Rural Residues for distributed generation through Biodigestion

How much can be competitively utilized and converted into electricity?

Elaboration: epe

This Fact Sheet provides an assessment of the technical and economic potential for electricity generation via Micro and Mini Distributed Generation (MMDG) from agricultural and livestock residues.

As a major food producer, Brazil generates billions of tonnes of residues every year. Studies show that, depending on the crop, between 30% and 50% of rural residues can be recovered for other uses without compromising low-carbon agricultural practices. Similarly, a significant share of residues from extensive livestock production can be utilized, as around 40% of manure is concentrated in the vicinity of salt troughs. These residues can be used for biogas production and then as fuel for generator sets to supply electricity, either on a continuous basis or, when gas storage is available, in a way that complements other electricity sources.

When their installed capacity is up to 5 MW, these thermal power plants qualify as Micro and Mini Distributed Generation (MMGD) and participate in the net metering system. This model, established under Law No. 14,300/2022, allows consumers to generate their own electricity and inject surplus energy into the grid, which is stored as energy credits that can be used for up to 60 months to reduce electricity bills. Given the decentralized nature of agricultural production, there is a significant opportunity to harness the energy potential of residues under the MMGD framework.

The technical potential for the energy use of residues has been analyzed by EPE for several years. **The SIEnergia plataforma consolidates** historical data on the potential of different substrates and conversion technologies.

The maps below show the technical potential of agricultural and livestock residues and their geographic concentration. A color intensity scale is used, with lower intensity represented in white.

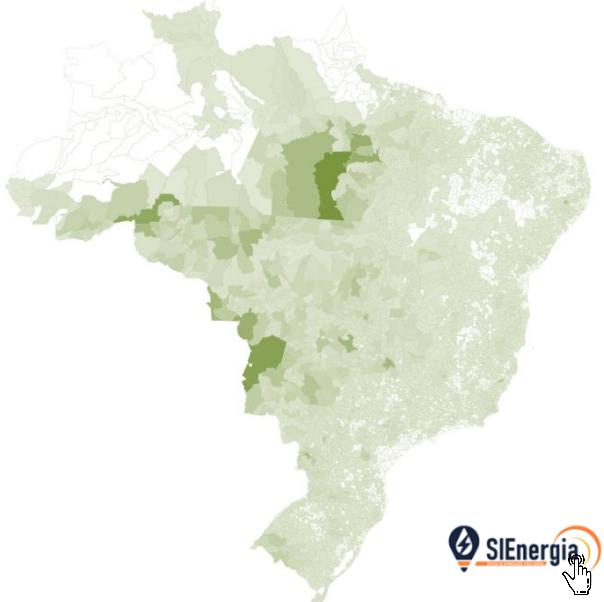
Technical potential for electricity generation from biogas (2022 data)

Agricultural residues

Total: Approximately 167 TWh (24 GW of installed capacity)

Livestock residues

Total: Approximately 75 TWh across about 11 GW



Note: The analysis considers cotton, rice, banana, sugarcane, beans, cassava, corn, soybeans, wheat, beef and dairy cattle herds, swine, and poultry.

WHAT SHARE OF THE TECHNICAL POTENTIAL IS ECONOMICALLY VIABLE? SIENERGIA PROVIDES THE ANSWER

Despite the high technical potential for biomethane production from residues, it is known that part of this potential is not economically viable for exploitation. EPE, through a Technical Cooperation Agreement with Itaipu Parquetec, developed a **simulator to assess economic viability**, which is available for installation on EPE's GitHub repository.

The tool enables the assessment of economic viability for the following technological pathways and applications:

- Anaerobic digestion of agricultural and livestock residues for biofuel production (here);
- Anaerobic digestion of agricultural and livestock residues for electricity generation;
- **Densification of agricultural residues for combustion in boilers for electricity generation and/or industrial uses – the focus of this fact sheet.**

Assessment of Economic Potential Using SIEnergia

To carry out the assessments, the tool uses direct costs, operational and financial indicators, revenues, and the low-voltage market consumption capacity within the electricity distributor's concession area. More information about the tool can be found at the User's Manual and at Documentation.

In an initial assessment, assuming a revenue of R$ 500/MWh, economic viability was identified for only six plants, all based on livestock residues. As a sensitivity analysis, viability was simulated assuming a revenue of R$ 700/MWh under the net metering scheme, which significantly increases the potential, as shown in the maps below. These analyses can be considered conservative, given that low-voltage electricity tariffs for final consumers range from R$ 677/MWh to R$ 1,214/MWh, including taxes, according to ANEEL (July 2025 data). Therefore, these are preliminary assessments whose main purpose is to illustrate the potential of the tool.

[1]1 US$ = 5.50 reais in 2025

Economic potential for electricity generation from biomethane (2022) – assuming revenues of R$ 700/MWh

Agricultural Residue

Total: Approximately 27 TWh across about 4 GW of installed capacity

Livestock Residue

Total: Approximately 3 TWh across about 0.5 GW of installed capacity

Municipalities with economically viable biomass utilization

Municipalities without economically viable biomass utilization

Note: The map results represent a preliminary analysis based on the parameters used in the simulation. Economic viability may vary according to the specific characteristics of each project.

WHAT DO THE RESULTS SHOW?

Assuming a remuneration of R$ 500/MWh, the tool indicates a low economic potential for electricity generation from biogas derived from agricultural and livestock residues. Increasing the compensation level for agricultural residues improves economic viability. At a revenue of R$ 700/MWh—a conservative value compared to final electricity tariffs—around 13% of the residues become economically viable for energy use. At this level of utilization, it would be possible to supply approximately 5% of national electricity consumption (2024 baseline).

- Assuming a revenue of R$ 700/MWh, resource utilization would be based on residues from more than 780 municipalities, supplying biomass to 891 plants located in 85 host municipalities (not shown on the maps).
- This initial output indicates the technological viability of biogas-based electricity generation in Brazil. However, additional market challenges remain for the realization of this potential, such as lower project modularity and more limited supplier availability when compared, for example, to photovoltaic generation. Further studies are needed to explore these barriers and identify potential solutions for the market.
- The tool also supports project assessments under the framework of the Fuel of the Future Law (Law No. 14,993/2024), including projects applying to the PNIIGB and the CGOB.
- EPE intends to continue developing studies based on SIEnergia with the aim of fostering discussion on this topic.

General Coordination
Thiago Ivanoski Teixeira

Executive coordination
Carla Costa Lopes Achão

Technical Team
Luciano Basto
Gabriel Konzen

Nota: ícones utilizados ao longo desta edição obtidos na plataforma www.flaticon.com

September/2025