Low-carbon biomethane production from crop residues and break/cover crops: integrating sustainable farming practice and CO2 utilisation

University of Southampton (UoS)	**Administrative lead** UoS will carry out the research on in-situ CO2 biomethanisation combined with electricity storage using second-life batteries (PT3). As well as participate in technology analysis and optimisation in lab conditions(PT2) and development of recommendations for implementation of the technology on industrial scale(PT5). Dr Zhang will provide project management leadership to ensure adherence to schedule, budget and planned goals as well as transparency and clarity of reports.
Ukrainian technology company (UTC)	**Industrial partner** UTC, as an engineering and manufacturing company, will develop and provide settings for demonstration of developed technologies in pilot conditions (PT4). UTC will design and manufacture pilot unit and carry out the trials, analysis and optimization of the technology, as well as participate in recommendations development(PT5).
Public Union "Bioenergy Association of Ukraine" (UABIO) info@uabio.org	**Technical Lead** UABIO is responsible for carrying out PT1 (Biomass Supply and Post-treatment Utilisation) and PT6 (Reporting and Results Dissemination). As well as play the lead role in PT2 (R&D for Anaerobic digestion of crop residues and break/cover crops) and PT5 (Assessment for all developed concepts). UABIO is going to support the development of a partnership, knowledge sharing, and marketing activities for biomethane production and use.

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Project tasks

#	Task	Lead partner	Advisory partner	Time
1	Biomass Supply and Post-treatment Utilisation	UABIO		January 2026 – December 2026
2	R&D for Anaerobic digestion of crop residues and break/cover crops	UABIO	UoS	March 2026 – September 2027
3	R&D of Biomethanation of CO2 from digestion	UoS		January 2026 – December 2027
4	Demonstration of Developed Technologies in Pilot Unit	UTC	UABIO	April 2025 – December 2027
5	Assessment for all developed concepts	UABIO	UoS, UTC	January 2026 – December 2027
6	Reporting and Results Dissemination	UABIO		Continuous (24 months)
7	Project management	UoS		Continuous (24 months)

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Exploitation plan

	Month																							
	2026												2027											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP 1 – Biomass Supply and Post-treatment Utilisation - UABIO																								
1.1 Analysis and selection of effective technologies for collection, transport and storage of crop residues and intermediate/cover crops as an integrated part of the agricultural cycle including digestate utilisation for nutrient management and recycling																								
WP 2 – R&D for Anaerobic digestion of crop residues and break/cover crops - UABIO (5 months) + UoS (7 months)																								
2.1 Crop residues digestion, analysis of efficiency of mechanical and thermal treatment including mechanical and thermal treatment (milling, pellets, briquettes, etc.)																								
2.2 Co-digestion of crop residues with break/cover crops silage, distillery stillageand other avvialible feedstock																								
2.3 Optimisation of the digestion parameters in flow mode																								
2.4 Evaluation and analysis of lab test results, pilot recommendations																								
WP 3 - R&D of Biomethanation of CO2 from digestion - UoS																								
3.1 Optimisation of operating conditions for the specific integration arrangements, and development of real-time control strategies for in-situ CO2 biomethanisation																								
3.2 Analysis of key parameters for anaerobic digestion of crop-related materials with in-situ CO2 biomethanisation combined with electricity storage using second-life batteries																								
WP 4 – Demonstration of Developed Technologies in Pilot Unit - UTC																								
4.1 Design, construction and commissioning of Pilot Unit																								
4.2 Demonstration, analysis and evaluation of technology																								
4.3 Improvement and optimisation of technology																								
WP 5 – Assessment for all developed concepts - UABIO (12 months) + UoS (5 months)																								
5.1 Pilot support, avaluation and analysis of pilot test results																								
5.2 Assessment of alternative routes for CO2 utilization including:																								
a) CO2 transportation and underground storage																								
b) CO2 utilisation through algae cultivation																								
c)CO2 consumption for industry applications (greenhouses, food&beverage, other potential markets)																								
d) in-situ CO2 biomethanisation;																								
5.3 Biomethane production FS																								
5.4 Biomethane production LCA																								
5.5 Evaluation of carbon intensity levels																								
5.6 Development of recommendations for improvement and implementation																								
WP 6 – Reporting and Results Dissemination - UABIO																								
WP 7 – Project management - UoS																								
7.1 General management																								
7.2 Inner reporting meetings																								
7.3 GEDSI trainings within the team																								

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Expected outcomes of the project

- Creation of **the most resource-efficient chain of actions from pre-fermentation preparation to post-treatment utilisation** of crop residues and break/cover crops.
- **Validation of AD of crop residues with with break/cover crops silage and distillery stillage** in lab conditions.
- Greater understanding of **alternative CO_2 routs**.
- **Demonstration and validation of the technologies** in pilot conditions
- Development of **recommendation for industrial implementation of the technologies**.
- **Comprehensive assessment of technologies** including FS, LCA, and carbon intensity analysis.

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Pilot Unit for AD Technologies Demonstration

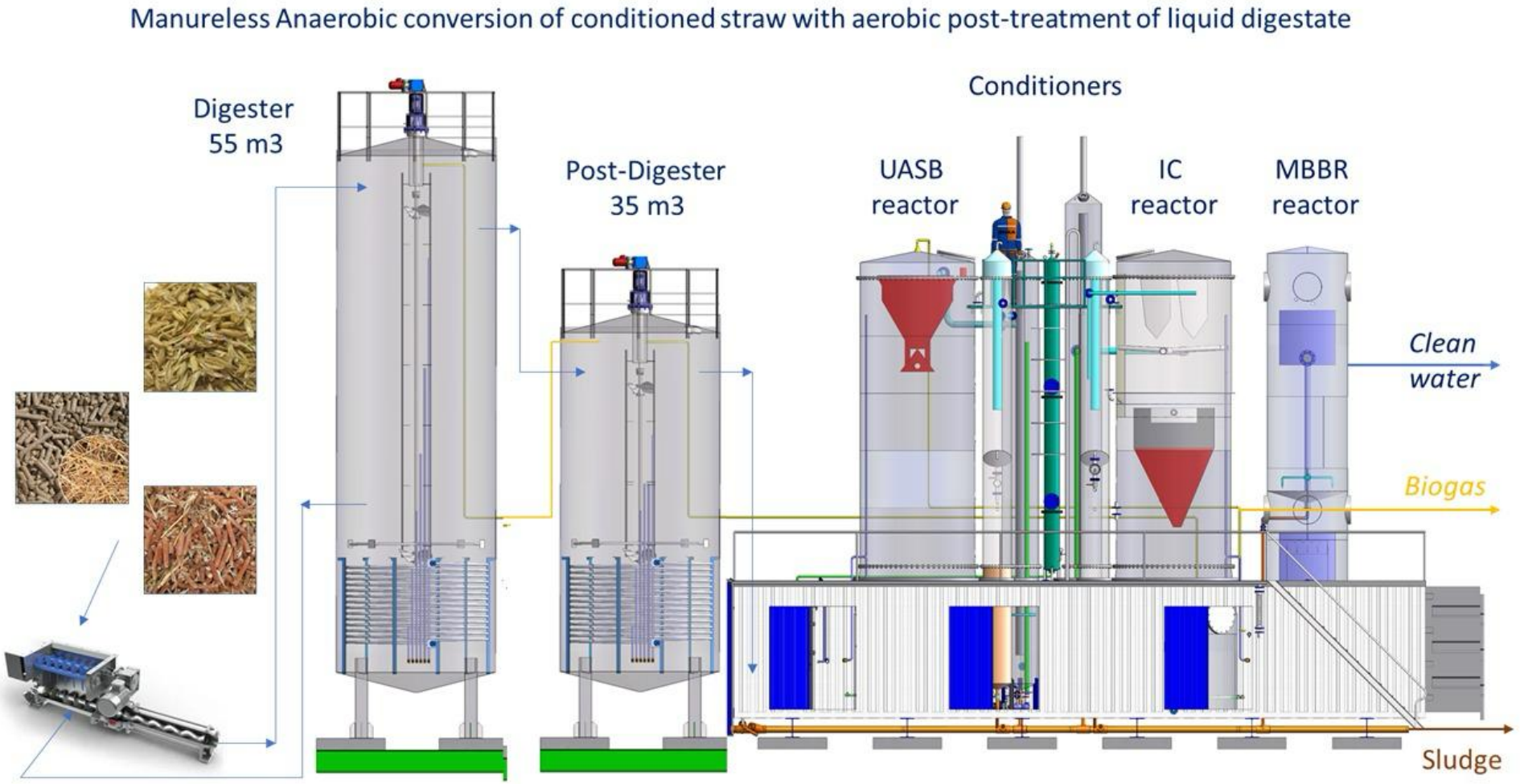

Fig.1 The scheme of cascade conversion of pretreated straw for biogas production and downstream digestate liquor treatment

What impact will this project have for Ukraine?

UABIO scenario of production and consumption of Ukrainian biomethane until 2050

	2027	2030	2035	2040	2045	2050
Biomethane production, bcm	0.25	1.00	2.1	4.5	9.5	**20.0**
Export biomethane, bcm	0.13	0.50	1.05	2.25	4,8	**10.0**
Biomethane consumption of the inner market, bcm	0.13	0.50	1.05	2.25	4,8	**10.0**
Number of biomethane plants, pcs	50	200	420	900	1900	**4000**
Necessary investments, billion €	0.5	2.0	4.2	9.0	19,0	**40.0**
Reduction of GHG emissions, million tons of CO2-eq	0.6	2.5	5.3	11.3	23,8	**50.0**
Created jobs, thousand units	3.1	12.5	26.2	56.2	118	**250**

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