consulting company in renewables, energy efficiency and sustainable mobility.
 UNIVERSITÀ DEGLI STUDI DI MILANO	Fabrizio Adani, Professor at UNIMI	University of Milano (UNIMI) is an academic public institute.
	Yifeng Zhang, Associate Professor and team lead at DTU	DTU Sustain is one of the largest university institutes in Europe specializing in environmental and resource technology.
	Jörg Kretzschmar, Professor of environmental biochemical engineering at Zittau / Görlitz University of Applied science	Zittau / Görlitz University is a University of Applied Science.
	Jörg Kretzschmar, former group leader “Microbial biotechnology for the diversification of	DBFZ is a non-profit research institute.












³ The signature it is valid as individual signature who appertains to the listed research institutes and Universities



	anaerobic processes” at DBFZ	
	Martijn Vis, Senior consultant at BTG Biomass Technology Group	BTG Biomass Technology Group has specialized itself in the conversion of biomass into fuels, energy, and biobased raw materials over the past 35 years. BTG is an independent, private company.
	Myrsini Christou Head of Biomass Department, CRES.	The Centre for Renewable Energy Sources and Saving (CRES) is the national agency for Renewable Energy Sources (RES), Rational Energy Use (RUE) and Energy Saving (EE).
	Bartosz Moszowski Director of the NitroSynCat Research and Development Center	Chemical Syntheses Institute is a research-and-development organisation which has been established over 70 years ago in Puławy, Poland to support the chemical industry in supplying innovative technologies to develop and optimise production processes and head towards a green transformation.
	Laia Llenas Argelaguet Deputy Director of BETA Technological Center	BETA is a Technological Center in Catalonia, Spain, aiming to improve the competitiveness and the quality of life of the rural societies, through the participation and leadership in national and international research projects and cooperating with companies, public administrations, and social entities.
	Mats Eklund, professor in Environmental Technology and Management and director of the Swedish center of excellence Biogas Solutions Research Center, Linköping University	The Biogas Solutions Research Center is a center that enhance society's ability to realize the sustainability potential of biogas solutions, by developing new knowledge that is societally relevant and of high scientific quality, through co-production with various societal actors.
	Robert Judd, Secretary General	GERG is a non-profit association for gas and energy research, bringing together a network of R&D professionals from industry and academia.
	Sandra Esteves, professor and director of the Wales AD Centre at University of South Wales	The University of South Wales is a public university in Wales, with campuses in Cardiff, Newport and Pontypridd. The university is the second largest university in Wales in terms of its student numbers, and offers around 500 undergraduate and postgraduate courses.
	David Chiamonti, professor at POLITO	The Polytechnic University of Turin (abbreviated as PoliTO) is the oldest Italian public technical university. The university offers several courses in the fields of Engineering, Architecture, Urban Planning and Industrial Design and is consistently ranked as one of the best universities in Italy and Europe.
	Frank Scholwin, CEO	The Institute for Biogas, Waste Management and Energy addresses complex issues surrounding biogas and advises biogas plant operators, utilities, and authorities in the areas

		of biogas, biomethane and the integration of renewable energy sources into the energy system.
	Dominik Rutz, Head of the Bioenergy and Bioeconomy Unit at WIP Renewable Energies	WIP is a private company founded in 1968. WIP has been active in the fields of all renewable energies and energy efficiency for over four decades, providing a range of technical expertise and non-technical services to both industrial and public-sector clients at the international level. Our mission is to bridge the gap between research and implementation of renewable energy and fuel systems.
	Manuel Coxe, Secretary General at MARCOGAZ	MARCOGAZ is the Technical Association of the European Gas Industry, acting as a reference entity for all technical matters for the midstream and downstream sectors.
	Wojciech Czekala, Professor at Poznań University of Life Sciences.	Poznań University of Life Sciences (PULS) is involved in many research activities, including sustainable development and renewable energy production. PULS has over 15,000 ha and 10 experimental farms, where there are currently 8 agricultural biogas plants, and in spring 2024 the first Polish biomethane plant will be launched. PULS also has the Ecotechnology Laboratory - the largest Polish biogas laboratory with nearly 250 fermenters, which supervises the operation of over 20 biogas plants.
	Daniele Molognoni, principal researcher at Leit at Technological Center	Founded in 1906, Leit at is one of the reference entities at state and European level in technology management. It has a team of more than 500 professionals, experts in applied research, technical services and management of technological and innovation initiatives. Leit at provides social, industrial, economic and sustainable value, offering comprehensive solutions in multiple sectors and areas. Leit at is recognized by the Ministry of Science and Innovation and is one of the main entities participating in the Horizon2020 and Horizon Europe program of the European Union.
	Sander Vandendriessche, Researcher Energy and Circular Economy at Inagro	Research and advisory centre for agriculture and horticulture. The department Energy and Circular Economy examines amongst others anaerobic digestion and biogas upgrading for the agricultural sector.
	Juan M. Lema, Emeritus Professor of Chemical Engineering at University of Santiago de Compostela	CRETUS is a cross-disciplinary research centre at the University of Santiago de Compostela, Spain, committed to developing and validating environmental technologies from a holistic perspective that considers technical, economic and environmental factors.

	<p>Mirko Cucina, Researcher at National Research Council of Italy (CNR)</p>	<p>ISAFOM (Institute for Agriculture and Forestry Systems in the Mediterranean) is an institute of the National Research Council of Italy (CNR), the biggest public research institute in Italy. ISAFOM is devoted to carry out investigation on the topics of sustainable agriculture and forestry systems.</p>
	<p>Francisco Gírio, Head of Bioenergy and Biorefineries Unit at LNEG</p>	<p>LNEG is a State-owned laboratory in the area of energy and geology. It has significant expertise in bioenergy, including renewable gases and chairs the national working group for the implementation of the Action Plan on Biomethane.</p>
	<p>Joana Bernardo, Chief Technical and Scientific Officer at CoLAB BIOREF Joana Bernardo</p>	<p>CoLAB BIOREF is a private non-profit association that links highly qualified knowledge and innovation to the industrial sector in two strategic domains: renewable gases & bioenergy and bioeconomy.</p>
	<p>Martin Soriano, R&D Project Coordinator at CETENMA</p>	<p>CETENMA is a private, non-profit Business Association, founded in 2000. It was set up to support companies with technological research, development and innovation in the energy and environmental fields. CETENMA is recognised as an RTD entity by the Spanish Ministry of Innovation at national level and registered as national Technology Centre with nº 116. CETENMA's R&D activities range over five main areas of knowledge: water technologies, waste valorisation, bioenergy, renewable energies and energy efficiency.</p>
	<p>Andrés Llombart, CEO AT CIRCE</p>	<p>Fundación CIRCE is a technology centre founded in 1993 to create and develop innovative solutions and scientific/technical knowledge and transfer them to the business sector in the field of energy for a sustainable development.</p>

The signatories – Horizon Europe and Horizon2020 projects

Project logo	Project coordinator	Project description
	David Farrusseng, research professor at CNRS	TITAN – Direct biogas conversion to green hydrogen and carbon materials by scalable microwave heated catalytic reactor for soil amendment and silicon carbide production
	Erik Meers, professor at UGhent	Nutribudget – Optimisation of nutrient budget in agriculture
	Erik Meers, professor at UGhent	Nutri2Cycle – Transition towards a more carbon and nutrient efficient agriculture in Europe
	Erik Meers, professor at UGhent	Novafert – Novel procedures and sustainable guidelines to enhance the use of alternative fertilisers
	Laia Llenas Argelaguet Deputy Director of BETA Technological Center	FERTIMANURE : Production of high-added value FERTILISERS from animal MANURE
	Victor Carbajal Perello, Strategic and Territorial Project Responsible, BETA Technological Center	NUTRI-KNOW : Broadening the impact of EIP-AGRI operational groups in the field of nutrient management
	Stefano Proietti, senior researcher at ISINNOVA	BIOMETHAVERSE : Demonstrating and connecting production innovations in the biomethane universe.
	Eduard Borràs, area manager at Leitat and scientific coordinator of Fuels-C	Fuels-C : Development of next generation advanced biofuel technologies.
	Sander Vandendriessche, Researcher Energy and Circular Economy at Inagro	Value4Farm : Integrating renewable energy in agriculture.
	Myrsini Christou Head of Biomass Department, CRES.	GreenMeUp : Green biomethane market uptake.
	Gonçalo Lourinho, Researcher at BIOREF	HyFuelUp : Hybrid biomethane production from integrated biomass conversion

	<p>Richard Heyn, Chief Research Scientist at SINTEF</p>	<p>eQATOR: Electrically heated catalytic reforming reactors</p>
	<p>Oscar Schoumans, Senior scientist soil and water quality and manure treatment at Wageningen University and Research</p>	<p>Systemic: Large scale eco-innovation to advance circular economy and mineral recovery from organic waste in Europe</p>

Contact

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