Biomethane Insertion in the Piped Natural Gas Network in the State of Bahia – Brazil

Paulo Roberto dos Santos[1]*, Hugo Saba[2], Marcio L.V. Araújo[3]
[1]Federal Institute of Bahia, Coordination of Natural Sciences and Mathematics; Simões Filho, Bahia; [2]Department of Sciences Exact and Earth Sciences, State University of Bahia—UNEB; [3]Center for Applied Research and Innovation (NPAI); Salvador, Bahia, Brazil

This study investigates the feasibility technical, economic and regulatory aspects of the introduction of biomethane in the headquarters energy of the state of Bahia, focusing in the distributor initiatives Bahiagás. The main objective is to assess whether the potential agricultural sector of the state estimated in more than 500 million Nm³/ year of biogas can be effectively converted in biomethane injectable in the natural gas network, considering you frames regulatory national and so-called public launched by the company. For this purpose, a revision systematics of literature scientific (Scielo, ScienceDirect, Scopus databases) and documents officers from the National Agency of Petroleum, Natural Gas and Biofuels (ANP), the Brazilian Association of Biogas and Biomethane (ABIOGÁS), the Ministry of Agriculture (MAPA), the Energy Research Company (EPE) and the companies themselves. Bahiagás notices (2022 and 2024). They were included only data with sources reliable, published between 2017 and 2025, with relevance direct to the context Brazilian and, preferably, to the Northeast region. The results point out that, although biomethane it is technically viable and have support normative robust (ANP Resolutions 886/2022 and 906/2022) and incentives financial via CBIOs (RenovaBio Law), the state of Bahia still no it has none unit producer operational according to ANP. The two calls Bahiagás public especially that of 2024, with a 10 - year contract and supply minimum of 5,000 m³/ day from 2027 onwards reveal a strong institutional interest, but also expose critical gaps: high investment costs (>R$ 15 million per average plant), absence of policies state support, logistics deficient waste collection and low training technique. The main conclusion is that, despite the enormous potential and conditions favorable, the implementation of biomethane in Bahia faces barriers institutional and structural that will beyond technology. To overcome them, it is essential to create a program state development, with lines of credit, assistance technique, centers collection regions. Without these measures, the 2027 commitment is at high risk of not being met.

Keywords: Bahiagás. Biomethane. Public Calls. Energy Policy. Energy Transition.

The energy transition to a sustainable and low-carbon matrix represents a major energy challenge for the 21st century. In this scenario, biomethane emerges as a relevant option with the capacity to replace, even partially, natural gas of fossil origin in several commercial, industrial and residential applications [1].

Biomethane can be obtained through the biogas purification process, increasing the percentage of methane (CH_4) to values close to that of natural gas sold by companies in the sector in their distribution networks or on road transport (Figure 1).

Received on 24 June 2026; revised 23 September 2026.
Address for correspondence: Paulo Roberto dos Santos. Via Universitária, s/n (R. Vital Brasil, 1394–1908), Pitanguinha, Simões Filho – BA, Brazil. ZIP code: 43700-000. E-mail: paulo.santos@ifba.edu.br.

J Bioeng. Tech. Health 2026;9(10):1047-1052
© 2026 by SENAI CIMATEC University. All rights reserved.

By inserting biomethane into the natural gas network, existing infrastructure can be used for distribution to end consumers [1]. The combustion of biomethane can be seen in Figure 2.

In Brazil, there are currently approximately 12 authorized biomethane producers, most of which are located in the Southeast and South regions of the country. In the Brazilian Northeast, only the state of Ceará has a biomethane production unit, according to the National Agency of Petroleum, Natural Gas and Biofuels (ANP) [2]. The current distribution is as follows: São Paulo (5 units), Rio de Janeiro (2 units), and the states of Mato Grosso do Sul, Minas Gerais, and Ceará with one unit each [2]. Biomethane production in 2025 has already exceeded 47 million Nm³, while in the whole of 2020 it did not exceed 40 million Nm³, demonstrating a significant increase in Brazilian production [2].

Figure 1. Process simplified biomethane insertion in the piped natural gas network.

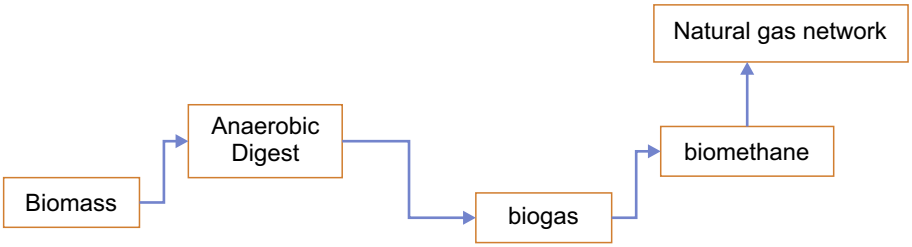

Figure 2. Flame of biomethane burning in the laboratory.



In the state of Bahia, which has enormous potential for biomethane production, due to its thriving agricultural sector and large urban centers such as Salvador and Feira de Santana with controlled landfills, there is still no large processing unit, but there is great potential for production [3].

According to the Brazilian Association of Biogas and Biomethane (ABIOGÁS), in the agricultural sector alone, the state has a production potential of over 500 million Nm^3/year of biogas [3]. A large portion of this biogas volume can be processed into biomethane, thus increasing its added value. The ANP (National Agency for the Promotion of Biomethane) is the federal government agency that regulates the sector; it has identified that in recent years, some states in the federation have taken the initiative to create laws that make biomethane more attractive, such as Mato Grosso do Sul, which supports projects in the production of biomethane with waste from ethanol production [3]. In 2022, the ANP issued two resolutions specifying biomethane's origin: Table 1 shows other sector resolutions.

- ANP Resolution No. 886/2022: Establishes the specifications and rules for approval of quality control of biomethane from landfills and sewage treatment plants intended for vehicular use and residential, industrial and commercial installations, to be marketed in the national territory [4].

- ANP Resolution No. 906/2022: Provides for the specifications of biomethane from agrosilvopastoral and commercial organic products and waste intended for vehicular use and residential and commercial installations to be marketed throughout the national territory [5].

Bahia Gas Company (Bahiagás), a mixed-capital company with the state government as the majority shareholder, is responsible for ensuring the distribution of natural gas in the Camaçari Petrochemical Complex and the Aratu Industrial Center [6]. In recent years, it has expanded its natural gas distribution potential, reaching the commercial, residential, automotive, and

Table 1. The main standards and resolutions on biomethane in Brazil.

Standard / Resolution	Organ Issuer	Year	Scope	Applicability
Resolution No. 886	ANP	2022	Biomethane specification from landfills toilets and ETEs	Vehicle, commercial, residential and industrial use
Resolution No. 906	ANP	2022	Biomethane specification originating from waste agrosilvopast oral and commercial	Vehicle, commercial, residential and industrial use
Resolution No. 685	ANP	2017	Authorization to commercializ e biomethane	Producers and distributors
Resolution No. 734	ANP	2018	Transportatio n rules biomethane road	Carriers bus stations
Law No. 13,576 (RenovaBio)	Federal Government	2017	National Biofuels Policy	Biomethane and CBIO producers

thermoelectric segments. Recent public calls for proposals in 2022 and 2024 demonstrate interest in expanding its network with biomethane. In 2022, a commercial proposal was launched for those interested in selling biomethane to the company, as well as projects for biomethane production. However, this public call was concluded without hiring any interested parties, on the grounds that the presented projects needed improvement.

Biomethane Public Call No. 01/2024, with supply scheduled to begin in 2027, a minimum supply of 5,000 cubic meters per day, and a ten-year contract. The published notices represent an important milestone for the sector, establishing clear marketing mechanisms, specific technical requirements, and contractual conditions that provide security for investors and developers of biomethane projects [7,8].

Materials and Methods

A decision was adopted approach qualitative and descriptive, based in revision systematic literature and documentary analysis. They were consulted you following databases and sources officials: Banks academics: Scielo, ScienceDirect and Scopus for articles scientists indexed. Government and institutional sources: National Agency of Petroleum, Natural Gas and Biofuels (ANP): resolutions, production reports and authorizations; Brazilian Association of Biogas and Biomethane (ABIOGÁS); diagnostics sectoral and statistical data; Ministry of Agriculture, Livestock and Supply (MAPA): waste inventories agricultural; Energy Research Company (EPE): reports on Energy and biofuels: Government of the State of Bahia: State Sustainable Energy Plan 2023-2030; Bahiagás: call for proposals public (2022 and 2024). The Inclusion criteria They were selected just you materials that served everyone you following criteria:

- Relevance direct: themes related to production, purification, injection, marketing or biomethane policy in Brazil;
- Frequency: published between 2017 (launch of the RenovaBio Law) and 2025;
- Reliability: origin in institutions recognized (governmental, academic) or research), with methodology clear and verifiable data;
- Geographical specificity: priority for data referring to the North East or to Bahia;
- Quantification: presence of values numerical (potentials, costs, emissions, volumes).

Results and Discussion

The results display important information found in the scientific materials researched, as well as on government websites.

Brazil holds great potential for biogas and biomethane production, estimated at 84.6 billion Nm^3/year and 44.7 billion Nm^3/year, respectively, with current production being around 1.5 to 2% of this value [3,7]. Most of the raw material for biogas comes from agricultural and urban waste, with a focus on agriculture in the Northeast [8,9]. The injection of biomethane into the natural gas network, already implemented in Ceará, has demonstrated technical feasibility and compatibility with the infrastructure of the local distributor (CEGÁS), including regulatory approval by the ANP [10]. Currently, biomethane represents approximately 15% of the company's distribution volume, positioning CEGÁS as reference national in solutions energetics sustainable [10]. Biogas purification must ensure strict control of impurities, such as siloxanes, volatile organic compounds, and metals, to meet the specifications defined by ANP Resolutions No. 886/2022 and 906/2022 [4,5]. The biomethane produced has an average calorific value of approximately 36 MJ/m^3, comparable to fossil natural gas, allowing its direct use in various applications [11-13].

Despite the promising outlook, the sector faces challenges such as high initial costs for purification plants, a lack of specific incentive policies, and the need to refine projects to meet the technical and financial requirements of public tenders [1,4]. Bahiagás's 2024 public tender provides for a 10-year supply contract for at least 5,000 m^3/day starting in 2027, representing a significant regulatory and commercial advance for the state. This was the second public tender, and the 2022 tender did not result in a contract [6]. Bahia has the potential to become a regional biomethane hub, given its agricultural vocation, but it requires coordination between public and private agents, as well as more robust state policies to encourage investment, technical training, and environmental certification [3,15]. The economic outlook for biomethane production depends directly on the scale of the project, the cost of collecting the raw material, the efficiency of the purification process, and the sales price guaranteed by long-term contracts. Studies indicate that medium and large plants (above 1,000 Nm^3/h of biomethane) can achieve competitiveness with fossil natural gas when carbon credits and tax incentives are used [16]. In Brazil, the Emissions Reduction Certificates (CBIOs) system, created by the RenovaBio Law (Law No. 13,576/2017), allows Biomethane producers can generate additional revenue from the sale of these certificates, improving project profitability [15]. Furthermore, partnership models between agricultural cooperatives and companies specializing in biogas engineering show promise, especially in regions with high concentrations of organic waste, such as the semi-arid region of Bahia [16,17]. Biomethane transportation and distribution infrastructure is still limited in Brazil, especially outside of large urban centers. In remote areas, such as the interior of Bahia, cryogenic (Liquefied Biomethane LBM) or high-pressure (Compressed Natural Gas CNG) truck transportation can be an alternative, but significantly increases operating costs [18]. Although direct injection into the natural gas network is a more efficient option, its viability depends on the production unit's proximity to the distribution network [19]. ANP Resolution No. 734/2018 establishes rules for the road transportation of biomethane, but there are still gaps in equipment standardization and operational safety. Investments in regasification terminals and regionalized supply centers can expand access to biomethane in areas not served by the pipeline network [20,21]. Biomethane production brings environmental benefits, such as reducing methane emissions from anaerobic waste loss and reducing the use of fossil fuels. Studies estimate that each Nm^3 of biomethane avoids between 1.8 and 2.5 kg of CO_2 equivalent when it replaces fossil natural gas [21]. Furthermore, the process generates biofertilizer as a byproduct, which can be used in agriculture, reducing dependence on synthetic

fertilizers and improving soil quality [22]. From a socioeconomic perspective, the biomethane chain can generate direct and indirect jobs in rural areas. Formalizing local cooperatives and training rural workers are essential strategies to ensure that the benefits are distributed equitably [23].

Conclusion

Biomethane represents a renewable energy solution with high potential for Bahia and Brazil. Large-scale production and injection into the natural gas grid are feasible, but depend on overcoming technical, economic, and regulatory barriers. Market expansion requires greater integration among industry players, regulatory alignment, and effective public policies that encourage the production, commercialization, and use of biomethane. Bahia, with its vast potential, is positioned to play a leading role in this energy transition.

This study confirmed that Bahia has all conditions natural, regulatory, and market requirements to become a national biomethane hub. The potential is real, the standards they are adequate, and Bahiagás' demand is clear. However, the absence of projects approved same after two calls public reveals one deep flaw in governance energetics state. Analysis of points raised in the search:

- Potential Technical-economic: Yes, it is viable, but only for medium / large projects. size with access to CBIOs and long- term contracts term.
- Policy adequacy nationals: They are adequate, but not they are translated in actions places.
- Barriers identified: High costs, logistics deficient, lack of training and absence of incentives state they are you main obstacles.
- Solutions proposals: A program state integrated is urgent.

The problem it is not technological nor resources. It is institutional. No there is an organ single in Bahia responsible put coordinate, guide and finance biomethane projects. Bahiagás is a distributor, not promoter. The ANP regulates, but does not help in an appropriate way because only regulates the sector. MAPA has data, but does not operate efficiently in the state. Biomethane in Bahia is arrested in a vacuum institutional. In view of this scenario we did some recommendations practices to overcome limitations.

- High investment cost: a biomethane investment fund could be created with the state and federal government through BNDES.
- Fragmented logistics: creation of 3 or 5 collection centers in cities with Vitória da Conquista and Feira de Santana.
- Low training: partnerships with universities and institutes federal.

Acknowledgments

To everyone who contributed directly and indirectly to this work.

References

1. International Energy Agency (IEA). Methane tracker 2023: biogas and biomethane. Paris: IEA; 2023.
2. National Agency of Petroleum, Natural Gas and Biofuels (ANP). Report on biomethane production in Brazil. Brasília: ANP; 2025.
3. Association of Biogas and Biomethane (ABIOGÁS). Biogas and biomethane potential in Brazil: sectorial diagnosis 2024. Brasília: ABIOGÁS; 2024.
4. National Agency of Petroleum, Natural Gas and Biofuels (ANP). ANP Resolution No. 886, of December 16, 2022: establishes biomethane specifications from sanitary landfills and wastewater treatment plants. Diário Oficial da União. 2022 Dec 19; Seção 1.
5. National Agency of Petroleum, Natural Gas and Biofuels (ANP). ANP Resolution No. 906, of December 23, 2022: biomethane specifications originating from agrosilvopastoral waste. Diário Oficial da União. 2022 Dec 26; Seção 1.
6. Bahiagás. Public Call for Biomethane No. 01/2024. Salvador: Bahiagás; 2024.
7. Biogas and biomethane production in Brazil: potential, policies and challenges. Renew Sustain Energy Rev. 2020;134:110316.
8. DM, et al. Potential for biogas production from livestock waste in Northeastern Brazil. J Clean Prod. 2022;331:130001.

9. Ministry of Agriculture, Livestock and Food Supply (MAPA). Agricultural waste and energy: perspectives for biomethane. Brasília: MAPA; 2023.
10. Cegás. Cegás presents pioneering experience with biomethane at national workshop on energy transition [Internet]. Available from: https://www.cegas.com.br/cegas-present-experiencia-pioneira-com-biometano-em-workshop-nacional-sobre-transicao-energetica/
11. Oliveira PV, Santos LM, Costa EF. Characterization of biomethane energy produced from anaerobic digestion. Sustainable Energy. 2022;10(3):112-125.
12. Sehnem S, et al. Barriers to the development of biomethane in Brazil: a multisectoral analysis. Energy Policy. 2021;158:112543.
13. Government of Bahia. State energy plan for sustainable development 2023-2030. Salvador: Secretariat of Economic Development; 2023.
14. Luz FC, et al. Economic viability of biomethane production in Brazil. Renew Energy. 2020;148:1039-1050.
15. National Agency of Petroleum, Natural Gas and Biofuels (ANP). CBIO market: annual report 2023. Brasília: ANP; 2024.
16. Almeida CM, et al. Cooperatives in the biogas chain: social and economic impacts on rural development in Brazil. Energy Sustain Dev. 2022;69:1-10.
17. Energy Research Company (EPE). National Energy Plan 2030 [Internet]. Available from: https://www.epe.gov.br
18. Brazilian Association of Piped Gas Distribution Companies (ABEGÁS). Biomethane transportation by CNG: technical study. São Paulo: ABEGÁS; 2023.
19. Bastos R, et al. Decentralized distribution of biomethane production in Brazil. J Nat Gas Sci Eng. 2023;110:104432.
20. K, et al. Quality of digestates from biogas plants and their potential as fertilizers. Waste Manag. 2022;140:1-15.
21. United Nations Development Programme (UNDP). Biomethane and sustainable development in Brazil. Brasília: UNDP; 2023.
22. Brazilian Institute of Geography and Statistics (IBGE). Rural labor statistics in the Northeast. Rio de Janeiro: IBGE; 2023.
23. Intergovernmental Panel on Climate Change (IPCC). Climate change 2023: mitigation of climate change. Geneva: IPCC; 2023.