Report on the International Advisory Board meeting

Turin, 15 March 2023

Deliverable 6.2

GREENMEUP

Funded by the European Union

Document control sheet

Project	GreenMeUp - Green biomethane market uptake
Call identifier	HORIZON-CL5-2021-D3-02: Sustainability and educational aspects for renewable energy and renewable fuel technologies
Grant Agreement n°	101075676
Coordinator	CRES - Centre for renewable energy sources and saving foundation
Work package n°	6
Work package title	Project Management
Work package Leader	CRES
Document title	Report on the IAB meetings
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Reference period	01/08/2022 - 31/05/2023
Due date	31/05/2023 (Month 10)

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This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No. 101075676.

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1 Summary of the GreenMeUp project

GreenMeUp – Green Biomethane Market Uptake is a Horizon Europe project that aims at providing a basis for policy-makers and stakeholders to develop more informed renewable energy policies and country-tailored market uptake measures, in order to improve and complement existing biomethane policy in Europe.

The core activity of GreenMeUp is to reduce the gap between countries with higher rates of biomethane production and countries with lower development rates, by analyzing and comparing their framework conditions and market dynamics and promote enabling policies and measures at country level. The project aims at providing societal acceptance of the biomethane value chain through science-based evidence and tools.

The EU has achieved significant progress the last decades in biogas and biomethane technologies and there is significant market deployment of several applications with a variety of feedstocks and uses of biogas and biomethane. In short, the EU is considered as a global leader in biogas and biomethane production technologies and applications. Furthermore, under the FIT for 55 legislation strong policy initiatives have been undertaken and the GreenMeUp project aims to contribute to these to whatever possible extend.

However, at the same time, developments in biogas and biomethane are taking place at a global scale with a variety of feedstocks, conversion technologies and support policies. To have a global perspective the GreenMeUp project has established an International Advisory Board with leading experts from key countries (Canada, India, USA & Japan) to collect information in all aspects of biogas and biomethane in view of eventually coming with recommendations concerning framework conditions for market uptake and enabling policy refinement.

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2 Introduction

This report refers to the first International Advisory Board (IAB) meeting held online on the 15th March 2023, in the frame of the second project meeting of GreenMeUp in Turin.

Role and Mandate of the IAB in the GreenMeUp

At the inception of the project, it was planned to have extensive cooperation with non-EU countries to gain knowledge on the various activities and issues related to policies and market deployment on biomethane market uptake. Biomethane has been globally recognized as a gaseous fuel that can help meet the decarbonization policies of all major economies. The focus was placed in cooperating with Mission Innovation countries which have strong policies in the market-uptake of biomethane. The international partners of the GreenMeUp project are listed in Table below.

Country	Representative
Canada	Nicolas Abatzoglou[1] & Warren Mabee[2] [1] Professor and ex-Head of the Department of Chemical & Biotechnological Engineering [2] Associate Dean & Director, School of Policy Studies, Queens University
India	Ramakrishna Y B, Partner, BEST Associates
USA	Sam Lehr, Manager of Sustainability and Markets Policy, The Coalition for Renewable Natural Gas
China	Shi-Zhong Li, Professor at Tsingua University

The role of the IAB representatives is to provide information on the policies, technologies and market uptake issues in their respective countries so that the GreenMeUp is well informed of non-EU activities, measures and actions on this field. The overall objective is that no effective action on market uptake issues will be missed by GreenMeUp so that the conclusions and recommendations of the project will be comprehensive and extensive.

The mandate of the IAB is to provide the latest information possible on biomethane in key Mission Innovation countries and establish a close cooperation with the EU experts so that the final recommendations by GreenMeUp at the end of the contract will also benefit the market uptake measures in the above-mentioned Mission Innovation countries.

The information in this report has been based on the presentations given at the meeting in Torino held on 15 March 2023. An updated analysis will be presented at the next meeting at Riga on 12-15 September 2023.

The complete agenda of the project meeting is given in the Annex. The meeting concerning the International Advisory Board took place between 14.00 and 15.10.

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3 Biomethane market in the Mission Innovation countries

3.1 Canada

Nicolas Abatzoglou presented the current market applications and policies.

Utilities across Canada have agreed to increased Renewable Natural Gas content targets for natural gas: 5% adding by 2025, 10% by 2030. However, there is not any binding legislation to enforce these targets. Targets and biogas market uptake varies considerably in Canada. In Quebec the Renewable Natural Gas Mandate (RNG-2019) aims at 1% RNG by 2020, 10% by 2030, being quite ambitious targets. In Ontario there is a Voluntary RNG program for residential customers, while British Columbia allows up to 15% RNG in the total annual supply of natural gas. Other major suppliers have varying targets; Enbridge (5% RNG by 2028) or FortisBC (75% RNG by 2050).

Regarding the technology update, biomethanization plants use anaerobic digestion to optimize the process of biomass degradation, in an oxygen-free and temperature-controlled environment: there are already units installed and operating across Canada and ongoing R&D to extend biomethanization on residual biomass (e.g. pulp and paper sludge; biomass steam-explosion residues and liquors). Hydrolysis, acidogenesis, acetogenesis and methanogenesis are the four in-series (and parallel) steps taking place. There are subject of intensive R&D activity to maximise the methane yield. Various active bacterial biomasses are tested and the role of inhibitors is investigated. Cleaning and purifying the produced biogas, mainly by removing heteroatoms impurities (i.e.; sulphur compounds) are used and are also subject to R&D endeavors. Pyrolytic gasification of biomass in the absence of oxygen with or without a subsequent catalytic conversion step produces a synthesis gas that can be converted into biomethane through catalytic processes. Methanation is another route under development: this is achieved through catalytic hydrogenation of CO2 obtained, for example, by purification of biogas.

Market up is quite extensive in Canada. Canadian biogas projects, developed by farmers, municipalities and commercial private sector entities, are varied in size and type and predominately located in British Columbia, Alberta, Ontario and Québec. They provide 6PJ of RNG that produces 196 MW of clean electricity and generate 260 Mm3 of biogas for direct use. Most of the biogas is used for electricity (~50%), another 30% is upgraded to RNG and the rest 20-25% is used for heat.

3.2 India

Ramakrishna Y B presented the Indian CBG (Compressed Biogas) emerging Scenario. He stressed that the world's first plant was set up in 1893 at Matunga in Mumbai. Since 1980's over 4.5 million small home and community biogas plants were set up in India to meet cooking and heating needs of homes mostly based on cow dung. There were two major initiatives to support biogas/biomethane deployment: the Gobardhan for biogas support and the SATAT – Sustainable Alternative to affordable transportation for supporting the use of biomethane in

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transportation. 40 plants were commissioned by March 2023, whereas another 100 are to be commissioned by the end of 2023. A target to replace 35% of total fossil gases consumed has been set in India that can replace 75% of imports of Natural Gas.

Feedstock come from waste/biomass streams, mainly recoverable cattle dung (285 mt) and the rest from agricultural residues, and MSW).

According to the SATAT, ambitious targets are set. 5000 commercial plants are to be set up by 2025 -26, with 15 MMT of CBG + 90MMT of fermented organic manure. 500 plants are to get fiscal incentive in 2023-24 and 100 % off take guarantee by OMC's companies. The pipeline injection of CBG has given a big push to connect biogas plants and CNG. This has been given priority lending by Public sector banks. 3300 Letters of Interest signed and 2400 MoU have been signed since the announcement of the policy. 40 plants have already been commissioned.

Most of the 2 and 3 wheelers will run on Compressed BG or E100 after 2025 besides already existing CNG vehicles.

However, major challenges remain, being:

- Streamlining the feedstock supply chain: there are several different feedstocks available, however, these are not available as commodities in the market. Therefore, supply chains have to be developed.
- Off take guarantee technical implementation: A plan for gas authorities to develop pipeline infrastructure to connect the biomethane plants to the main biomethane pipelines and CNG plants.
- Offtake market guaranties: a new narrative for the organic manure in comparison to chemical fertilizers on the NPK components is being developed by the Ministry of Agriculture, Ministry of Fertilisers and Ministry of Petroleum and Natural gas, aiming to set on organic carbon content getting back to soil. It is expected to be launched by summer 2023.
- Low cost & impact financing is another barrier: Working with various financial institutions including the World Bank for a plan to provide financing; it is expected also by summer 2023.
- Carbon credits: a new plan accounting and rewarding mechanism for carbon saving, expected to be introduced by the end of this 2023.
- Budgetary Provisions made for the 2023-24.

3.3 USA

Sam Lehr presented the activities of the Renewable Natural Gas (RNG) Coalition he represents. In USA RNG mainly comes from MSW -landfills (69%) and agricultural wastes the volume of which increased significantly recently (19%). Waste waters have the lowest potentials. Food wastes are expected to increase by time. Uses are thermal applications, use in transportation, electricity production, hydrogen production and various bio-based products. RNG in USA is regulated by mandatory, voluntary, and other enabling policies in 44 states and provinces. The production capacity is 94.8 tBtu/yr, another 82.7 tBtu/yr are planned which shows that the planned is practically equal to the expected capacity. This indicates that market deployment and growth is expected to continue. The AD-biomethane can reach 1,425.3 – 4,300 tBtu/yr by 2040, which is the 12-26% of the current gas demands in the USA.

Low Carbon/Clean Fuel Standards is the main policy that continue to expand, and existing programs are focusing on increases in ambition. British Columbia is committed 30% by 2030

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(from 2010), Washington is examining up to 20% by 2034 (from 2017), Oregon is examining 20% by 2030, 37% by 2035 (from 2015) and California is examining at least 25% by 2030, 54% by 2035 (from 2010), whereas Canada is examining 15% by 2030 (from 2016).

Regarding the Renewable Gas and Clean Heat Standards, BC RGS targets 15% by 2030, OR RGS targets 5% by 2024, 30% by 2050, CA RGS mandates 12.2% by 2030, CO CHS: Investment via utility "Clean Heat Plans", VT CHS: Uses "Clean Heat Credits" to meet unspecified targets, MA CHS: Renewable gas standard; broad renewable thermal incentives, NH RGS: Allows up to 5% RNG, QC RGS: Mandates 10% by 2025, MN CHS: Investment via utility "Innovation Plans". A big pull for the market.

The Inflation Reduction Act contains beneficial tax policies advocated for by RNG Coalition:

- Biogas property, including cleaning and conditioning equipment, as qualifying equipment for purposes of the Section 48 energy credit for AD-based biomethane.
- Extension of $.50 alternative fuel tax credit applies also to a number of other biofuels.
- New clean hydrogen tax credit that allows for the use of RNG as a qualifying feedstock.
- 45Q carbon oxide sequestration credit.

Some broad considerations for the uptake of biomethane is his use in circular Economy, sustainability, Carbon Neutrality/Negativity, GHG Accounting.

3.4 China

In China, policy developments related to biogas/biomethane started in December 2019 with the Guidance on Promoting the Development of Bio-Natural Gas Industrialization issued by National Development & Reform Commission and other nine ministries, and continue to be in power since then. Two major acts are highlighted: i) in May, 2022 the "Fourteenth Five-year Plan, Bio-economy Development Plan" issued by National Development & Reform Commission, and in Oct., 2022 the "Energy Carbon Peak & Carbon Neutral Standardization Improvement Action Plan" issued by National Energy Administration.

Regarding the technology update including any new major plants, the transition from small scale house-hold biogas tank for farmers' family use to industry-based anaerobic digester for bio-natural gas production, led to more than 40 million house-hold biogas tanks to produce around 17 billion Nm3 biogas for improving farmers' energy use and more than 100,000 industrial digesters to produce around 3 billion Nm3 biogas for power generation and biomethane production. 300 million Nm3 biomethane were produced to be injected to natural gas pipeline or for vehicle use annually.

Liquid state anaerobic fermentation is the dominant technology, and wastewater is one of the biggest issues for biogas and biomethane production.

The production efficiency of batch solid state anaerobic fermentation is poor, hence there are only a few plants using solid state fermentation technology.

Since most bio-natural gas plants are not profitable, the infant industry is at a dilemma state.

As for the biomethane market uptake in China, 300 million Nm3 biomethane were produced in 2022 to contribute 0.0892% of natural gas consumption. According to the Development Plan of Bio-Natural Gas issued by NDRC, 10 billion cubic meters biomethane will be produced by 2025, and 20 billion cubic meters by 2030. Biomethane production potential from agricultural waste, urban organic waste, and industrial wastewater is round 300 billion cubic meters.

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Continuous solid state anaerobic fermentation is a promising technology, and at pre-commercialization stage. Biomethane carbon monoxide reforming to produce syngas as the feedstock to produce sustainable aviation fuel (SAF) is a new option of biogas utilization.

4 Conclusions

- The members of the International Advisory Board presented ambitious targets for biomethane production and use aiming to replace natural gas in all 4 countries.
- It was clear that the Mission Innovation countries have similar strategies in promoting the market uptake of biomethane.
- From the presentations and discussions, it was made clear that technology is not a deployment barrier. However, the cost of converting biogas to biomethane is a financial and economic barrier that hinders more widespread deployment in India and China.
- It was also concluded that the feedstock for biogas production is mostly agricultural and animal husbandry residues or other waste streams and as such there are no apparent barriers related to their sustainability or availability for the foreseeable future.
- The production of biomethane from biomass via the gasification route still needs technological development before in could become commercially competitive. However, the CAPEX costs of this value chain is considered significantly more expensive than anaerobic digestion followed by upgrading the biogas to biomethane.
- To strengthen the cooperation, it was discussed that it would be imperative that the representatives from IAB would meet with their European counterparts in one of the future project meetings. The coordinator, Mrs Christou informed the project participants that she would endeavour to invite the IAB experts to attend physically one of the future project meetings. To be able to have more concrete discussions it was proposed to wait till the 4th project in spring 2024 meeting by when the work would have progressed, and more results would be available.

Note:

The terminology is different and varies as:

Biomethane in the EU and China

Renewable Natural Gas in Canada and the USA

Compressed Biogas in India

Although this is not a problem in discussion amongst experts, it may result into misunderstandings with citizens.

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5 Annex

Project Meeting #2

Turin, 15-16 March 2023

NH Collection Piazza Carlina

Agenda of the project meeting

Wednesday 15 March 2023	
10:00 - 10:10	**Opening** Myrsini Christou/CRES **Welcome** Lorenzo Magioni, Carlo Pieroni/CIB
10:10 - 10:20	**Agenda and practicalities**
10:20 – 10:40	**The GreenMeUp project** Myrsini Christou/CRES
10:40 – 11:30	**WP3 (Stakeholders' engagement)** Laura Garcia Laverde /DBFZ (30 min) Spyros Karytsas/CRES (30 min) D3.1 Report on established policy, market and stakeholder hubs in the 7 target countries (M12 – 31 July 2023).
11:30 – 12:00	**WP4 (Market uptake measures)** Christos Tourkolias/CRES D4.1 Policy briefings for EU and 7 target countries (M12 – 31 July 2023).
12:00 – 12:30	**WP5 (Outreach)** Maurizio Cocchi, Teresa Ridolfi/ETA D5.2 Report on policy workshop 1 (M14 – 30 September 2023).
12:30 - 13:00	**WP6 (Coordination)** Myrsini Christou/CRES D6.1 Project Management Plan: Updated timetable, work plan, protocols (M2 – 30 September 2022) D6.2 Report of the International Advisory Board meetings (M10 – 31 May 2023)
13:00 – 14:00	Networking lunch break
14:00 - 15:10 (10 min each)	**A word from our International Advisory Board (online)** Kyriakos Maniatis **GreenMeUp in a nutshel** Myrsini Christou/CRES **China**: Shi-Zhong Li / Executive Director of MOST-USDA Joint Research Centre for Biofuels **Canada**: Nicolas Abatzoglou / Université de Sherbrooke (UdS), specialist in Process Engineering **India**: Ramakrishna Y B / Member Expert - Working Group on Bio Fuels, MOP&NG, Chairperson - IFGE - CBG Producers Forum **USA**: Sam Lehr/RNG Coalition's Manager of Sustainability and Markets Policy **Canada**: Warren Mabee / Canada Research Chair for Renewable Energy Development and Implementation, Executive Director in Queen's Institute for Energy and Environmental Policy, and Associate Task Leader in IEA Bioenergy Task 39 - Liquid Biofuels **Questions**
15:10 - 15:30	**R&I policy for biomethane and renewable fuels** Dr Maria GEORGIADOU, EC RTD
15:30 - 16:00	**WP1 (Market dynamics & framework conditions in advanced European and MI countries)** George Osei Owusu, Antony Lorin/EBA (20 min)

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	– **In Italy** Lorenzo Maggioni, Carlo Pieroni/CIB (5 min) – **In Germany** Laura Garcia/DBFZ (5 min) D1.1 Overview of production routes and end-uses of renewable energy gases and existing policy frameworks in advanced European and MI countries (M6 – 31 January 2023).
16:00 – 16:30	Coffee break
16:30 – 18:00 (10 min each)	**WP2 (Market dynamics & framework conditions in target countries)** Myrsini Christou/CRES – **in Poland** Beata Wiszniewska/PIGEOR – **in the Danube region** Peter Canciani/INCE – **in Latvia** Baiba Brice/LBA – **in Czech Republic** Vojtech Pospisil, Adam Moravec/CZBiom – **in Estonia** Tauno Trink/EstBA – **in Spain** David Fernandez/ – **in Greece** Emmanouil Zafeiris/DEDA D2.1 Country reports on existing production routes, end-uses, policy frameworks and market dynamics (M10 – 31 May 2023).
18:00 -18:15	**General remarks – Other issues-End of meeting**

Thursday 16 March 2023	
	Visit to Cooperativa Speranza **(2 MWel + 6 ton per day bioLNG + CO2 capture and storage).**
09:00 – 09:30	**Departure from the NH hotel at 9-9.30 by coach.**
13:30 – 14:00	**Arrival back in Torino at 13.30-14.00**

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