

Strategic dialogue

Waste to energy



Context

Biogas and biomethane

Case study

How we can help

In 2015, Brazil assumed an international commitment (COP 21) to reduce greenhouse gases by 2030, which includes an increase in the use of biofuels and renewable energy. In addition, international conflicts can affect the supply of the national industry



At COP 21 and COP 26, international agreements were adopted to strengthen the global response to the threat of climate change, including the reduction of greenhouse gases emissions



Brazil has committed to reducing **greenhouse gas** emissions by **43%** below 2005 levels by 2030 and **reducing its methane emissions by 30% by 2030**

Reduction of greenhouse gases

2005

-43%

2030

The commitment aims to:

Increase the share of sustainable bioenergy in its energy source to approximately **18%** by 2030

Restore and reforest **12 million hectares of forest**

Achieve a share of **~45%** of renewable energies in the composition of the energy source by 2030



RenovaBio

- The RenovaBio program was created to encourage industries to produce more biofuels in order to reduce carbon emissions
- Through RenovaBio, certain industries can qualify with the ANP to issue **CBIOs, incentivized debentures for infrastructure**, from the biofuels production regulated market
- **RenovaBio** is a program that actively contributes together with companies in meeting the environmental goals agreed by Brazil during COP21, through a **highly strategic and competitive environment, socio-economic and environmentally**

War in Ukraine



The conflict between **Russia** and **Ukraine** has triggered a rise in the price of barrels of oil, putting pressure on industries and services to **seek alternatives** to replace **fossil fuels** and **fertilizers** from countries that have suffered sanctions – or that are derived from fossil fuels

Alternative processes that use **waste to generate energy, fertilizers** and other value-added products can bring **cost savings** and **new sources of revenue**

Rural producers, the sugar-energy sector, slaughterhouses, MDF companies, among others, can benefit from such alternatives

Source: ESG Tech elaboration



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Use of waste for energy production reduces treatment costs and generates value for agricultural enterprises



Analysis and mapping of by-products

Seeking solutions oriented to each client, ESG Tech performs an analysis and mapping of waste or by-products of the production process

We map:

- Diagnosis of the current situation in the context of the customer considering scale factors, product and by-product specifications and production process
- Differentials and limitations taking into account production scale and particularities of each by-product



Energy use and by-products

To understand how best to use the analyzed and mapped waste, we study and understand the best recovery routes

We study:

- Routes of use within the industry itself
- We generate recommendations for a long list of opportunities for energy use, considering the client's diagnosis and potential synergies



Study of new markets and economic viability

As a final step, we study possible markets for the use of these by-products and the economic viability of the project

We analyze:

- The product and by-product market, including new markets
- The feasibility of marketing new products considering possibilities for reducing disposal costs and revenue generated
- Strategic planning and recommended business model for the proposed scenario

Context

 **Biogas and biomethane**

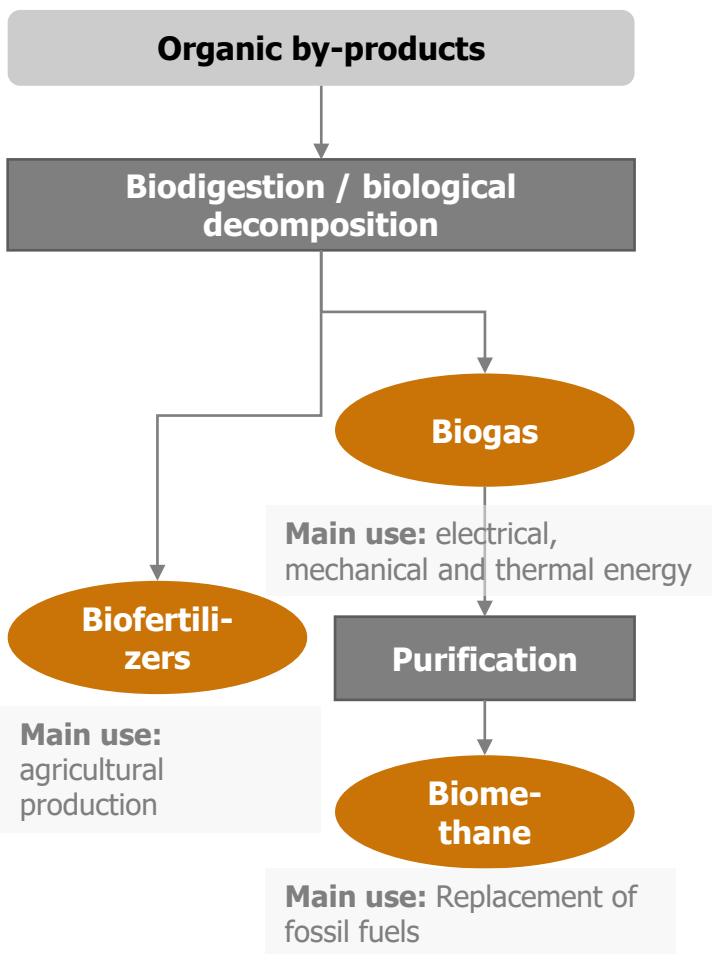
Case study

How we can help

Biogas is an example of sustainable alternatives for proper management of organic by-products and can be used to generate electrical and thermal energy. The organic residue formed in the biodigestion process can be used as agricultural fertilizer

**Example:
biogas and
biomethane**

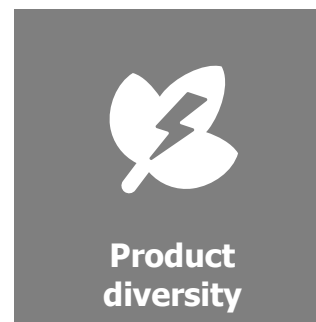
Biogas production: process and products



Advantages of biogas

Biogas can be **consumed at the place where it is produced**, without the need for transmission, transport or distribution networks. It can also be transported as Compressed Natural Gas (CNG) or injected into distribution pipelines, enabling the internalization of methane gas

It is the only fuel that originates from environmental liabilities with the potential to become an energetic and environmental asset: **it is produced from residual organic substrates**. It enhances the **environmental sustainability** of various activities, allowing for the proper treatment and disposal of waste generated in accordance with the current legislation



The final products of digestion are: **biofertilizer** – of high strategic value for **agricultural production**, and biogas, a gaseous fuel potentially usable for the **generation of electrical and thermal energy**, and in its purified form – the biomethane – it can be used as **automotive fuel** and **substitute for fossil fuel methane (natural gas)**

Biogas can be used to generate **basic electrical energy** and, when there is a surplus of electrical energy, it can be used as **biomethane**, which makes it a very **flexible** energy source. This feature also allows it to be considered as a **continuous generating source**, unlike other renewable energies, which are intermittent

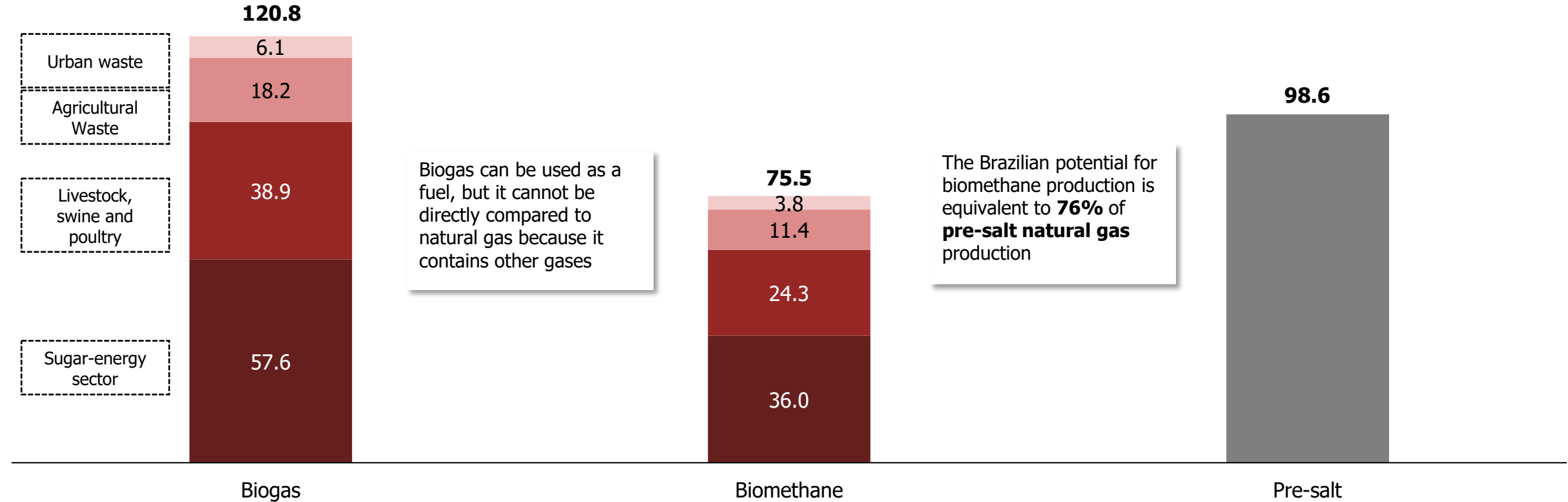
Source: ESG Tech elaboration

Brazilian agriculture brings a great opportunity in the bioenergy sector. Its residues have the potential to produce 75.5 million Nm³/day of biomethane, equivalent to 76% of Pre-salt natural gas production

Example:
biogas and
biomethane

Brazilian potential for biogas and biomethane generation compared to pre-salt production (January/2022)

[millions of Nm³/day]



Source: Brazil/Germany Conference on Waste Utilization (Abiogás, 2021), ANP 2022

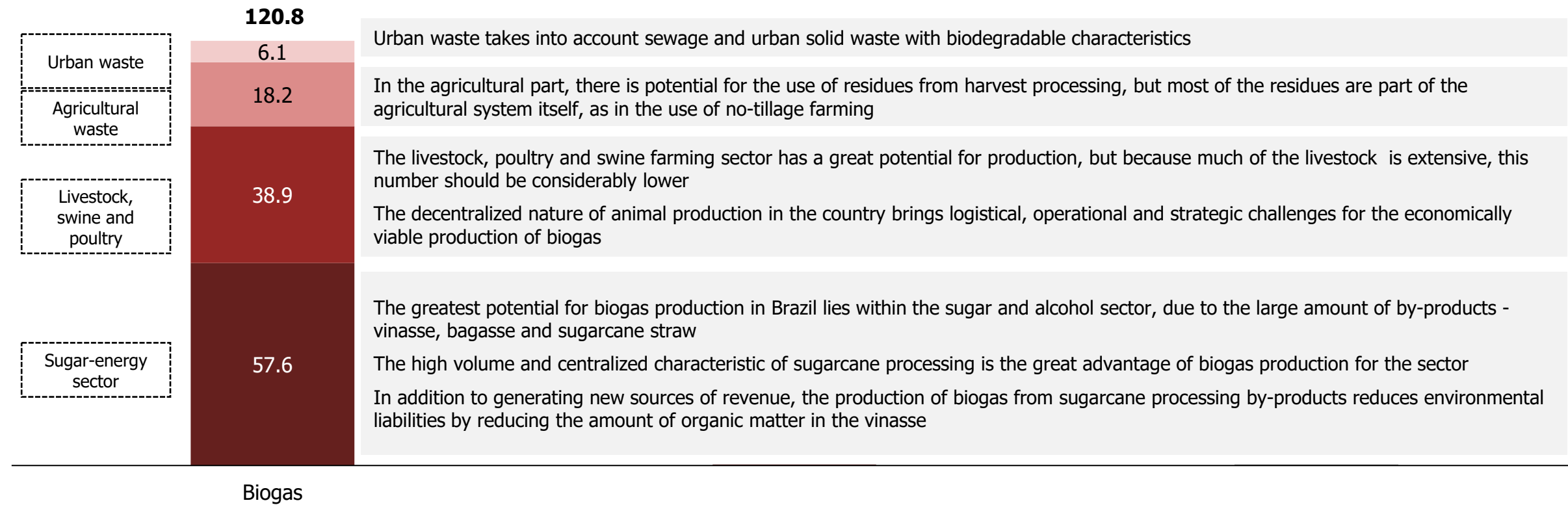


The sugar and ethanol sector has the most favorable characteristics for the production of biogas. On the other hand, projects in other sectors need special attention to the scale and decentralization of the production to obtain the project's economic and operational viability

Example:
biogas and
biomethane

Brazilian potential for biogas generation

[millions of Nm³/day]



Source: Brazil/Germany Conference on Waste Utilization (Abiogás, 2021), ANP 2022



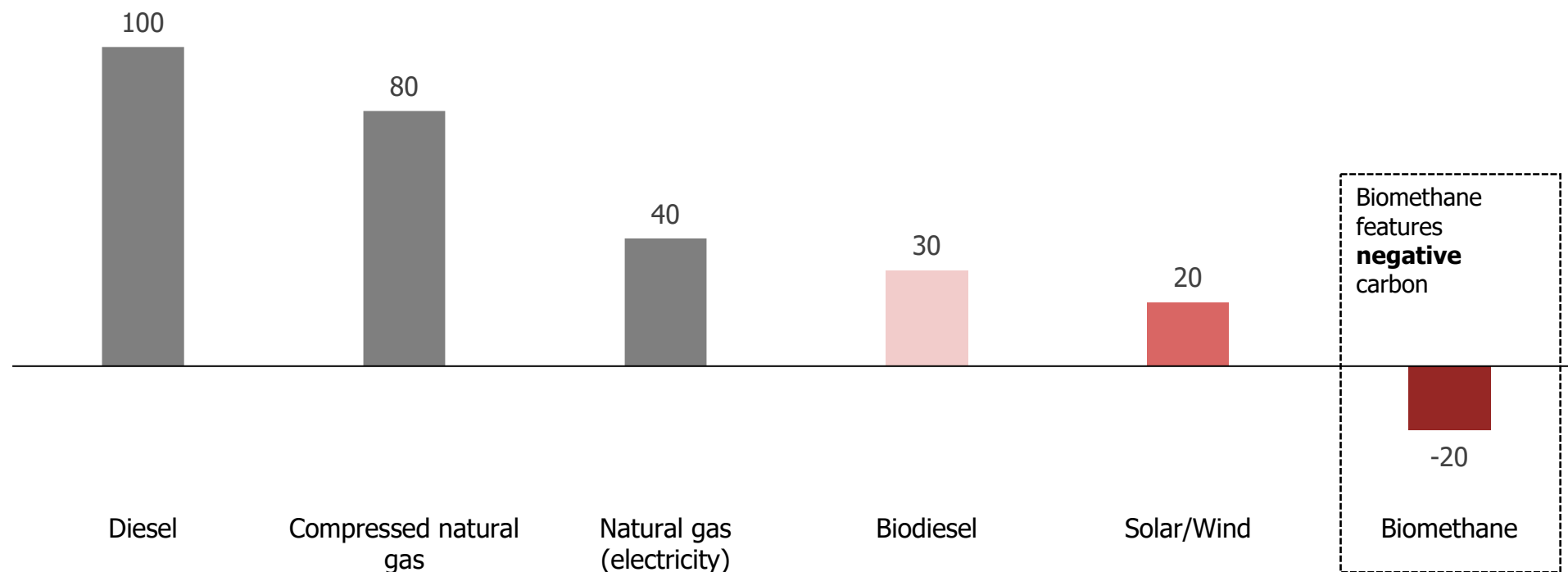
Renewable and clean fuels still emit CO2. Unlike biodiesel and solar and wind energy, biogas captures the methane generated by waste, transforming it into a biofuel with lower global warming potential

**Example:
biogas and
biomethane**

- The use of biomethane as a fuel allows a negative impact on the intensity of CO2 emissions, contributing to decarbonization
- In addition to having lower CO2 emissions on its life cycle, the use of biogas/biomethane is a predictable and storable renewable alternative, unlike other renewable fuels
- Currently, biomethane has a regulated market, with incentive policies such as RenovaBio, which allows certification and generation of decarbonization credits (CBIO)

CO2 emission intensity within the fuel life cycle

[gCO₂eq/MJ]



Source: Abiogás, Brazil-Germany Conference on biogas and biomethane

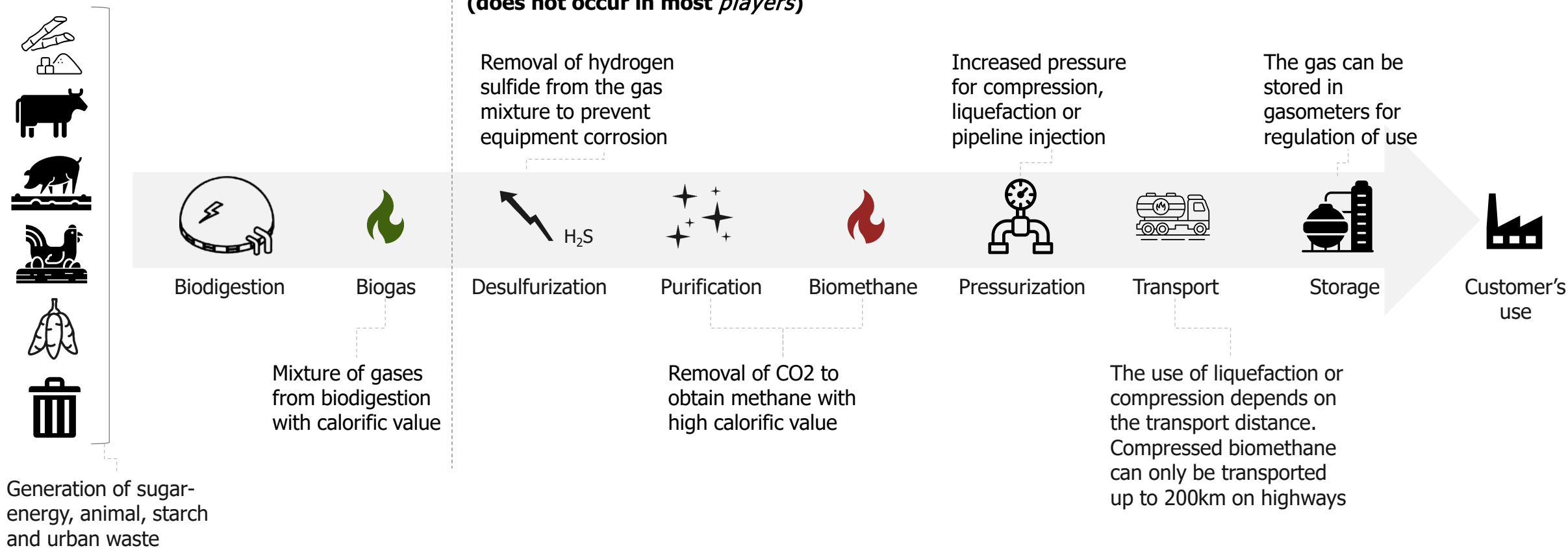


The production chain of biogas and biomethane from waste goes through several processes. The intense use of machinery makes the need for a technical-economic analysis essential to determine whether or not the enterprise is viable

**Example:
biogas and
biomethane**

Production of biogas and biomethane

Relevant processes of the energy supply chain with biogas (does not occur in most *players*)



Source: ESG Tech elaboration



Context

Biogas and biomethane

 **Case study**

How we can help

Case study - strategic planning

Customer: Food and beverage industry

THE CHALLENGE

The consultancy carried out a **biofuel market study** in Brazil, based on the availability of alternative fuels and environmental sustainability, to **supply the factory** by 2030

Operating cost of
R\$ 27,2 million /year
in conventional fuel

Biofuel market in Brazil and trends

- What is the current availability and infrastructure of these renewable fuels?
- What are the sources and annual production potentials of these fuels?
- Is the availability of such fuels sufficient to meet the factory's needs – including expansions?
- How competitive is it against other conventional fuels?

Supply model that optimizes the cost of supply

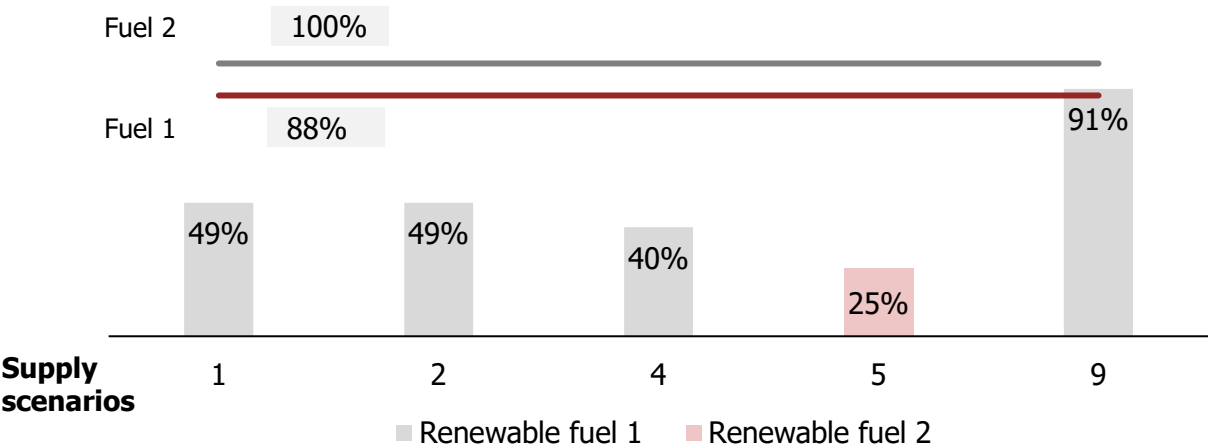
- Are there other *players* that produce and consume such renewable fuels in the study region?
- What is the most strategically competitive energy source?
- What are the risks and opportunities associated with the project?

RESULTS

The consulting project analyzed 9 strategic supply scenarios. **1 scenario** was selected, considering economic feasibility, socio-environmental factors, to guarantee the supply of the factory

The chosen scenario presents an NPV of
R\$ 43,1 million
compared to conventional fuel

Estimated final cost of renewable fuels compared to conventional fuels 1 and 2



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The use of by-products to generate value has great potential to have a positive impact on a company's operations, however, the technical conditions, economic feasibility and alignment with the ESG strategy need to be analyzed by a specialist

Economic

- In the specific case, is **there availability, scale and economic feasibility** for new investments to use residual material from the production process?
- Is it more interesting to invest in alternative fuels, conventional fuels or renewable fuels (solar/wind)?
- In which production unit of your company would the **investment** be more interesting?
- What are the **specific incentives** for your company? How best to take advantage of them?
- How can we make use of **waste** from your **operation** in an economically viable way?

Environmental

- Does your company have an updated **environmental impact** study and a comprehensive analysis of actions to **mitigate** potential **negative impacts**?
- How big is your company's **carbon footprint**?
- How can biogas/biomethane **reduce** your company's **environmental liabilities**?

ESG Strategy

- Is your company's **ESG strategy** in line with future trends in using the full **potential** of **biowaste**?
- What are the **synergies** for the production of co-products from waste and your company's **emission reduction goals**?
- What is the **socio-environmental impact** of adopting such a process in the study region?
- How can waste transformation fit into the **circular economy** context?

How does ESG Tech contribute to this dialogue?



ESG Tech is a strategy and business development consultancy focused on the forestry and agribusiness sectors. ESG Tech does not commercialize technologies or is linked to any supplier, in order to ensure the independence of our analyzes and the freedom to seek in the market the solutions that will bring the greatest return to our customers.

Our team of consultants has specialists in different cultures and different links in the agribusiness chains that can assist our clients in all stages of decision making and execution

- **Market studies:** market size, competitiveness, entry model and financial projections
- **Feasibility analysis:** investment and return projections; determination of optimal scale and location
- **M&A:** from the selection and evaluation of targets or potential strategic partners, to the structuring and negotiation of transactions, as well as support in the management of post-acquisition integration





📍 **Condomínio Alphabusiness - Edifício Jerivá**

Rua Aguaçu, 171 - Bloco D - Sala 206
Campinas / SP - 13098 321 - Brasil

☎ +55 19 3324 3019

💬 Skype: contato.innovatech

✉ faleconosco@esgtech.com.br

🌐 **www.esgtech.com.br**

