The Need to Connect Biomethane Production to the Interconnected Gas Pipeline Network, for the Development of Brazil's Biomethane Market

Felipe Freitas da Rocha, Pontifícia Universidade Católica do Rio de Janeiro, +1 647 889-7651, felipefreitasdarocha@hotmail.com

Edmar Luiz Fagundes de Almeida, Pontifícia Universidade Católica do Rio de Janeiro, +55 21 98104-9352, edmar@puc-rio.br

Luciano Dias Losekann, Universidade Federal Fluminense, +55 21 99602-3831, luciano.dias.losekann@gmail.com

Niagara Rodrigues da SIlva, Universidade Federal Fluminense, +55 21 98030-0665, niagararodrigues@gmail.com

Francisco Raeder, Universidade Federal Fluminense, +55 21 98834-8943, francisco.raeder@yahoo.com.br

# Overview

Although the biomethane market is still in its infancy in Brazil, it has been growing rapidly. Biomethane production has doubled in the last 4 years, jumping from 99 thousand cubic meters per day (Mcm/d) in 2020 to 202 Mcm/d in 2023 (ANP, 2024b). Currently, there are 6 biomethane plants with operating authorization granted by the National Petroleum, Natural Gas and Biofuels Agency (ANP), totaling an authorized capacity of 417 Mcm/d. The ANP is evaluating the authorization request for another 18 biomethane plants, which have an authorized capacity of 793 Mcm/d. Therefore, in the medium term, Brazil will be able to count on 24 biomethane plants and an authorized production capacity of 1,210 Mcm/d.

Furthermore, the regulatory framework has also developed. In 2015, the ANP published ANP Resolution No. 08/2015, which regulates the quality standards of biomethane from agroforestry and commercial organic waste. In 2017 it was the turn of biomethane from landfills and sewage treatment plants, which was regulated through ANP Resolution No. 685/2017. It is worth noting that both resolutions were updated in 2022 through ANP Resolution No. 906/2022 and ANP Resolution No. 886/2022, respectively. In 2018, the ANP established the authorization process for the construction and operation of a biomethane plant with the implementation of ANP Resolution No. 734/2018.

Therefore, a great expansion of biomethane production in Brazil is expected over the next few years. Some estimates suggest that biomethane production could reach 32 million cubic meters per day (MMcm/d) in 2030 (Roitman, 2023). This large increase in production would be a consequence of the exploration of Brazil's voluminous biomethane potential. It is estimated that the potential for biomethane production can reach 119 MMcm/d (ABiogás, 2024). As a form of comparison, Brazil's available natural gas production was 52 MMcm/d in 2023 (MME, 2023).

It is worth noting that this biomethane potential would come mainly from waste from the sugar-energy sector. This occurs because Brazil is the largest producer of sugar cane in the world and, consequently, has a large amount of sugar cane waste concentrated in ethanol plants. Furthermore, the potential for producing biomethane from other waste is limited. First, the potential for biomethane production through urban waste (i.e., urban solid waste and sanitary sewage) is low, even assuming a scenario in which all of this waste is collected and processed in Brazil, which is not true. Second, the use of agricultural and livestock residues is not easily available to produce biomethane, as they require collection for their aggregation and pre-processing.

Therefore, in Brazil, the development of a large biomethane production will necessarily be the result of the exploitation of sugar cane waste. However, ethanol plants are located in the countryside of Brazil, in regions with low natural gas demand. Furthermore, Brazil's natural gas transport infrastructure is poorly developed and concentrated on the coastline, making it difficult to transport biomethane to consumer centers. This demand restriction could limit the development of the biomethane market in Brazil, contradicting the forecasts of a large increase in production.

Therefore, this paper aims to estimate the biomethane potential from the sugar cane waste, in order to identify whether this potential is found in regions with low demand for natural gas. Furthermore, this paper seeks to develop, in a simplified way, a strategy for connecting the biomethane potential to the interconnected gas pipelines network, aiming at the development of the biomethane market in Brazil.

# Methods

This paper will use a methodology based on technical factors to estimate the biomethane potential. That is, we will multiply the installed capacity for ethanol production, by the technical factor of sugar cane waste generation and by the biomethane production rate of each respective sugar cane waste.

For this, we will use the ANP data on the installed capacity of hydrated ethanol from each ethanol plant authorized to operate in February 2024 (ANP, 2024a). Furthermore, as ethanol production is seasonal in Brazil, we will use a production capacity utilization rate that reflects such seasonality. We used historical data to obtain this rate and estimated it at 55%.

We will only use filter cake and vinasse as sugar cane waste, excluding bagasse and straw. This is because bagasse already has an established demand and, consequently, a market value through its use for energy cogeneration. Regarding straw, as it is generally left in the cultivation area to cover the soil, and there is a high cost for collecting and transporting it to the ethanol plant.

The waste generation factor and production rate from filter cake and vinasse will be taken from Abiogás (2020).

In order to compare the biomethane potential with the demand restriction, we will use natural gas consumption data from local distribution companies as a proxy for the demand for biomethane. This data will be taken from MME (2023).

# Results

Our estimates point to a biomethane potential from sugar cane waste of 17.2 MMcm/d. We identified that 82% (or 14.2 MMm3/d) of this potential is located in regions with low demand for natural gas, especially in the concession areas of Nectagás, Goisgás, MTgás, MSgás and Gasmig (Triângulo Mineiro and Alto Paranaíba). As a comparison, in 2023, natural gas consumption was 1.3 MMcm/d in the same area.

# Conclusions

Although the biomethane potential is considerable, it is located in regions with low demand for natural gas. In other words, only a small part of Brazil's biomethane potential could be consumed locally. Therefore, if Brazil's biomethane production is not connected to the interconnected gas pipeline network, enabling this production to reach large consumer regions, it will be limited by the lack of demand. Therefore, for the biomethane market to develop in Brazil, it is necessary to connect biomethane production to the interconnected gas pipelines network.

However, the natural gas transport network is poorly developed in Brazil, which would make it difficult to connect biomethane production to the interconnected gas pipelines network. Therefore, it is necessary to develop a strategy that allows this connection. This paper proposes “Biomethane Injection Hub” strategy. This strategy consists of building connecting gas pipelines that would depart from GASBOL towards biomethane production centers in the countryside. This connecting gas pipeline would have several entry points along its route. In this way, biomethane producers would transport their production through BioCNG and BioLNG and inject it into the connecting pipeline.

Finally, if biomethane production is not connected to Brazil's natural gas transportation network, the development of the biomethane market will be compromised. This is because the development of biomethane potential would not involve its commercialization in the Brazilian market, but rather through the self-consumption of biomethane in sugarcane plantations (being limited by the low demand) or through the use of biogas to power generate (without the production of biomethane). Therefore, the main conclusion of this paper is that, if biomethane production is not connected to the interconnected gas pipeline network, the result will be an insignificant development of the biomethane market in Brazil, far below current forecasts.

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Although the biomethane market is still in its infancy in Brazil, it has been growing rapidly. Some forecasts indicate that biomethane production in Brazil is expected to grow exponentially over the next few years. Some projections indicate that biomenthane production in Brazil is expected to grow exponentially over the next few years. This will occur through the exploration of Brazil's great biomethane potential, in particular through the use of sugar cane wastes. However, ethanol plants are located in the countryside of Brazil, in regions with low natural gas demand. Furthermore, Brazil's natural gas transport infrastructure is poorly developed and concentrated on the coastline, making it difficult to transport biomethane to consumer centers. This demand restriction could limit the development of the biomethane market in Brazil, contradicting the current forecasts. Therefore, this paper aims to estimate the biomethane potential from the sugar cane waste, in order to identify whether this potential is found in regions with low demand for natural gas. Furthermore, this paper seeks to develop, in a simplified way, a strategy for connecting the biomethane potential to the interconnected gas pipelines network, aiming at the development of the biomethane market in Brazil. Our estimates point to a biomethane potential from sugar cane waste of 17.2 MMcm/d. We identified that 82% (or 14.2 MMm3/d) of this potential is located in regions with low demand for natural gas, especially in the concession areas of Nectagás, Goisgás, MTgás, MSgás and Gasmig (Triângulo Mineiro and Alto Paranaíba). As a comparison, in 2023, natural gas consumption was 1.3 MMcm/d in the same area. In other words, only a small part of Brazil's biomethane potential could be consumed locally. Therefore, the main conclusion of this paper is that, if biomethane production is not connected to the interconnected gas pipeline network, the result will be an insignificant development of the biomethane market in Brazil, far below current forecasts. This is because the development of biomethane potential would not involve its commercialization in the Brazilian market, but rather through the self-consumption of biomethane in sugarcane plantations (being limited by the low demand) or through the use of biogas to power generate (without the production of biomethane). In this way, it is necessary to develop a strategy that allows this connection. This paper proposes “Biomethane Injection Hub” strategy. This strategy consists of building connecting gas pipelines that would depart from GASBOL towards biomethane production centers in the countryside. This connecting gas pipeline would have several entry points along its route. In this way, biomethane producers would transport their production through BioCNG and BioLNG and inject it into the connecting pipeline.