Updated Report on the International Advisory Board meeting

Tallin, 16-18 April, 2024

Deliverable 6.5

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	Updated Report on the IAB meeting
Author	Kyriakos Maniatis / KM-IIC & Myrsini Christou / CRES
Reference period	01/08/2022 - 31/07/2025
Delivery date	17/7/2024

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

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

Table of Contents

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

List of Tables

List of Figures

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

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.

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

2 Introduction

This report is an update of the first Report on International Advisory Board (IAB) submitted as Deliverable D6.2 and it is based on the presentations and discussions of the IAB members of ICARUS at the 4th project meeting that took place in Tallin on 16-18 April 2024.

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 1 below.

Table 1. International partners of the GreenMeUp project

Country	Representative
Brazil	Renata Isfer Executive President Abiogás, the Brazilian Biogas Association
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.

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

The information in this report has been based on the presentations given at the meeting in Tallin held on 16-18 April 2024. The complete agenda of the project meeting is given in the Annex. The meeting concerning the International Advisory Board took place on 16 April 2024 between 14.30 and 16.30.

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

3 Biomethane market in the Mission Innovation countries

3.1 Brazil

Brazil is a new member of the International Advisory Board and the presentaion was given by Mrs Renata Isfer - Executive President of ABiogás, the Brazilian Biogas association.

Biogas applications are widespread in the country, however, biomethane plants are mainkly found in the southern states of Brazil as shown in Figure 1 below. There are 885 biogas plants in the country producing 4.6 million cubic meter per day while about 20 plants produce 985,000 cubic meter per day biomethane.

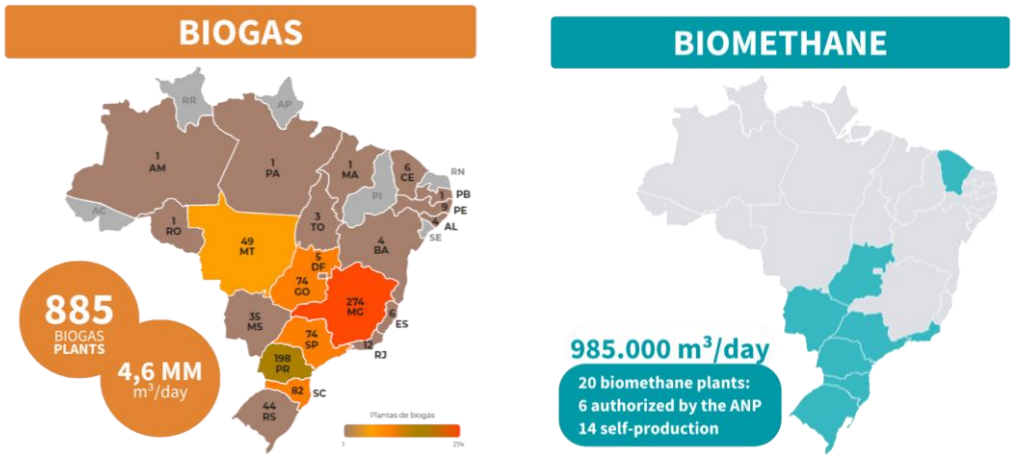

Figure 1. Biogas and biomethane geographical distribution in Brazil

The biomethane potntil is estimated at 120 million cubic meter per day as shown in Figure 2 below.

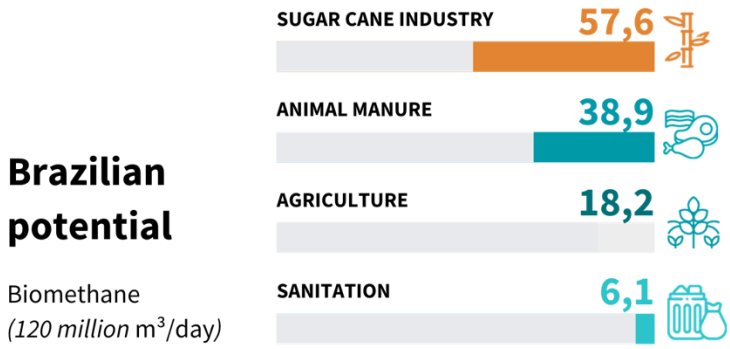

Figure 2. Brazilian potential for biomethane based on feedstock availability

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

There are several regulatory incentives in Brazil and these are summarised in the Table 2Table 1 below.

Table 2. Regulatory incentives in Brazil

Name of Incentive	Description
NEW GAS LAW[1]	Brought measures to opening the gas market in Brazil and establishes that biomethane that complies with ANP standardization must have equal regulatory treatment of natural gas.
NATIONAL POLICY FOR SOLID WASTE	Established targets for improving the management of urban solid waste, including biogas production.
NATIONAL BIOFUELS POLICY - RENOVABIO:	Program that sets decarbonization goals for liquid fuel distributors, who need to acquire decarbonization credits (CBIOs) from biofuel producers, see Figure 3.
THE SUSTAINABLE CORRIDORS PROGRAM	State incentives to adapt fuel stations to supply trucks with natural gas and biomethane and federal incentives for the substitution of diesel truck fleet to CNG and LNG motors.
PARANÁ RENEWABLE RURAL ENERGY - RENOVAPR:	Special financing conditions for renewable energy generation, including biogas and biomethane production
GREEN SUPPLY CONTRACT	Natural Gas distribution companies in the State of São Paulo may sign with consumers a contract that will provide biomethane to consumers, by charging an additional price.
MOVER	Establishes that all government incentives must consider life cycle energy analysis when making policies to incentivize green mobility.
BIOMETHANE MANDATORY MIXTURE	State of Sao Paolo obliges natural gas distribution companies to have a 10% mixture of biomethane, but it sets a very low cap price for the acquisition of biomethane.

The RenovaBio incentive signed into law (Federal Law Nº 13.576[2]) in December 2017, has been proven a successful one and its principles are depicted in Figure 3. The National Biofuels Policy (RenovaBio) aims to reduce greenhouse gas emissions, improve the life cycle energy efficiency of biofuels, and promote the national biofuel industry.

[1] https://faolex.fao.org/docs/pdf/bra203769.pdf
[2] https://www.gov.br/anp/pt-br/assuntos/renovabio/arq/law-13576-2017.pdf

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

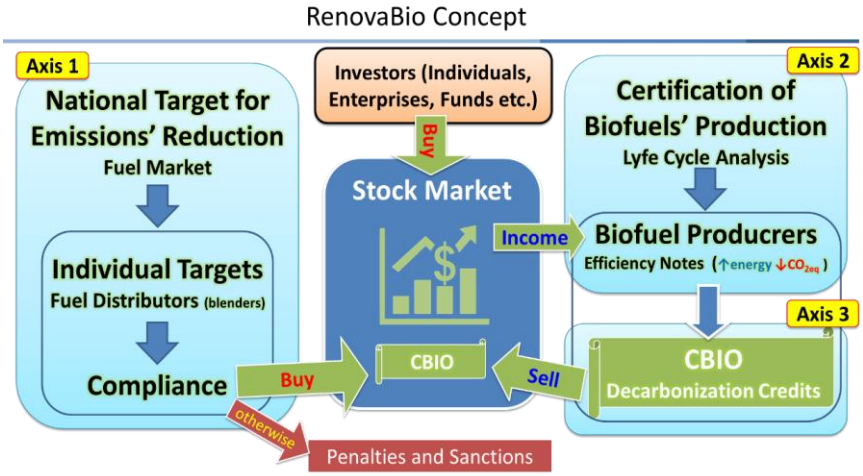

Figure 3: Depiction of the successful RENOVABIO concept

In addition to the RenovaBio, the Biomethane Mandatory Mixture of Sao Paolo State if of interest since the state is seeking to capitalize on growing demand for renewable energy, announcing a series of measures to increase biogas and biomethane production across various sectors, including sugarcane, waste management firms and waste agriculture. The focus will initially be on the sugar and ethanol industry, which can produce 30mn m^3/d of biogas. Biogas contains 50pc methane, which can be processed into biomethane, a drop-in substitute for natural gas[3]. Finaly the state also aims to attract investment in biogas production from animal waste, which can produce up to 5mn m^3/d.

In addition to the above policies there are also several tax incentives to support the market development for renewables that could alo be applied to biogas/biomegthane deployment. However, specific to biogas and biomethane is Law No. 9,635/2022[4], of the State of Rio de Janeiro, The new law reduces the ICMS tax rate on local transactions in biogas and biomethane to 12% of the transaction value.

In spite of the above numerous initiatives to promote biogas and biomethane there are still critical barriers impeding thr market uptake of biomethane. The most critical of them are;

Infrastructure: the gas grid in Brazil is very limited and this hinder th deployment of biomethane. At present prctically all applications are for local use.

Costs: the technology costs especially for biomethane remain relative high and small SMEs can't afford th procure the technology.

Effective Public Policies and Regulation: there are several iniotiatives and regulations but their effectiveness is questionable due to their complexity and often state approach.

[3] https://www.argusmedia.com/en/news-and-insights/latest-market-news/2567783-sao-paulo-state-seeks-biomethane-boost

[4]https://www.tauilchequer.com.br/en/insights/publications/2022/04/state-law-no-96352022-state-of-rio-de-janeiro-reduces-icms-on-biogas-and-biomethane-transactions

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

3.2 Canada

Nicolas Abatzoglou presented the current market applications and policies.

Regarding policy support for low carbon fuel policies Canada adopted the Clean Fuel Standard[5i] (2022). Furthermore British Columbia issued the Low Carbon Fuel Standard[6] (2022) while Quebec issued the Regulation[7] respecting the integration of low-carbon-intensity fuel content into gasoline and diesel fuel. However, it is notable that none of these policies include gaseous fuels at this time.

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).

Canada and some of its provinces has adopted carbon offset system[8] as shown in Table 3 below:

Table 3: Carbon offset systems in Canada

Canada/Province	Offset system
Canada	Greenhouse Gas Offset Credit System (2023), includes landfill gas abatement but not biogas (yet)
British Columbia	Greenhouse gas offset protocol (2022), includes biogas substitution
Alberta	Alberta Emission Offset System, Includes biogas production for energy generation
Quebec	Quebec carbon market offset credits, Includes biogas for energy generation

Canada's Greenhouse Gas (GHG) Offset Credit System encourages municipalities, Indigenous communities, foresters, farmers and other project developers to undertake innovative projects that reduce GHGs compared to business-as-usual practices. Proponents of offset projects can generate federal offset credits if they register and implement projects meeting requirements in the *Canadian Greenhouse Gas Offset Credit System Regulations* and an applicable federal offset protocol. The Canadian Offset Credit System however, doesn't include biogas or biomethane and this prompted the three provinces in the above Table 3 to issue their own offset system that includes biogas applications.

Regarding the technology update, biomethanization plants use anaerobic digestion to optimize the process of biomass degradation, in an oxygen-free and temperature-controlled

[5] https://laws-lois.justice.gc.ca/eng/regulations/SOR-2022-140/
[6]https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels
[7] https://www.legisquebec.gouv.qc.ca/en/document/cr/P-30.01,%20r.%200.1
[8]https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/federal-greenhouse-gas-offset-system.html

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

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 28% is upgraded to RNG and the rest 20-25% is used for heat. The biogas end use in Canada is shown in Figure 4 below.

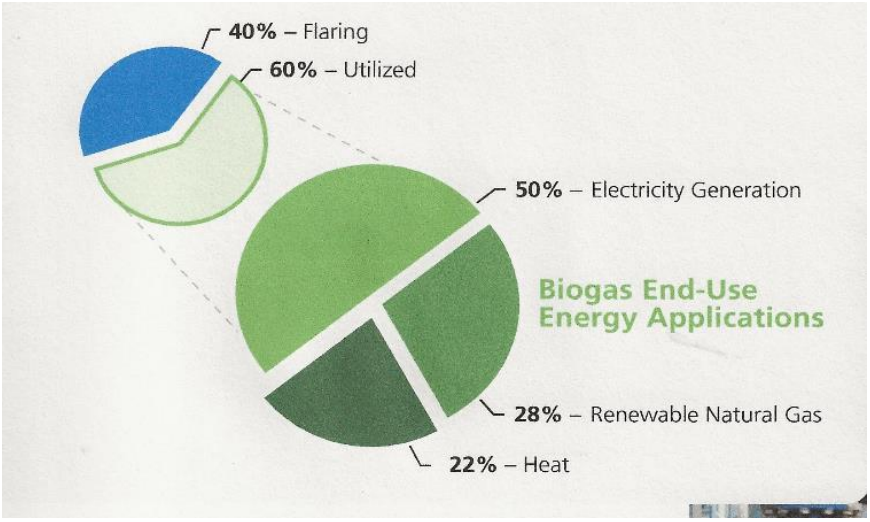

Figure 4: Biogas end use applications in Canada (https://biogasassociation.ca/)

The market uptake of biogas and biomethane per province and sectors is shown in Figure 5.

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

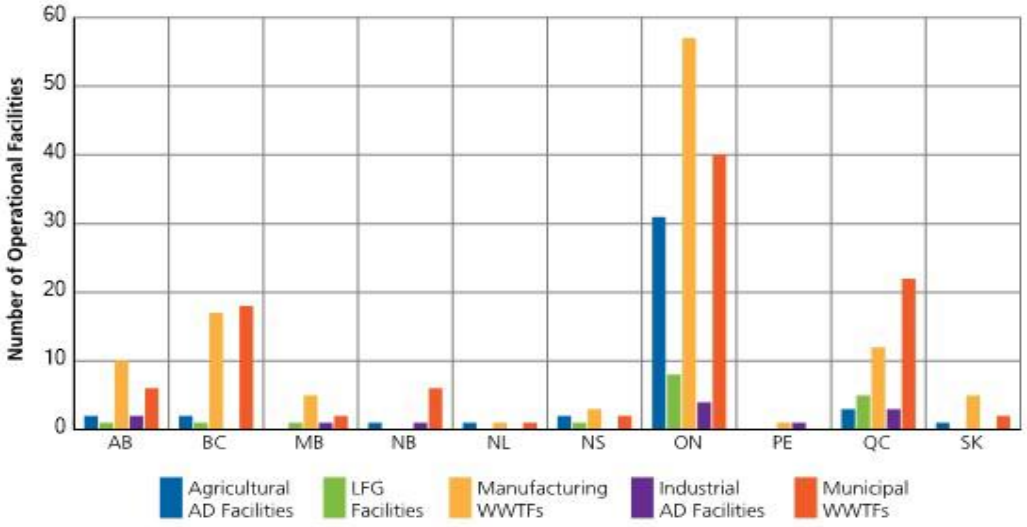

Figure 5: Market uptake per province and sectors

From Figure 5 it can be seen that there are big variations in the various provinces of Canada concerning market uptake with Quebec being the most active followed by Bristish Columbia and Alberta.

Since 2020 there has been significant increase in the number of biogas/biomethane projects as indicated in Figure 6. It is also characteristic that Ontario has been very active in new biogas/biomethane projects and as of 2025 it is expected that it will lead the market uptake in Canada.

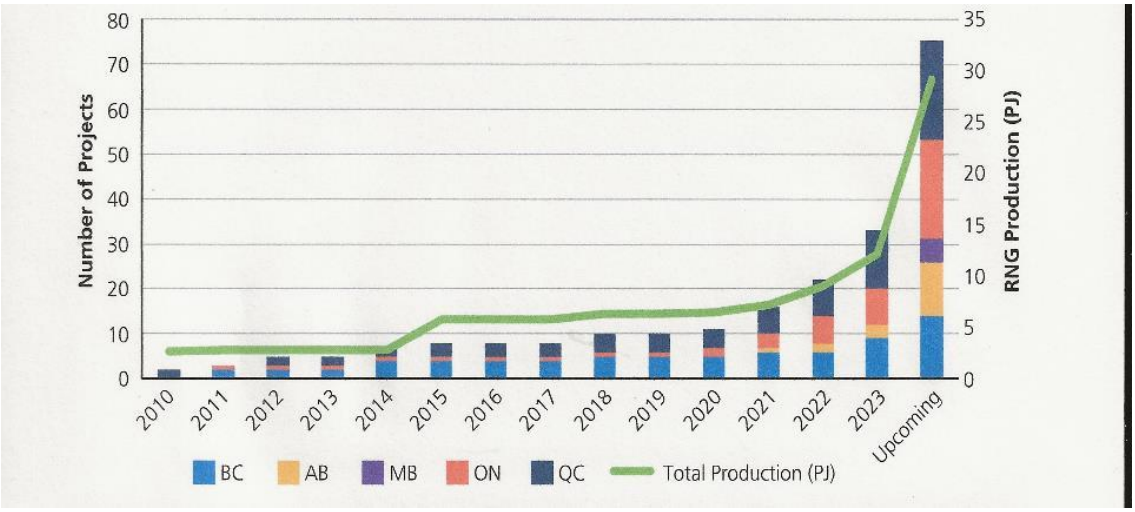

Figure 6: Renewable Natural Gas project in Canada, (https://biogasassociation.ca/)

According to the Canadian biogas Association the following are some key take away messages:

1. Only 14% of the biogas potential is so far exploited; thus, there is significant more potential for market uptake of biogas/biomethane applications in Canada.
2. While policy and support are important for the biogas & Renewable Natural Gas (RNG) sector to achieve its full potential, most of the potential projects are under

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

development to demonstrate their technology value to business and communities. There are currently 43 RNG projects under development which account for an additional 16.85 PJ.

3. Barriers to realizing the full potential of biogas & RNG energy in Canada: need for significant investment tax credits (ITC) for clean tech and hydrogen.
4. There are significant challenges connecting to the natural gas and electricity grid.
5. There is a serious lack of technology understanding and awareness

3.3 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. This was thanks to an initiative by the Ministry of New & Renewable Energy (MNRE) that gave a big push for setting up small, medium biogas plant. Some medium sized plants were either community based (piped gas for homes) or industry based for heating applications.

There were two major initiatives to support biogas/biomethane deployment: the Galvanizing Organic Bio-Agro Resources Dhan[9] (Gobardhan) for biogas support and the 2018 Sustainable Alternative to Affordable Transportation[10] (SATAT) for supporting the use of biomethane in 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 almost 50% of imports of Natural Gas.

The SATAT also had the wider objectives listed below:

- 100 % off take guarantee by OMC's on CBG at remunerative price.
- To enable Pipe line injection of CBG.
- Priority lending by Public sector banks.
- Move towards Organic Farming by promoting Fermented Organic Manure (FOM).
- Auto Industry - Most of the 2 and 3 wheelers will run on CBG after 2025 besides already existing CNG range of vehicles.

Feedstock come from waste/biomass streams, mainly recoverable cattle dung (285 mt) and the rest from agricultural residues, and MSW) as indicated in the Table 4 below.

[9] https://www.india.gov.in/spotlight/gobardhan-galvanizing-organic-bio-agro-resources-dhan
[10]https://mopng.gov.in/en/pdc/investible-projects/alternate-fuels/sustainable-alternative-towards-affordable-transportation

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

Table 4: Feedstock resopurces for biogas/biomethne in India

Waste/Biomass stream	Estimated waste/ Biomass generated	Bio-CNG Potential	Compost or Fermented manure
	(in MMT/annum)	(in MMT)	(in MMT)
Surplus Agri-residue	150	20	70
Spent wash/Press mud	20	2	3
MSW	100	5	15
Sewage treatment plants	-	10	-
Recoverable cattle dung	1100	25	285
Total potential	**1370**	**62**	**373**

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. In the financial year in 2023-2024 22,097 tonnes of CBG were sold in India.

In 2023-2024 period there have been several capital subsidies announced/ These are listed below:

- An outlay of Rs. 8.58 billion Central financial assistance (CFA) approved for implementation of various biogas programs – covering urban/Industrial/agricultural wastes to be spent by March 2026.
- For small Biogas plants CFA would be Rs.9800 to 70400 based on size of the plant from 1-25 cubic meters/day.
- For Biogas to energy plants of size 25-2500 cubic meter the CFA would be Rs.35000 to 45000 per KW capacity.
- Capital subsidy (CFA) to large CBG plants would be Rs. 40 Million up to plant size of 4800KG/Day with a cap of Rs.100Million per plant.

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. It is necessary to balance supply and demand.
- It is necessary to build a pipeline infrastructure to transport the gas especially to industrial users and the lack of such a network will cause delays in the market uptake of biomethane.
- 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

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

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.
- It would be important to encourage farmers to migrate to organic farming.
- Carbon credits: a new plan accounting and rewarding mechanism for carbon saving, expected to be introduced by the end of this 2023.
- More effective coordination between ministries is needed to provide clarity in the various policies and initiatives.
- It is critical to sensitise and increase the involvement of state and local government.
- Budgetary Provisions made for the 2023-2024.

In conclusion the policy and market ecosystems are evolving well with the Central government being highly proactive and willing to address all genuine concerns of the industry. However, not all states are proactive and it will be a challenge to get all of them promoting the biogas/biomethane uptake. Financing small scale biogas projects in farming communities remains a problem and this area needs innovative solutions. An area that needs more attention is that the CO2 (often seen as a waste stream) can be a very important revenue stream and more research in needed in this area.

3.4 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.

Figure 7 shows the Renewable Gas development in the US. The overall production capacity is 119 BCF/y from 334 installations while there are 165 installations under construction expected to deliver another 147 BCF/y when taken into operation. At present this provides about 1.6% of the natural gas dmand for heating.

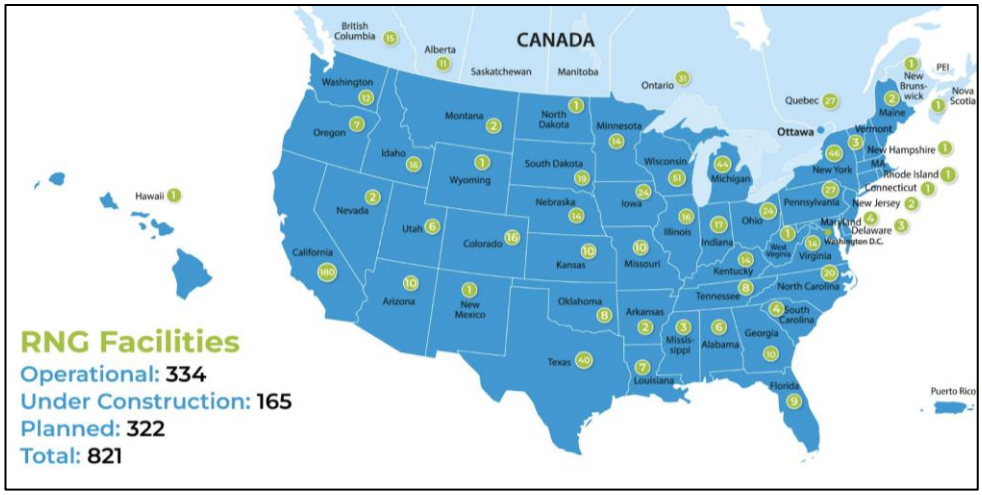

Figure 7: Renewbale gas development in the US

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

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. Figure 8 shows the development of policies in the US and Canada.

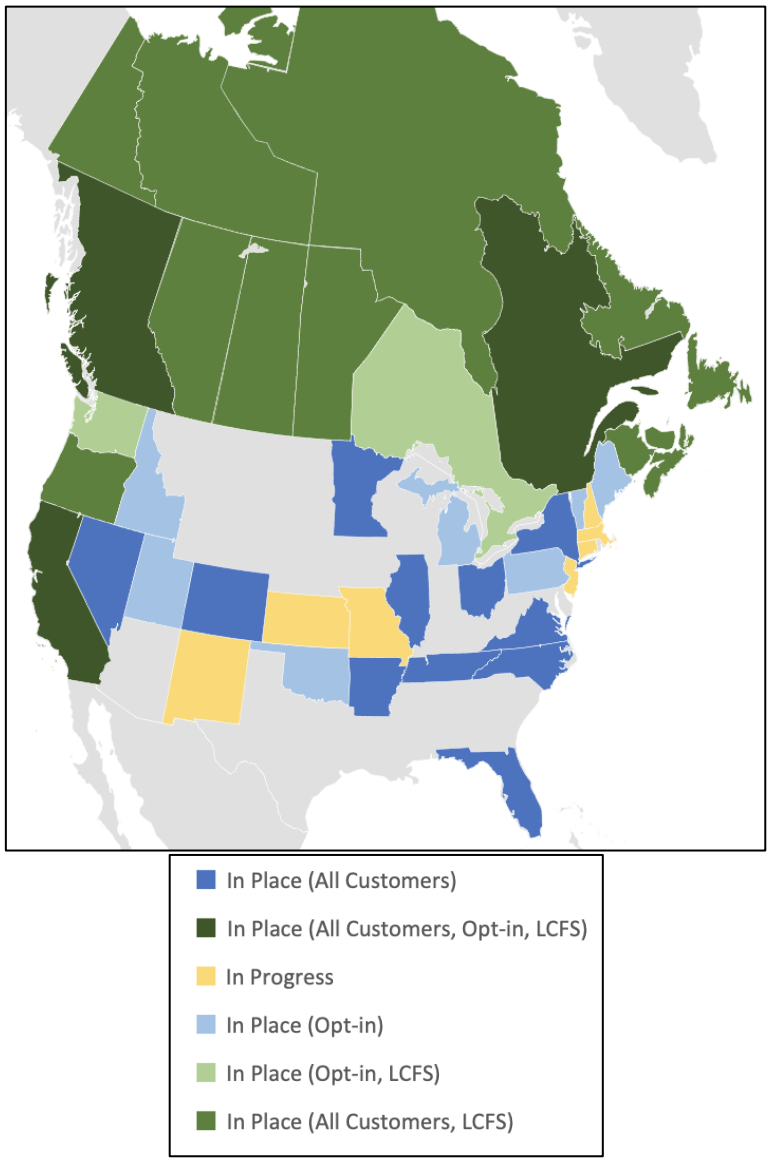

Figure 8: Biogas/biomethane Policy in Noerth America

British Columbia is committed 30% by 2030 (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%

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

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 its use in circular Economy, sustainability, Carbon Neutrality/Negativity, GHG Accounting.

3.5 China

Biogas has a long history in China, and received continuous support of state after 2000, from one billion yuan a year, to four billion, up to 6 billion, focused on small digester for farmers’ household use. Since 2014, it gradually shifted to support large-scale and industrial biogas projects for transformation and upgrading of the industry. The potential of biomethane production in China is 150 billion to 200 billion Nm3 annually.

The biomethane industry is still in its early stage with an annual capacity of only **300 million Nm3**.The policy and standard system needs to be formed and improved.

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.

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.

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,

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

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.

Figure 9 indicates the raodmap for industrial development of biomethane in China.

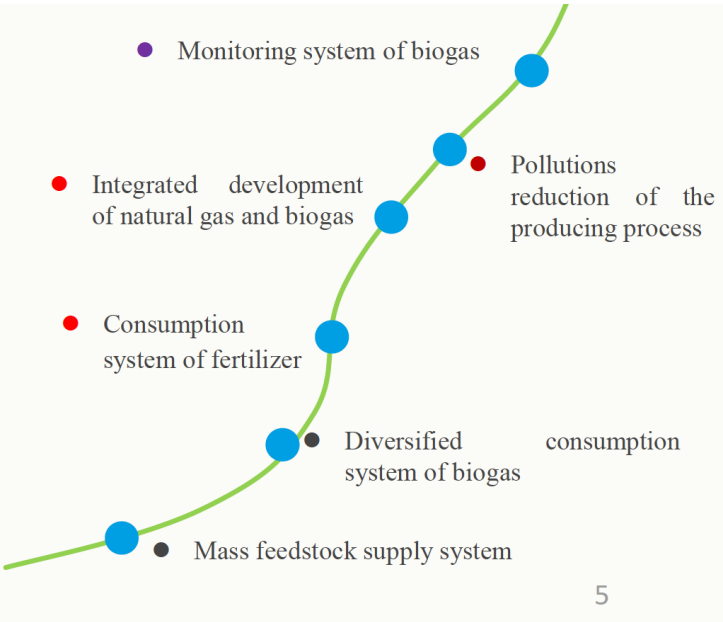

Figure 9: Roadmap for industrial biomlethane development

The roadmap is accompanied by the support measures listed below:

- Priority of land use of project.
- Tax reduction & exemptions on utilization of resources, energy and water saving.
- Import duties concession on equipment procurement of project construction.
- Preferential electricity prices on agri-wastes feedstock pretreatment and fertilizer process.

In spite of the progress there are some fundamantal barriers that still hinder the widespread market uptake of biogas/biomethane. The mist critical ones are:

- Poor profit for biomethane producers.
- High cost of biomass feedstock
- There is no subsidy policyfor biomethane.
- Management of different biomass feedstock.
- The treatment of liquid anaerobic digestate.
- Biogas electricity is difficult to sell to the grid, and biomethane is not recepted by local natural gas network or the price doesn't make economic sense.

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

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 final disposal or treatment and use of the liquid digestate remains a problem in some areas.
- The production of biomethane from biomass via the gasification route still needs technological development before it 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.

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.

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

5 Annex

Project Meeting #4
Tallin, 16-18 April 2024
Metropol SPA Hotellis

Agenda of the project meeting

Tuesday 16 April 2024	
09:00 - 09:10	Welcome Ahto Oja, Lauri Jasmin/EstBA Opening, agenda and practicalities Myrsini Christou/CRES
09:10 - 09:30	EU support, policies and potential of biomethane Maria Georgiadou / DG R&I
09:30 – 10:30	WP1 (Market dynamics & framework conditions in advanced European and MI countries) Andrea Rizzo /RECORD (T1.3), Myrsini Christou /CRES (T1.4), George Osei Owusu, Angela Sainz/EBA, Kyriakos Maniatis /KM-IIC (T1.5) Laura Garcia /DBFZ (T1.6)
10:30 – 11:00	WP2 (Market dynamics & framework conditions in target countries) Laura Garcia /DBFZ (T2.4) Myrsini Christou /CRES (T2.5)
11:00 –11:30	Coffee break
11:30 - 12:00	WP3 (Stakeholders' engagement) Laura Garcia, Ronja Wollnik /DBFZ (T3.1, T3.2) Spyros Karytsas /CRES (T3.3)
12:00 – 12:30	WP4 (Market uptake measures) Christos Tourkolias/CRES
12:30 – 13:00	WP5 (Outreach) Teresa Ridolfi /ETA
13:00 – 14:00	Lunch break
14:00 – 14:30	WP6 (Coordination) Myrsini Christou/CRES – Any other issues
14:30 – 16:30	IAB Kyriakos Maniatis /KM-IIC - Renata Isfer, ABiogas / Brazil - Nikos Abatzoglou, Warren MacBee / Canada - Shizhong Li / China - Ramakrishna YB / India - Sam Lehr / USA
16:30	End of meeting
20:00	Dinner

Wednesday 17 April 2024	
All day	Visit in 2 biogas plants

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

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