Biogás BRASIL

METHODOLOGIES FOR INTEGRATING BIOGAS IN THE AGRIBUSINESS VALUE CHAIN

GEF BIOGAS BRAZIL

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MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATIONS

PÁTRIA AMADA BRASIL BRAZILIAN GOVERNMENT

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PARTNERS OF THE GEF BIOGAS BRAZIL PROJECT

ABiogás Associação Brasileira do Biogás

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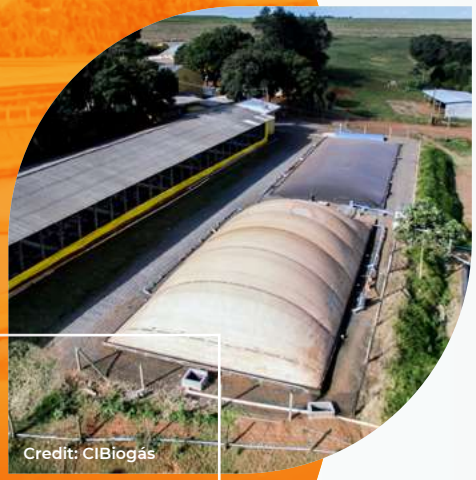


Credit: CIBiogás

THE GEF BIOGAS BRAZIL PROJECT

Biogas is a renewable source of energy generated from the decomposition of organic waste produced by enterprises such as farms, restaurants, and others. The waste is stored in biodigesters, where its thermal decomposition results in the release of biogas and biofertilizer (GEF Biogás Brasil, 2021).

Brazil as an agro-industrial powerhouse, with intense production of organic waste, presents extremely favorable conditions to produce biogas and biomethane that can be used in the generation of electricity, thermal energy or as vehicular fuel, contributing for increasing energy supply and reducing greenhouse gas (GHG) emissions.

Thus, the GEF Biogas Brazil Project foresees actions and investments to encourage the integration of biogas in the Brazilian production chain. Besides the economic and social benefits, generating energy from biogas also reduces the emission of greenhouse gases into the atmosphere, improving the environmental performance of Brazilian agribusiness and waste management in the country.

Among the direct beneficiaries are the equipment and service industries; utilities of energy and gas; rural producers and agro-industry cooperatives; municipal governments; research institutes, and populations of municipalities with high concentrations of organic waste.

With resources from the Global Environment Facility (GEF), US$ 7,828.000 In direct investments, the GEF Biogas Brazil Project is led by the Ministry of Science, Technology and Innovations (MCTI) and implemented by the United Nations Industrial Development Organization (UNIDO).

For its execution, the project counts on a Steering Committee, composed of the International Renewable Energy Center (CIBiogás), Itaipu Binacional, Ministry of Mines and Energy (MME), Ministry of Environment (MMA), Ministry of Agriculture, Livestock and Supply (MAPA) and Ministry of Regional Development (MDR), and a Partner Network.


Credit: Embrapa

Reduce greenhouse gas emissions and national fossil fuel dependence.

Goal

The project's main objective is to reduce greenhouse gas (GHG) emissions and the national dependence on fossil fuels.

Strategy

Through a network of local, national and international strategic partners, international benchmarking and the application of scenario forecasting methodology - Foresight - , the GEF Biogas Brazil Project works with the agribusiness in the southern region of the country, initially in the state of Paraná, where there is great development potential of biogas in the short term. As for municipal waste, the project works in cooperation with the Federal District Government to develop initiatives in the area of organic solid waste treatment for biogas production.

Governance

The governance of GEF Biogas Brazil Project, structured from a Steering Committee, is composed of a network of partners that act independently, with the mission of organizing the supply of technological services and create a favorable environment for new investments, and thus contribute to the expected results.

Targets

Among the goals set by GEF Biogas Brazil Project are:

- Promoting biogas energy, mobility solutions, strengthening production and the biogas value chain in Brazil, and foster technological innovation in the sector;

- Offer technical support for the conversion of organic residues into energy and fuel, as well as support in the creation of business models and specialized assistance in financing and public policies related to the sector;

- Provide up-to-date data on biogas supply and demand, new business models for the sector, regulatory analysis, favorable public policies, specialized financial services, technology and business demonstration units, and training services.


Credit: CIBiogás/Marcos Labanca

The Foresight methodology creates synergy between its actors and the project resources to achieve its goals.

Expected outcomes

Among its expected outcomes are:

- Strengthening of the biogas and biomethane value chain, encouraging the conversion of organic agro-industrial residues, currently considered a negative externality, into a competitive differential for Brazilian agribusiness;
- Development of projects in the area of organic solid waste treatment by anaerobic biodigestion in an urban environment;
- Expansion of the use of biogas and biomethane as a source of electricity, thermal energy, or renewable fuel;
- Production of an online data platform with complete and up-to-date information about the sector, available free of charge;
- Creation of business models and innovative technological packages, validated by sector agents and adapted to the Brazilian reality;
- Modernization of public policies and regulation of the sector;
- Support to Demonstration Units of technologies and processes for energy generation through biogas;
- Availability of business arrangements and specific financial services for the sector, with national and international fundraising for investment;
- Offering services and resources for technical and professional training.

Foresight Methodology

The GEF Biogas Brazil Project, for presenting perspectives of significant changes in the country's current energy scenario, used the Foresight as a tool for the territorial approach process, allowing filtering the essential elements to meet the specific demands of the territory, while creating synergy between its actors and the project resources to achieve its objectives.

In this sense, as an introduction to the Foresight Methodology, a brief approach follows:

INTRODUCTION

Brazil's economic growth potential is significantly conditioned to the generation of energy to meet future demands.

The Brazilian energy matrix is one of the most diversified in the world, with 48.4% of energy coming from renewable sources (Source: EPE, International Energy Agency), which allows the expansion of several renewable sources.

According to the Brazilian Agricultural Research Corporation - EMBRAPA, the agribusiness in Brazil, has a participation of approximately 6% in the Brazilian Gross Domestic Product (GDP). As an agro-industrial powerhouse, with intense production of organic residues, it presents extremely favorable conditions to produce biogas and biomethane that can be used to generate electricity, thermal energy or as vehicular fuel, contributing to the increase in the supply of energy and the reduction of greenhouse gas emissions.

In parallel to the energy potential of agro-industrial organic residues, the solid waste background presents a worrisome environmental liability, but with the possibility, like the agribusiness, of turning it into an economic asset, contributing to strengthen the country's energy matrix and mitigate socio-environmental impacts.

In order to contribute to the process of changing this scenario through the proposed set of actions, the GEF Biogas Brazil Project adopted the Foresight Methodology.
The approach of this book is to present this Methodology in a pragmatic way through a case study structured in four parts:

PART 1 **Theory of Change** ACCESS HERE

PART 2 **Guidelines for applying the Foresight to the development of the Biogas Value Chain** ACCESS HERE

PART 3 ***Foresight and its Application - Case of the State of Paraná*** ACCESS HERE

PART 4 **Multiplication of Good Practices** ACCESS HERE

Credit: UNIDO Brasil

PART 01

THEORY OF CHANGE

1.1. THE THEORY OF CHANGE

Credit: Getty Images

Craig Valters
Overseas Development
Institute Researcher

The Theory of Change
is like a compass, serving
to guide the way, but without
restraining it.

A set of local actions that includes facilitating investment in biogas market segments.

1.1.1. STATEMENT OF THE THEORY OF CHANGE

The GEF Biogas Brazil Project's Theory of Change calls for: establishing a set of local actions that include facilitating investment in biogas market segments that are ready to "take off"; expanding professional capacities and skills to increase the supply of energy from biogas and biomethane; providing technical assistance and disseminate best practices; thereby reducing project costs and accelerating the penetration of biogas technology in the market pyramid; then the project generates positive impacts to reduce greenhouse gas emissions and dependence on fossil fuels by promoting biogas-based energy, mobility solutions in agro-industrial value chains in Brazil, and strengthening of biogas technology supply chains.

1.1.2. POSTULATES OF THE THEORY OF CHANGE

Emissions
Brazil is still a significant emitter of CO_2, currently seventh in the world in terms of production-based emissions. It is necessary to reduce the emission of pollutant greenhouse gases.

Little explored energy potential of biomass
The energy potential of biomass and biogas feedstock in agro-industry is little explored, which translates into a great opportunity to add value to the production chain and to address environmental issues related to agro-industrial waste and effluents.

Limited technological innovation
There are barriers that restrict technological innovation in the biogas sector in agribusinesses, signaling: the need for a broader approach in the sector to mitigate the restrictions, lack of technical knowledge, regulation and funding lines, and market strategies.

1.1.3. APPLICATION OF THE THEORY OF CHANGE IN THE BIOGAS VALUE CHAIN IN THE PARANÁ AGRIBUSINESS

The GEF Biogas Brazil Project's Theory of Change in the biogas value chain in the agro-industry of Paraná is composed of five logically linked and interrelated elements that encompass actions, outputs, outcomes and impacts.

INPUTS
Resources needed to carry out the project

ACTIVITIES
Actions that must be carried out in order for the project to be realized, considering pre-conditions or premises

OUTPUTS
Immediate effects of the activities performed - products

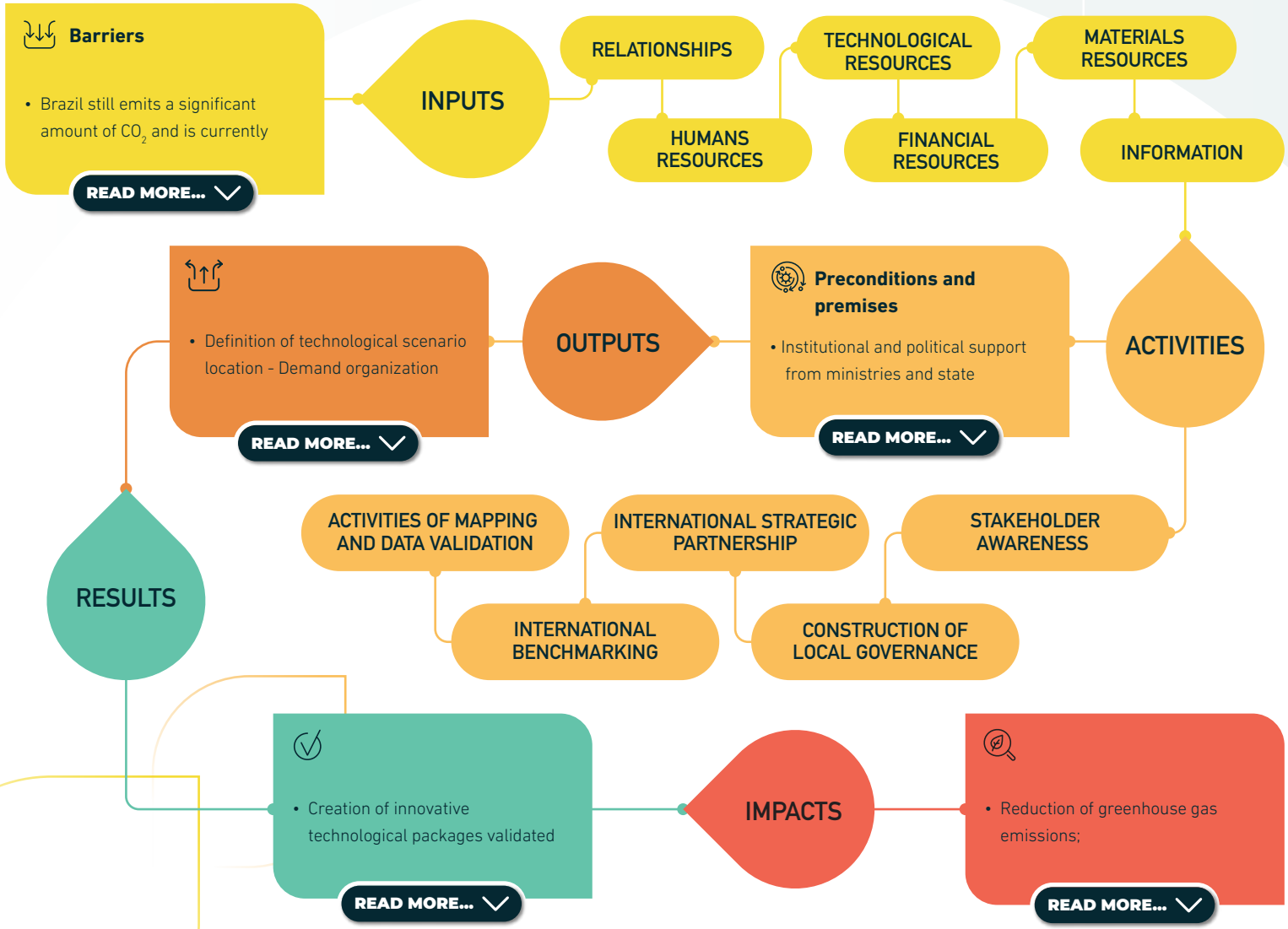
RESULTS
Short and long-term results generated by the project to the beneficiaries

IMPACTS
Long-term results that promote structural changes in solving or mitigating problems

APPLICATION OF THE THEORY OF CHANGE IN THE BIOGAS VALUE CHAIN IN THE PARANÁ AGRIBUSINESS

ACCESS HERE

THEORY OF CHANGE DIAGRAM - BIOGAS VALUE CHAIN IN THE PARANÁ AGRIBUSINESS

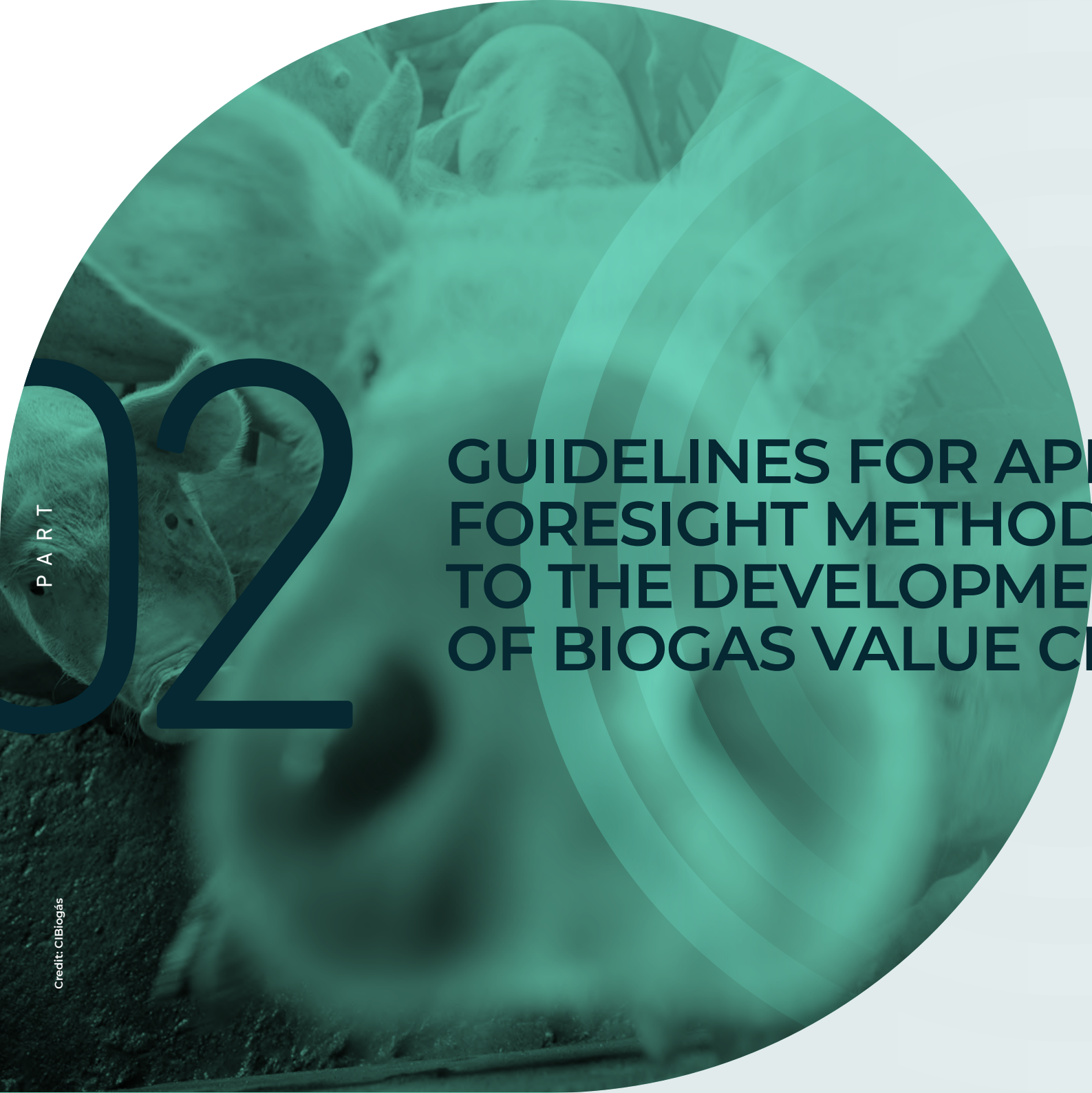


Theory of Change enables the detailing how the GEF Biogas Brazil Project will be able to promote changes in the sector.

In practice, as observed in the box, by **clicking on the link below**, the application of the Theory of Change enables the detailing how the GEF Biogas Brasil Project will be able to promote changes in the sector, from the previously identified conditions in energy and environmental scenarios of the agroindustry of Paraná. The theory applied through a set of actions involving its beneficiaries, creating solutions with the results of impact so that the country is more competitive and develop with sustainability.

THEORY OF CHANGE IN THE BIOGAS VALUE CHAIN IN THE AGROINDUSTRY OF PARANÁ

Adapted from Mid-term Review (MTR) of the Biogas Brazil Project, 31Mar 2021 - ITPEnergised.technical and professional.

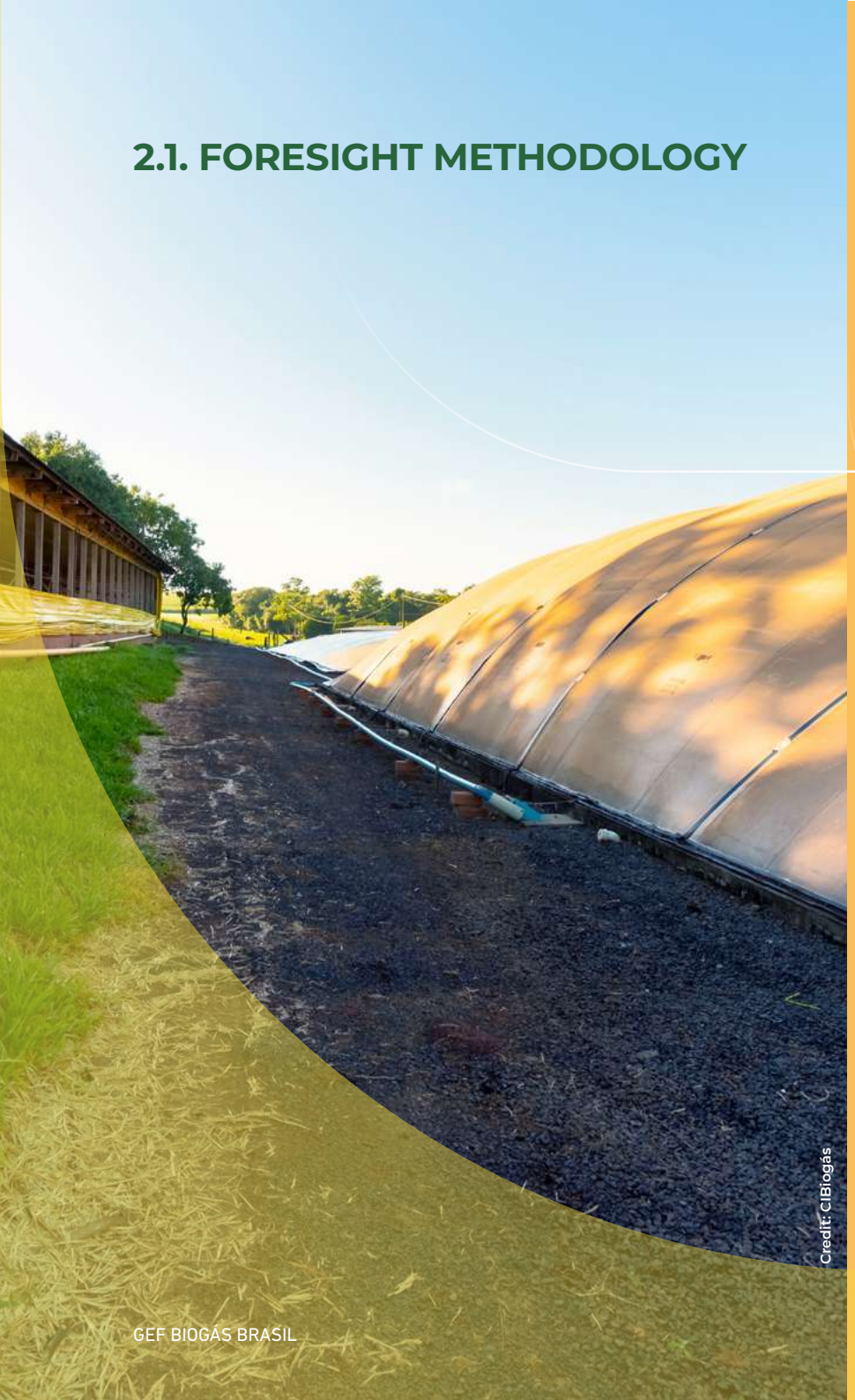


PART 02

GUIDELINES FOR APPLYING FORESIGHT METHODOLOGY TO THE DEVELOPMENT OF BIOGAS VALUE CHAIN

Credit: CIBiogás

2.1. FORESIGHT METHODOLOGY



Credit: CIBiogás

Martin Amsteus

"Foresight" is a systematic approach that aims to understand technological solutions for the future.

A world in which constant market changes are driven by the expectation that the global population will increase by 2 billion people in the next 30 years.

2.1.1. THE FORESIGHT METHODOLOGY AND ITS APPLICATION IN SCENARIO FORECASTING

In today's world, increasingly dynamic and with constant changes in market environments, public policies, production, technology, among others, thinking about the future is challenging and essential. It is through change that you reposition yourself properly in the economy to meet the challenges of a changing world order. According to the **UN Department of Economic and Social Affairs**, these challenges are driven by factors such as growth of the world population, expected to increase by 2 billion people in the next 30 years, the aging of the current population and the decreasing fertility rate in countries with decreasing population size.

The changes generate important consequences inherent to the fulfillment of the **Sustainable Development Goals (SDGs)**, the globally agreed targets for improving economic prosperity, social well-being, and environmental protection. of the environment.

To keep up with these changes and maintain competitiveness, companies need to differentiate themselves by innovating and trying to anticipate trends and signs of change. And for that, the importance of monitoring the external environment is growing.

But, how to do it?

The starting point is to draw a new scenario to rethink strategies and contribute to decision-making for investments.

To this end, there are various methodologies for studying future scenarios, as presented in the following table.

- ANALYSIS OF CHANGES IN MARKET DEMAND
- ANALYSIS OF CHANGES IN TECHNOLOGY
- ANALYSIS OF PRODUCTION CHANGES
- ANALYSIS OF CHANGES IN PUBLIC POLICY AND LEGISLATION
- ANALYSIS OF CHANGES IN INVESTMENTS AND FINANCE

FORESIGHT
RETHINK STRATEGIES

NEW SCENARIO

DECISION MAKING FOR INVESTMENT

DRAWS THE NEW SCENARIO AND IDENTIFIES WHAT THE TECHNOLOGIES ARE, AS WELL AS THE KNOWLEDGE THAT RESPONDS TO THE NEW CHALLENGES OF THE MARKET, FOSTERING INVESTMENTS.

To this end, there are various methodologies for studying future scenarios, as presented in the attached table.

ACCESS HERE

Foresight

A method that assumes a future under construction that can be actively influenced or created.

These methodologies can be applied to help companies be more competitive and better prepared for the future by minimizing uncertainty, enhancing relevance, and providing trend information to guide decision-makers in defining medium and long term strategies.

Among these methodologies, Foresight stands out as it is a method that identifies that "the future is under construction and can be actively influenced or even created" (UNDP - Foresight Manual 2018).

In the "Foresight Methodology , a benchmarking activity is used to collect value-added inputs to be used in designing technology development strategies in different sectors" (COSMOB 2021). For example, the European Technology Platforms were analyzed, which are "industry-led groupings of stakeholders in a specific sector, with the objective of defining a Strategic Research Agenda (SRA) on strategically important topics with high societal relevance, to achieve the objectives of growth, competitiveness and sustainability, guided by technological and research advances in the medium and long term" (European Commission, 2005).

Thus, by adopting the Foresight methodology, the GEF Biogas Brazil Project is referenced with technological parameters of international level for the identification of the favorable and necessary environment in the recognition and dissemination of technological opportunities and innovations for the biogas sector (GEF Biogas Brazil, 2019).

Credit: CIBiogás

In addition to the reference of the platforms in the application of the methodology, the universal agenda defined by the **17 Sustainable Development Goals (SDGs) of the United Nations (UN)** was used, from which indicators highlighted as the most relevant before the biogas sector were analyzed: clean and affordable energy; industry, innovation and infrastructure.

In practice, the Foresight prioritizes the qualitative approach in the analysis of the future, through the application of questionnaires with cross-referenced data that show the technological gaps in the productive sector segments as a function of the growth potential of the local system, taking into account the local capacity to absorb knowledge and technologies. Thus, a wide range of information can be made available to improve the decision-making process, which is often associated with the long term. This process is fundamental to create competitive advantage for companies, converging with the main objective of the method to connect the efforts of those involved in defining the future scenario and its feasibility.

The methodology acts on the value chain and takes into consideration strategic themes that can be transversal to the productive chains of each sector, as is the case of sectors such as milk and dairy products, opportunized by Sebrae Paraná, with the application of Foresight for the prediction of the future, carried out in three phases.

The following image shows the three phases of the Foresight Methodology applied in the GEF Biogas Brazil Project and its respective steps.

FORESIGHT APPLICATION PROCESS: GEF BIOGAS PROJECT BRAZIL

PHASE 1

DEFINITION OF LOCAL TECHNOLOGICAL SCENARIO - DEMAND FOR KNOWLEDGE

The **FIRST PHASE** aims to build the sectorial technological route, identifying the technological demand and knowledge of the companies.
This phase is important for building the value chain of the biogas industry.

3 MONTHS*

PHASE 2

ORGANIZATION OF THE LOCAL ECOSYSTEM - KNOWLEDGE SUPPLY

In the **SECOND PHASE** it is important to organize the ecosystem and governance of local institutions in the form of a network, in order to facilitate access to knowledge for companies, creating a favorable environment for new investments in a structured way.

2 MONTHS*

PHASE 3

BUSINESS MODEL

Once the technological routes of the companies have been defined and the local governance organized, the **THIRD PHASE** aims to elaborate different business models by sector, showing the market the various investment possibilities.

1 MONTH*

*Depending on local needs, deadlines can be adjusted.

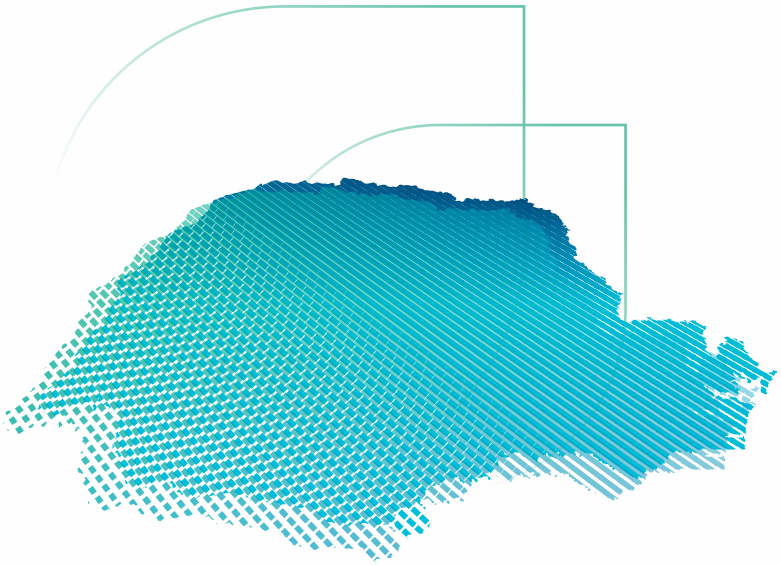
PART 03

FORESIGHT AND ITS APPLICATION CASE OF THE STATE OF PARANÁ

Credit: Embrapa

3.1

FORESIGHT AND ITS APPLICATION CASE OF THE STATE OF PARANÁ



Why use Foresight?

To meet the constant global challenges imposed on companies, which require continuous investments allocated appropriately in technologies appropriate in different strategic areas, in line with the design of new scenarios.

Benchmarking

In order to approach indicators with an international vision, benchmarking activities were carried out in international technology platforms, which already apply the Foresight Methodology, to compare Brazilian sectorial trends with technologies used abroad.

For these activities, a partnership was established with the Cosmob Technological Center, located in Italy.

Indicators for the Sustainable Development Goals (UN SDGs) were also defined, considering the most relevant SDGs to the biogas sector.

Methodological approach

The Foresight Methodology approach is carried out in the value chain, taking into consideration strategic themes that may be transversal to the production chains. Its application is divided into three phases: **definition of the local technological landscape, organization of the local ecosystem** and **business model**.

Scope

Introduce the Foresight Methodology in a systematized way to enable other institutions to reapply it in other contexts, contributing to the multiplication of good practices in the territories and productive segments.

Challenges

Keep the ecosystem alive, organized, active, generating value and business for the territory.

WANT TO KNOW MORE ABOUT UNIDO TECHNOLOGY FORESIGHT? CLICK HERE

SUSTAINABLE DEVELOPMENT GOALS

The GEF Biogas Brazil Project used the Foresight Methodology as a tool for the territorial approach process, allowing filtering of the essential elements to meet the specific demands of the territory, while creating synergy between its actors and the project resources to achieve its objectives.

The most relevant United Nations SDG indicators for biogas were analyzed by applying the methodology.

The application of the Foresight Methodology in the State of Paraná was carried out in three phases referencing technological parameters of international level for the identification of the favorable and necessary environment in the recognition and dissemination of technological opportunities and innovations for the biogas sector. The UN Sustainable Development Goal most relevant to the biogas sector was also analyzed, following UNIDO's main purposes: **industry, innovation and infrastructure** (SDG 9).

The image below shows the three phases of the Foresight Methodology applied in the GEF Biogas Brazil Project and their respective steps.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

SUSTAINABLE DEVELOPMENT GOALS

WANT TO KNOW MORE ABOUT SDGS? CLICK HERE

9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and cross-border infrastructure, to support economic development and human well-being, with a focus on equitable and affordable access for all

9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly increase industry's share of employment and GDP, according to national circumstances, and double its share in the least developed countries

9.3 Increase access to financial services for small industries and other enterprises, particularly in developing countries, including affordable credit and its integration in value chains and markets

9.4 By 2030, modernize infrastructure and rehabilitate industries to make them sustainable, with increased efficiency in use of resources and greater adoption of clean and environmentally friendly technologies and industrial processes, with all countries acting in accordance with their respective capabilities

9.5 Strengthen scientific research, improve the technological capabilities of industrial sectors in all countries, particularly developing countries, including by 2030, encouraging innovation and substantially increasing the number of research and development workers per million people and public and private spending on research and development

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

9.a Facilitate the development of sustainable and resilient infrastructure in developing countries through increased financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing states

9.b Supporting domestic technological development, research and innovation in developing countries, including by ensuring an enabling policy environment for, among other things, industrial diversification and value addition to commodities

9.c Significantly increase access to information and communication technologies and strive to provide universal and affordable Internet access in the least developed countries by 2020.

About the SDGs Sustainable Development Goals

SOURCE:: https://brasil.un.org/pt-br/sdgs

THE SUSTAINABLE DEVELOPMENT GOALS IN BRAZIL

The Sustainable Development Goals are a global call to action to end poverty, protect the environment and the climate, and ensure that people everywhere can enjoy peace and prosperity. These are the goals to which the United Nations is contributing so that we can achieve the 2030 Agenda in Brazil.

UNIDO is guided by the principle of Inclusive and Sustainable Industrial Development (ISID).

WANT TO KNOW MORE ABOUT ISID? CLICK HERE

FORESIGHT AND ITS APPLICATION - CASE OF PARANÁ STATE

PHASE 1 — DEFINITION OF LOCAL TECHNOLOGICAL SCENARIO - DEMAND FOR KNOWLEDGE

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	
Alignments	Definition and consolidation of strategic themes	Definition of the relevance and uncertainty indexes	Definition of the accordance indexes	Technological classification of the companies	Technology scenario definition	3 MONTHS

ACCESS HERE

PHASE 2 — ORGANIZATION OF THE LOCAL ECOSYSTEM - KNOWLEDGE SUPPLY

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	
Analysis of the technological scenario and indicators definition	Preparation of the technological supply questionnaire	Indicators validation	Technical visits	Definition of the knowledge supply scenario	Results presentation	2 MONTHS

ACCESS HERE

PHASE 3 — BUSINESS MODEL

STEP 1	STEP 2	STEP 3	
Identification business	Structuring the work plan	Structuring the business model	1 MONTH

ACCESS HERE

3.1.1

PHASE 1

DEFINITION OF THE LOCAL TECHNOLOGICAL SCENARIO

For the definition of the local technological scenario, the application of the Foresight Methodology considered six steps, over a period of three months, presenting the territory's positioning through the definition of strategic themes that enabled the identification of uncertainty and relevance indicators and, consequently the technological classification of the companies that allowed the design of the technological demand scenario, as a first step towards the organization of the biogas value chain in the state of Parana.

PHASE 1 **DEFINITION OF LOCAL TECHNOLOGICAL SCENARIO**
DEMAND FOR KNOWLEDGE

STEP **1** Alignments — ACCESS HERE

STEP **2** Definition and consolidation of strategic themes — ACCESS HERE

STEP **3** Definition of the relevance and uncertainty indexes — ACCESS HERE

STEP **4** Definition of the accordance indexes — ACCESS HERE

STEP **5** Technological classification of the companies — ACCESS HERE

STEP **6** Technology scenario definition — ACCESS HERE

3 MONTHS


Credit: Getty Images

PHASE 1

STEP 1
ALIGNMENTS

With the support of Sebrae Paraná, This preliminary step was essential to present the project and methodology to the network of future partners and establish the engagement in the GEF Biogas Brazil Project. In this step, in addition to internal meetings for operational alignments, local stakeholders were mapped, the necessary coordinations were made for the sequencing of the following steps, and partnerships were formalized.

TABLE STEP 1

Credit: AB Energy

GEF BIOGÁS BRASIL

PHASE 1

STEP 2
DEFINITION AND CONSOLIDATION OF STRATEGIC THEMES

With the active participation of CIBiogas, Sebrae and UNIDO, the starting point for the definition of the scenarios was an analysis of six themes and a set of thirty specific technical aspects related to the main areas of interest for the development of the biogas sector in Paraná, called priority or strategic competitiveness sub-themes. Therefore, in partnership with the COSMOB technology center, all the questionnaires applied throughout the project were designed and the processing and analysis of the data from the phases was carried out.

ACCESS HERE

TABLE: STRATEGIC THEMES AND SUB-THEMES FOR THE COMPETITIVENESS OF THE BIOGAS SECTOR IN PARANÁ

Then, to consolidate and validate the strategic themes and sub-themes and allow the continuity of the process, workshops and on-site visits were conducted with local leaderships from the Western, Central and Northern regions of the state of Paraná, involving 95 participants from 19 institutions and business entities, among them, industries, equipment and technology suppliers for biogas, unions, institutions, universities, research centers, and sector specialists.

The strategic themes and sub-themes validated in this step determined the inputs for the identification of the relevance and uncertainty indexes, described in the next section.

TABLE STEP 2

PHASE 1

STEP 3

DEFINITION OF RELEVANCE AND UNCERTAINTY OF THE STRATEGIC THEMES

Using the validated themes and sub-themes, the relevance and uncertainty questionnaire was designed, structured in six dimensions analogous to the strategic themes, each with questions composed of the strategic sub-themes. For its application, workshops were held, as in the previous step, with businesspeople from the sector. On the same occasion a questionnaire was also applied for the technological classification of the companies, to be discussed in the next section.

After analyzing the results inherent to relevance and uncertainty, two sub-themes were selected for each strategic theme based on the average between the two indexes, thus selecting a set of 12 sub-themes.

The most relevant indexes were identified, highlighted in the table below, will serve as inputs in the future for the definition of the accordance indexes of the strategic themes.

TABLE STEP 3

RELEVANCE AND UNCERTAINTY INDEXES	
1 **Technological development**	· Equipment, Machines, Technology of biogas production; · Storage, conservation and distribution of biogas.
2 **Level of energy efficiency and safet**	· Power quality; · Biogas plant monitoring.
3 **Product and Quality**	· Legal obligations and technical standards; · Public programs to encourage biogas production
4 **Good environmental practices/ sustainability**	· Encouraging the use of alternative energies; · Environmental problem solving.
5 **Increased business competitiveness**	· Market diversification: LPG transport gas, CO_2 gas for pig slaughtering, bio-fertilizers; · Adoption of new business models and financing, feasibility, income opportunity.
6 **Infrastructures and territory**	· Infrastructure for distribution and logistics; · Definition of a single growth strategy for the sector through sector governance.

PHASE 1

STEP 4

DEFINITION OF THE ACCORDANCE INDEXES

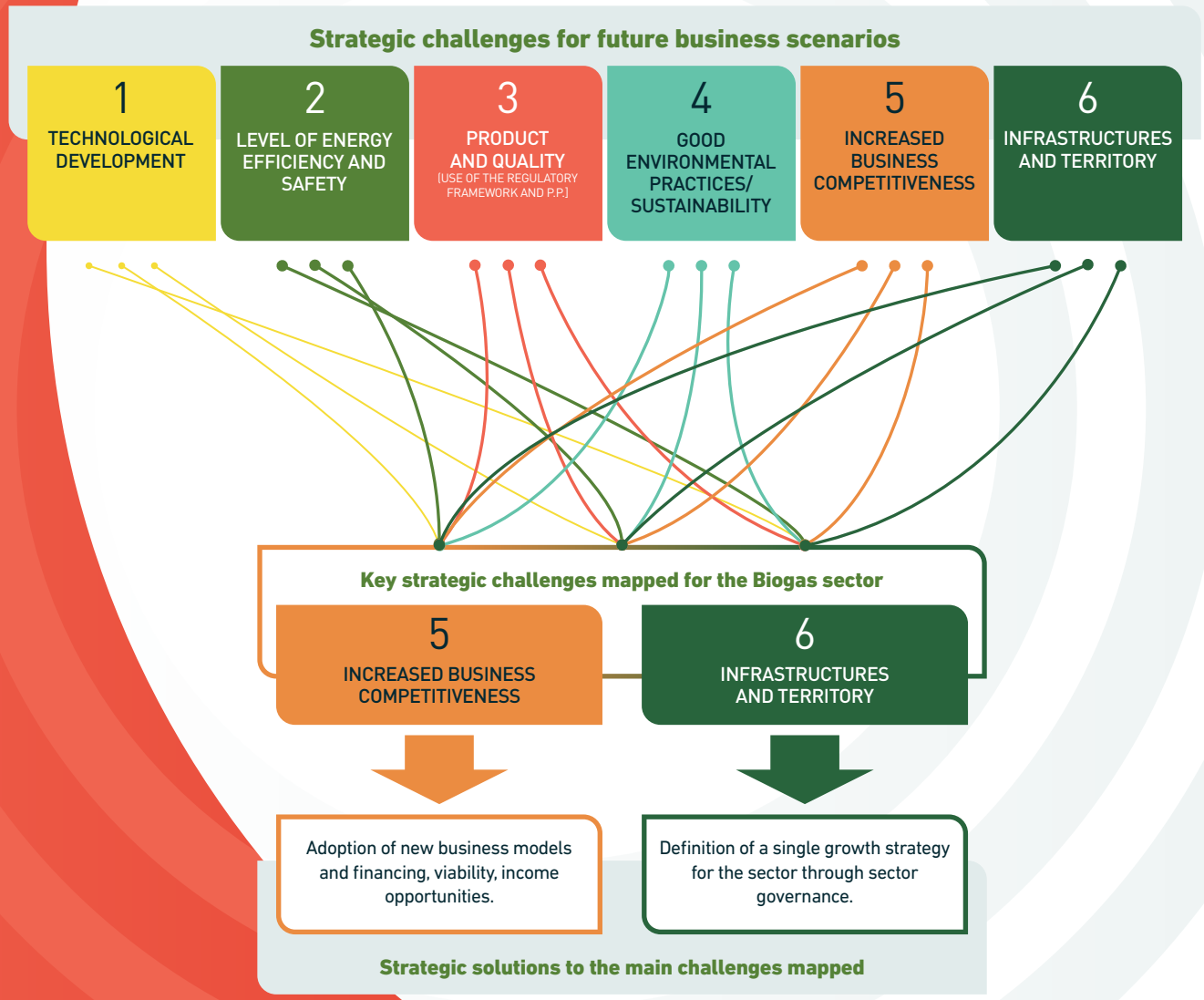
The Accordance Index, necessary to measure the degree of uncertainty of the companies, allows us to identify the level of difficulty in making forecasts inherent to each sub-theme under analysis.

For its definition, first the Accordance Index Questionnaire was elaborated, containing two questions for each of the two selected sub-themes, with the purpose of identifying the levels of impact of the strategic themes on the future scenarios.

The questionnaire for defining the Accordance Index was applied to to entrepreneurs of the biogas sector in a workshop held specifically for this purpose, resulting in the indication of two strategic themes and two more uncertain strategic sub-themes as shown in the following picture.

TABLE STEP 4

STEP 4 RESULTS



PHASE 1

STEP 5
TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES

The technological classification of Paraná companies in the biogas sector, carried out by means of a questionnaire structured in seven dimensions containing a set of questions based on studies and methodological references, allowed the identification of an interesting technological level, pointing out potential demand for products and services, as shown in the illustration below, with emphasis on the investment trend for the coming three three years and the sources of financial resources.

TABLE STEP 5

Credit: UNIDO Brasil

STEP 5 RESULTS

TABLE: TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES IN THE BIOGAS SECTOR

ACCESS HERE

PHASE 1

STEP 6
TECHNOLOGY SCENARIO DEFINITION

Considering the results of the previous steps, emphasizing the competitive levers, the indexes of greatest uncertainty were determined quantitatively. Thus, applying the criteria of the Foresight methodology, which guides for the selection of two variables that present the highest uncertainty index, it was possible to establish as drivers, **innovation** and **competitiveness**.

Future technological scenarios, or situations assumed in the present that can be realized in the future, depend essentially on a dichotomous configuration of these drivers, as shown in the illustration below, where innovation is configured into high and low innovation capacity and the market competitiveness configured into high and low competitiveness.

DRIVERS OF THE BIOGAS SECTOR SCENARIOS IN PARANÁ

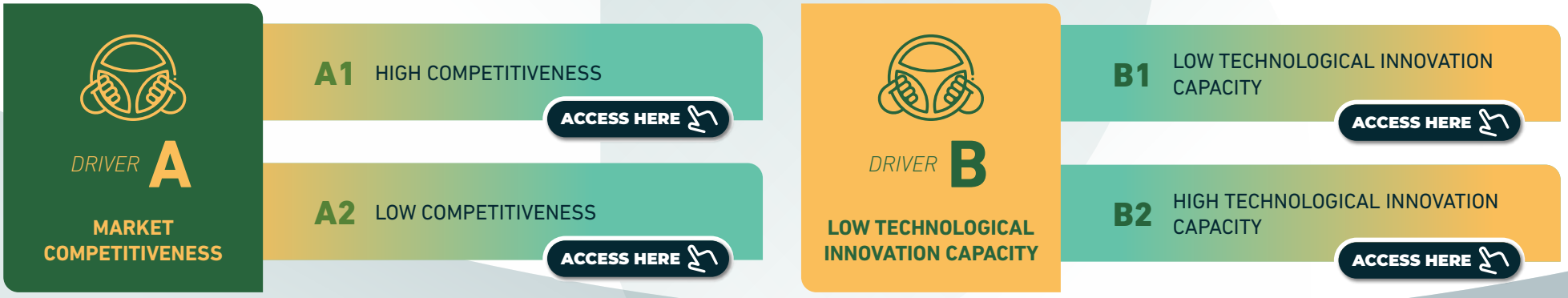
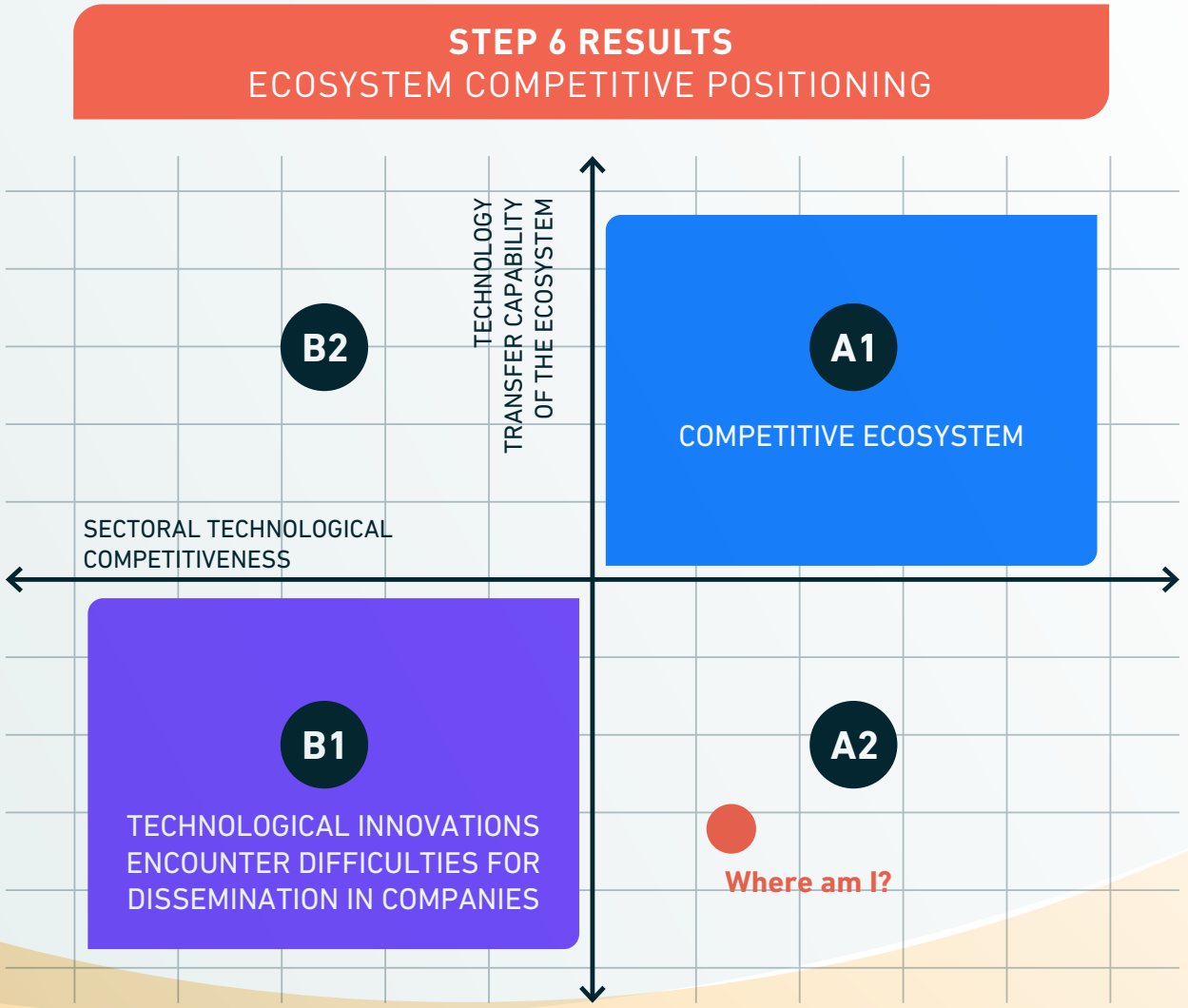


TABLE STEP 6

WANT TO KNOW MORE ABOUT THE DRIVERS AND THEIR PERFORMANCE SCENARIOS? ACCESS HERE

In a competitive environment, with traditional ways of acting in the productive chains, profitability is low, restricting the growth of companies, making it urgent to survive in the market, the search for new technological solutions.

To illustrate this context, the table on the right shows the ecosystem competitive positioning, due to Sectorial Technological Competitiveness and Technology Transfer of the Ecosystem.



RESULTS OF STEP 6 | COMPETITIVE POSITIONING OF THE ECOSYSTEM

TABLE: STRATEGIC INDICATORS IN THE FUTURE PROSPECTION

STRATEGIC INDICATORS

- **TECHNOLOGICAL DEVELOPMENT**
- **LEVEL OF ENERGY EFFICIENCY AND SAFETY**
- **PRODUCT AND QUALITY** [USE OF REGULATORY FRAMEWORK AND PUBLIC POLICIES]
- **GOOD ENVIRONMENTAL PRACTICES/SUSTAINABILITY**

MOST RELEVANT INDICATORS

INCREASED BUSINESS COMPETITIVENESS	Market diversification: gas for transportation LPG, CO_2 gas for pig slaughtering, biofertilizer. Adoption of new business models and financing, feasibility, income opportunities
INFRASTRUCTURES AND TERRITORY	Infrastructure for distribution and logistics. Definition of a unique growth strategy of the sector through sectorial governance.

PROJECT PARTICIPANTS

95 PARTICIPANTS OF THE PRODUCTION CHAIN

19 SECTORIAL INSTITUTIONS AND ENTITIES

With support from Sebrae PR, 95 public and private partners were engaged during the research of the agro-industrial environment in the state of Paraná. The survey resulted in six strategic themes relevant to the organization of the local production chain, through field activities in the territory and through benchmarking processes, which is the search for better management practices. The indicators produced by Foresight reveal that the increase in business competitiveness and territorial development must be the priority objectives of local governance to ensure the transfer of technology and knowledge to the sector.

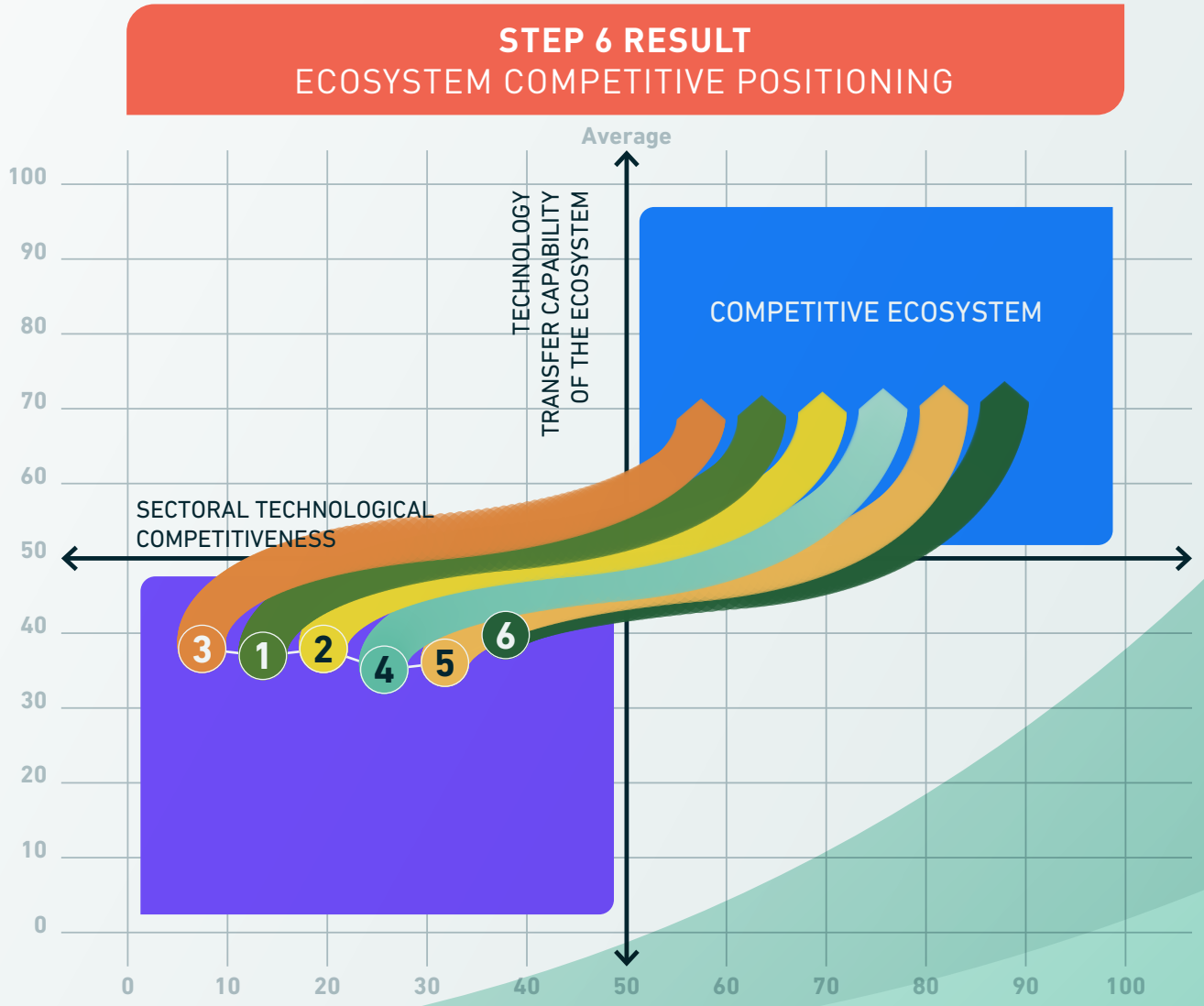
MAIN TYPES OF INVESTMENTS FORESEEN FOR THE NEXT 3 YEARS (TRENDS)

1. **PROCUREMENT OF AND EQUIPMENT**
2. **EXPANSION OR RENOVATION OF STRUCTURES**
3. **MARKETING AND ADVERTISING**

SOURCES OF FUNDS

Analyzing the future scenarios of the biogas sector in Paraná under the perspective of competitiveness and innovation technology, it was possible to determine the impact of these variables on the six strategic themes defined for the sector, resulted in a redesign of the positioning of companies, where the local ecosystem signals the need improvement between demand and offering knowledge, to become more competitive.

The graph on the side demonstrates the arrangement of the six strategic themes where the indicators in the purple quadrant associated with low competitiveness and low capacity for technological innovation, and in the blue quadrant are associated high competitiveness and high capacity of technological innovation.



In the face of the established scenarios, it is possible to draw conclusions from this Phase 1 highlighted in the table.

See page 39, the image illustrating the results of Phase 1 - Technology Scenario Definition location, used as input for Phase 2.

STEP 6 RESULTS
ECOSYSTEM COMPETITIVE POSITIONING

DEFINITION OF THE LOCAL TECHNOLOGICAL SCENARIO - CONCLUSION

The strategic themes evaluated in the biogas sector in Paraná presented transversality and scalability among them, and may reflect in the development of the entire sector, with regard to technological innovation, energy efficiency and safety, product and quality, good environmental practices and sustainability and competitiveness.

Considering the strategic themes with the highest levels of uncertainty, and therefore greater difficulty in predictability, it was found that the results are aligned with global trends converging on themes that require greater attention:

- Increased competitiveness of companies;
- Infrastructure: defining a single growth strategy for the sector through sector governance.

However, the sector is facing restrictions in its capacity to invest in innovation, technology and services motivated by:

1. Limited financial resources from the companies themselves or from the private initiative, due to the lack of public resources for this purpose;
2. Lack of support from the public sector for access to services for innovation and technological development;
3. Excessive bureaucracy.

The scenarios based on the need for technological innovation and competitiveness designed in this phase, present a broad and promising horizon for improvements for companies in the sector, requiring, for this purpose, the acquisition of machinery and equipment, expansion or renovation of structures, promotional services and advertising in order to reposition themselves as highly competitive.

3.1.2

PHASE 2

ORGANIZATION OF THE LOCAL ECOSYSTEM LOCATION

PHASE 2 was carried out in six steps over two months to organize the local ecosystem and thus define the knowledge offer, in convergence with the demand for knowledge defined in the previous phase.

PHASE 2 **ORGANIZATION OF THE LOCAL ECOSYSTEM**
KNOWLEDGE SUPPLY

STEP 1 Analysis of the technological scenario and indicators definition — ACCESS HERE

STEP 2 Preparation of the technological supply questionnaire — ACCESS HERE

STEP 3 Indicators validation — ACCESS HERE

STEP 4 Technical visits — ACCESS HERE

STEP 5 Definition of the knowledge supply scenario — ACCESS HERE

STEP 6 Results presentation — ACCESS HERE

2 MONTHS

3.1.2
PHASE 2
ORGANIZATION OF THE LOCAL ECOSYSTEM

The dynamism and complexity of the business environment require the implementation, adaptation, control of variables, and the interaction of all players, with the purpose of making them more competitive. As a way to solve this equation, the governance culture has been increasingly adopted, because it is "a critical factor in the successful delivery of a project" (Chang, 2015).

Governance is a set of principles, rules and procedures concerning the management and governance of a company, an institution, **a collective phenomenon** (Commission on Global Governance, 1996).

In this sense, considering the GEF Biogas Brazil Project, a project with its own characteristics, which brings together a set of government entities, institutions and companies that act both collectively and independently, **without hierarchical level and harmonically** in favor of converging interests, we can consider its **governance** as:

A favorable environment that allows the organization of the technological services offer through a network of partners, transforming knowledge into innovation insertion, technology, and investment capture for the biogas sector.

This fact is verified with greater intensity in Phase 2 - Local Ecosystem Organization - Knowledge Supply, where governance becomes fundamental due to the demand for knowledge, determined by the most relevant and uncertain strategic themes of Phase 1.

Credit: UNIDO Brasil

PHASE 2

STEP 1
ANALYSIS OF THE TECHNOLOGICAL SCENARIO AND INDICATORS DEFINITION

The starting point for the organization of the ecosystem of the biogas sector in Paraná was the scenario analysis in Phase 1, which resulted in the indicators for the identification of the technological supply of the biogas sector with the mapped institutions that hold knowledge in technological innovation.

Participated in this phase:

- **CIBiogas;**
- **SEBRAE/PR - Service of Support to Micro and Small Enterprises of Paraná - ;**
- **FAEP/SENAR-PR System - Agriculture Federation of the State of Paraná and National Rural Learning Service;**
- **UNILA - Federal University of Latin American Integration - Foz do Iguaçu;**
- **UTFPR - Federal Technological University of Paraná - Ponta Grossa Campus.**

TABLE STEP 1

PHASE 2

STEP 2
PREPARATION OF THE TECHNOLOGICAL SUPPLY QUESTIONNAIRE

Based on the technological scenario indicators, a questionnaire was prepared for the supply of technological services, aiming to meet the demands identified in the previous phase, to contribute to the organization of the biogas production chain in Paraná.

The questionnaire was structured in three parts:

1. **Technological classification;**
2. **Technological services offering and**
3. **Services for the most relevant topics offering.**

TABLE STEP 2


Credit: UNIDO Brasil

PHASE 2

STEP 3

INDICATORS VALIDATION

The questionnaire with its indicators was presented and validated in a workshop with the local institutions to be applied in the next step of the activities, through technical visits to the mapped institutions.

TABLE STEP 3

PHASE 2

STEP 4

TECHNICAL VISITS

In this step, technical visits were made to the selected public and private institutions with qualified personnel, laboratories, and research centers, to enable the mapping of data to identify the supply of technological services for the most relevant themes, presented below.

TABLE STEP 4

PHASE 2

STEP 5

SCENARIO DEFINITION OF KNOWLEDGE OFFER

The mapping of technological services supply resulted in the identification of suppliers in five areas converging with the biogas sector in Paraná: consulting and technical assistance, training, information and updates, testing and trials, and research and development, each offering a set of services.

The following illustration demonstrates the results of mapping the supply of technological services.

TABLE STEP 5

Credit: UNIDO Brasil

PHASE 2

STEP 6
RESULTS PRESENTATION

TABLE STEP 6

The implementation of GEF Biogas Brazil Project in the territories started with a strategy focused on the construction of a Partners Network, from the **GEF Biogas Brazil Project Steering Committee**, aiming to establish the integration of the project with the other sector initiatives present in the states. By means of a discussion forum, availability of digital tools, engagement in the digital community, among others, actions were promoted in the territories in order to organize and manage strategic information in the biogas value chain.

Thus, a key factor in the constitution of a network of partners was the structuring of sectorial governance in the territories, promoting the integration of local actors in a systematic way and creating synergies between the actions of GEF Biogas Brazil and the local initiatives already underway. This has allowed the opening of a dialogue with a network of partners made up of 30 public and private institutions in the state of Paraná alone, and the creation of a favorable environment of cooperation that allowed the transfer of knowledge, insertion of innovation and technology in the companies, as well as the attraction of investments for the sector, reinforcing the biogas value chain.

Together with governance, the new business models implemented in the companies were identified, meetings were held with the private market encouraging the structuring of the value chain, among other activities.

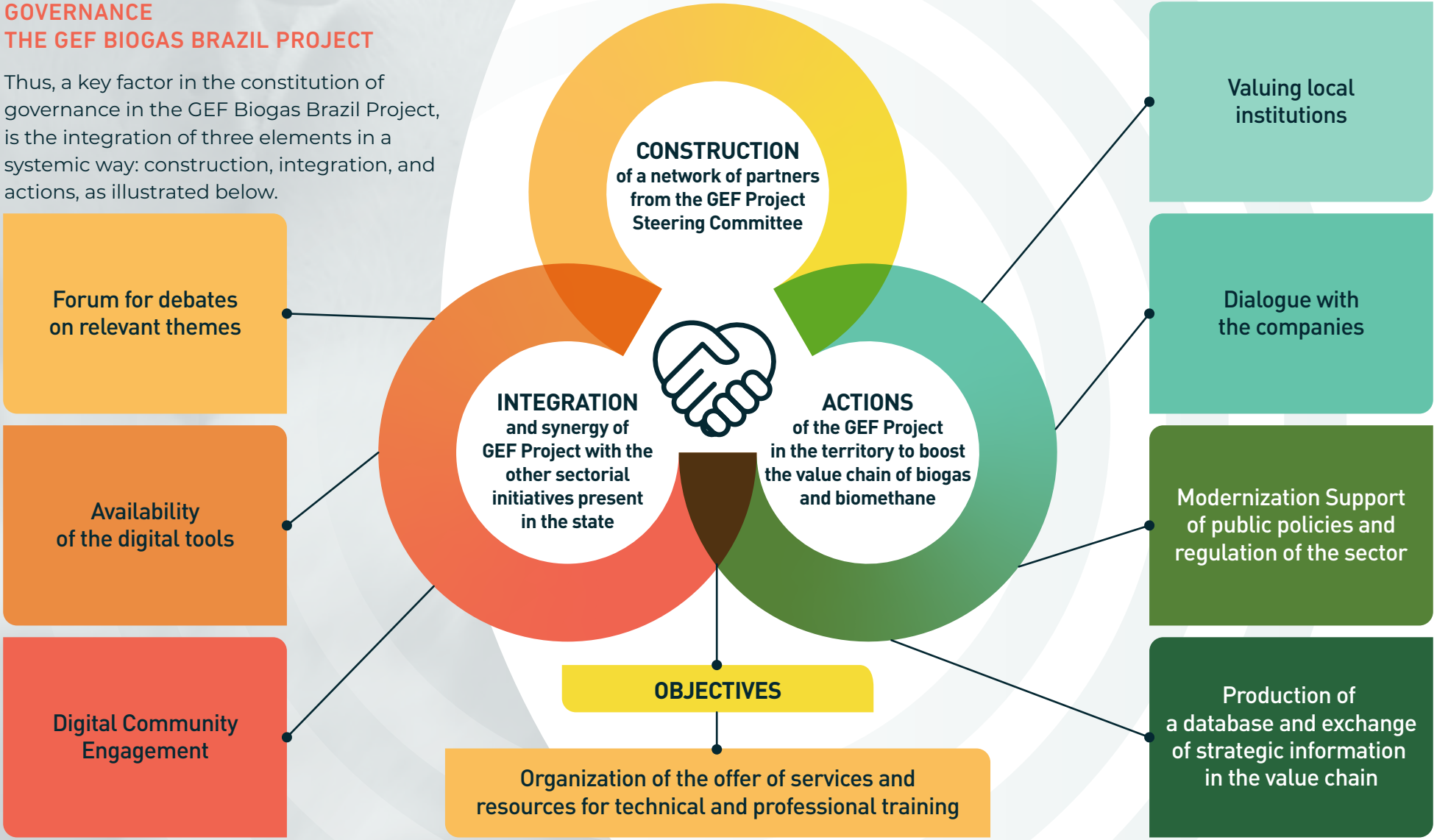
GOVERNANCE

PARTNER NETWORK IN PARANÁ

1. **SEBRAE** - Brazilian Service of Support to Micro and Small Enterprises
2. **ABiogás** - Brazilian Biogas Association
3. **EMBRAPA** - Brazilian Agricultural Research Corporation
4. **ITAI** - Institute of Applied Technology and Innovation
5. **PTI** - Itaipu Technological Park Foundation
6. **UTFPR** - Federal Technological University of Paraná
7. **FIEP** - Federation of Industries of the State of Paraná
8. **FAEP** - Agriculture Federation of the State of Paraná
9. **BRDE** - Regional Bank of Far Southern Development
10. **Lar Cooperative**
11. **Geo Energática**
12. **NRG Hub**
13. **BANCO DO BRASIL**
14. **FGV** - Getúlio Vargas Foundation
15. **Sulgás** - Gas Company of the State of Rio Grande do Sul
16. **SIMA** - Union of Furniture Industries of Arapongas - PR
17. **OCEPAR** - Cooperative Union and Organization of Paraná
18. **Klabin**
19. **SIMP** - Union of the Cassava Industries of Paraná
20. **Araucária Foundation**
21. **TECPAR** - Paraná Technology Institute
22. **BEP** - Energy Program for Brazil
23. **SANEPAR** - Company of Paraná Sanitation
24. **COMPAGÁS** - Paraná Gas Company
25. **Copel** - Paraná Energy Company
26. **Government of Paraná State**
27. **Toledo City Hall**
28. **Arapongas City Hall**
29. **Rural Producers' Cooperatives - AMBICOOP** (Sustainable Energy Generation Cooperative)
30. **COPERSAN of Nova Santa Rosa** - Cooperative of Health Administrative and Technical Support Professionals

GOVERNANCE
THE GEF BIOGAS BRAZIL PROJECT

Thus, a key factor in the constitution of governance in the GEF Biogas Brazil Project, is the integration of three elements in a systemic way: construction, integration, and actions, as illustrated below.



Credit: UNIDO Brasil

PHASE 2 RESULTS

FOCUSED ON THE STRATEGIC THEMES WITH THE HIGHEST UNCERTAINTY INDEX IN PHASE 1, THE NEXT TABLE SHOWS THE SERVICES OFFERED BY SERVICE PROVIDERS IN THE BIOGAS SECTOR IN PARANÁ

SERVICE OFFERINGS FOR THE MOST RELEVANT THEMES

	STRATEGIC THEMES	CONSULTING TECHNICAL ASSISTANCE	TRAINING	INFORMATION AND UPDATES	TEST AND EVIDENCES	R&D
GOOD ENVIRONMENTAL	1. Environmental problem solving 2. Sustainable Product Cycle 3. Encouraging the use of alternative energies 4. Gas emissions (greenhouse effect)	The four services inherent in Good Environmental Practice/Sustainability are offered by the institutions active in the five service provider areas. However, there is a predominance of providers of **solutions to environmental problems**, followed by a smaller number of providers of services related to the sustainable product cycle and promotion of alternative energy use. In even smaller numbers are the providers of gas emission services (greenhouse effect).				
INCREASED COMPETITIVENESS	1. Adoption of new business models and financing, feasibility, income opportunities 2. Market diversification: LPG transportation gas, CO_2 gas for pig slaughtering, Biofertilizer 3. Associative model and Networks of companies in the production chain 4. Working conditions and training, Management system and organization 5. Family Succession	As for the supply of services to increase competitiveness, it is observed among service providers a transversal supply of the five services analyzed, with, however, a greater supply of services related to the **adoption of business models and financing, viability, income opportunities**, the others being offered by fewer providers, except family succession that presents a very small number of providers for this service.				
INFRASTRUCTURES AND TERRITORY	1. Adding value to production and territory (by using alternative energy) 2. Production infrastructure 3. Transportation of Biogas/Biomethane 4. Infrastructure for distribution and logistics.	Finally, infrastructures and territory present a wide range of services offered by all service providers, with a predominance of services related to the **valorization of production and territory**, and a reduced number for infrastructure services **for distribution and logistics**.				

WANT TO KNOW MORE ABOUT TECHNOLOGY SERVICE OFFERINGS? ACCESS HERE

IN AN ONLINE WORKSHOP PROMOTED BY THE GEF BIOGAS BRAZIL PROJECT, THE RESULTS OF THE FIRST PHASES WERE PRESENTED TO THE NETWORK OF PARTNERS IN THE TERRITORY.

Based on the analysis of the results obtained in phase 1 and 2, an action plan was proposed, built with the local governance and divided into three components:**Technology Cluster**, **Technology Platform** and **Innovation Projects**.

In this context, the definition of a medium-term action plan based on the three elements described represents a response to the needs expressed by the sector and implies the establishment of synergy and sharing of intentions between the public and private sectors.

1 TECHNOLOGICAL CLUSTER	A geographically concentrated grouping of interrelated companies and related institutions in a given area linked by common and complementary elements (Porter, 1999). The cluster has as its essence the competitive advantage of the productive chain resulting from the relationships of its players, being in the biogas sector in the state of Paraná, companies, unions, universities, research centers, local institutions focused on the field of innovation. Among the cluster 's objectives is the development of a strategic plan with the purpose of identifying priorities, intervention models, and specific tools. The plan must necessarily be referenced in the Foresight project analysis.
2 TECHNOLOGY PLATFORM	System to make the cluster tangible, coordinated by a technology center that aggregates companies, universities, research centers, innovation, and technology transfer, focused on the field of innovation and increment of the interrelations between the scientific system and the business world, enabling the creation and sharing of new knowledge and technologies, fundamental conditions for supporting companies and the emergence of innovative startups and research spin-offs, as well as virtual research laboratories.
3 INNOVATION PROJECTS	They play a key role in providing direct financing to companies for the design, development, and marketing of new products and the introduction of innovation in processes, organization, and services. Innovation can mean the inclusion of innovative production technologies and instrumentation, the acquisition of R&D services, the introduction of new organizational forms, and the opening of new markets.

3.1.3. PHASE 3 - BUSINESS MODEL

There are three fundamentally different types of business: customer relationship business, product innovation business, and infrastructure business.

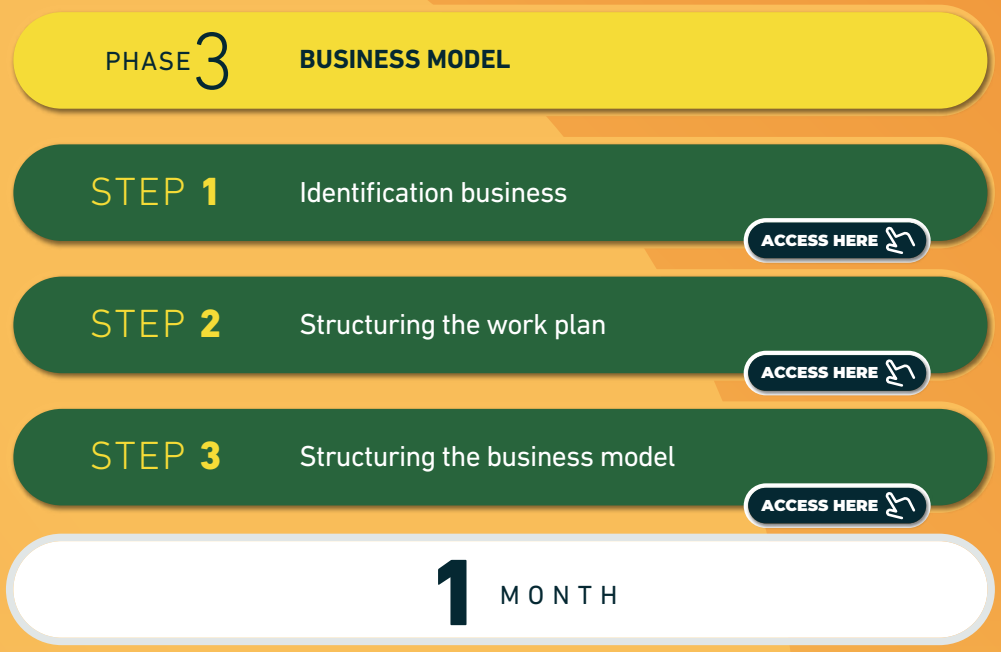
Alexander Osterwalder

Credit: Getty Images

3.1.3
PHASE 3
BUSINESS MODEL

Once the technological scenario is defined and the local ecosystem is organized, it is time to define the business model for transfer technology.

Phase 3, carried out in three steps over the course of a month, makes it possible, at its conclusion, the organization of the biogas value chain in Paraná.



PHASE 3

STEP 1
BUSINESS IDENTIFICATION

In line with the purposes of the GEF Biogas Brazil Project, business identification should converge to the circular economy optics, in order to enable the structuring of business models oriented towards a sustainable future.

In this sense, due to the expressive set of variables to be evaluated in the business model, at this step it is necessary to analyze the biogas value chain.

Value chain analysis allows for a comprehensive assessment of the scope of activity performed by a given firm and how these activities interact in the context of the dissemination of a given technology (Porter 1989).

In the biogas sector, the **value chain** is related to the transformation of the final product - biogas - into different products with added value, or new applications, unlike the production chain, where one only observes the transformation of biomass into biogas, which has little usability in its natural form. This transformation of biogas allows for different forms of monetization, among them the sale of electricity, biofertilizers, carbon credits, and also contributes to the reduction of greenhouse gas emissions.

The knowledge of the entire biogas production chain is fundamental to propose and consider measures for the production and use of energy, adding value to agro-industrial effluents, generating business opportunities and environmental benefits.

TABLE STEP 1

Credit: Getty Images

1.1. VALUE CHAIN

Global value chains refer to the national and international sharing of production, a phenomenon in which production is divided into activities and tasks performed in different territories.

UNIDO's value chains approach studies aim to generate substantial economic, social, environmental, resilience impact.

https://iap.unido.org/articles/what-are-global-value-chains-and-why-do-they-matter

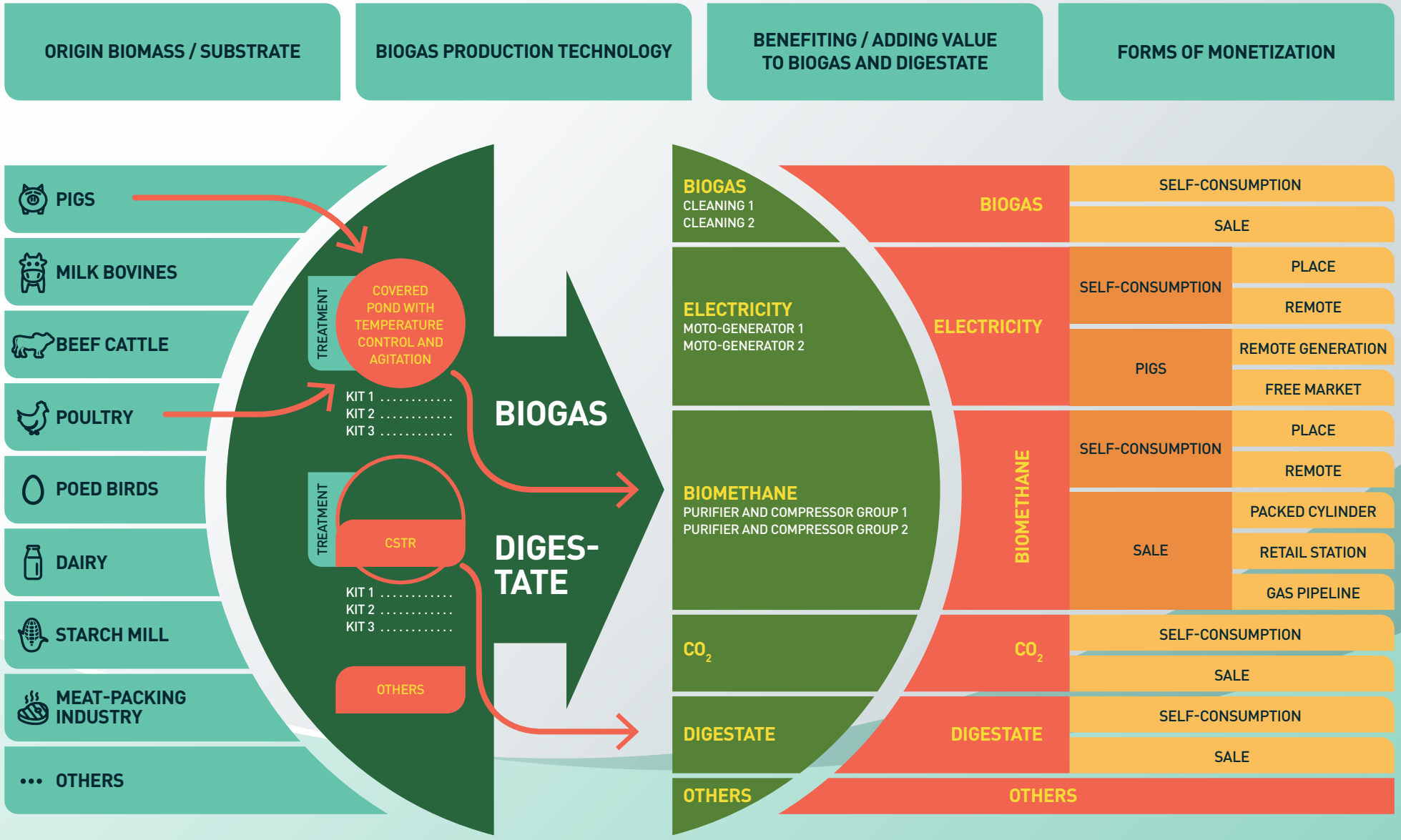
https://www.unido.org/what-are-value-chains

The value chain related to biogas is a technological route that covers different industrial sectors from agribusiness to metalworking and automotive in transformation of biomass into biogas or biomethane among others.

Thus, the dynamism of the sector does not allow the links in its value chain to be seen in isolation, because as is known, biogas production is not restricted to energy generation.

The main links that make up the biogas value chain are illustrated in the following, and then definitions and particularities of these links, fundamental to structure in the **Business Model**.

BIOGAS VALUE CHAIN

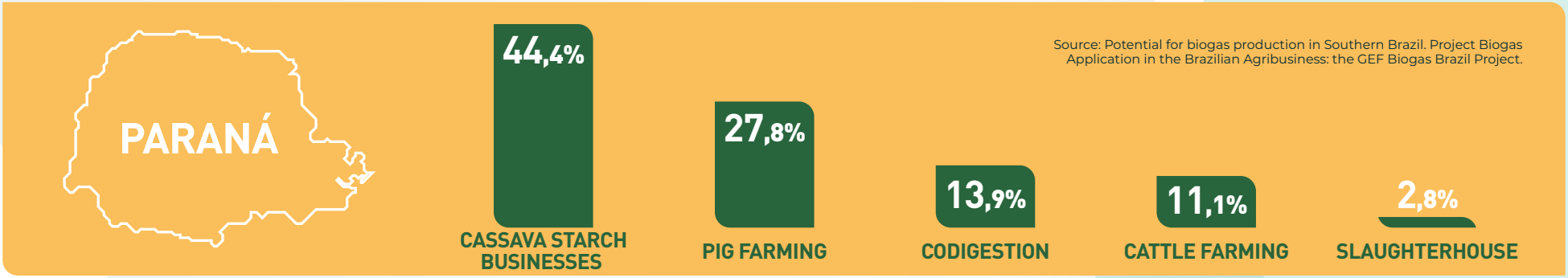


1.1.1. BIOMASS

The biomass used for the production of biogas through the biodigestion process must meet a series of requirements to ensure the efficiency of the process. Most important is the creation of a favorable ecosystem for the development and metabolic activity of the microorganisms involved in the process.

There are several sources of biomass or raw material used in biogas production, among them, waste from **livestock** production (pigs, dairy and beef cattle, poultry and layers), waste from **agro-industrial** processes (dairies, meat packing plants, cassava starch businesses), forestry waste, agricultural waste, sludge from sewage treatment plants - STP - and wastewater; urban solid residues - garbage.

In Paraná, the main biomass sources are:



Source: Potential for biogas production in Southern Brazil. Project Biogas Application in the Brazilian Agribusiness: the GEF Biogas Brazil Project.

Each of these sources of biogas has its own characteristics that influence the links in the value chain - technologies, processing, monetization.

The biodigester models are adapted to different economic realities and weather conditions with different purposes and technology levels.

1.1.2. BIOGAS PRODUCTION TECHNOLOGY

There are many biodigestion technologies to meet the most diverse market demands, each with its own level of investment, some lower, and some extremely high. The choice of these technologies depends on logistical issues of the raw material, the resources available for construction and maintenance of the processing plant, scale, size of the production plant and the fundamental purpose of the plant. While some focus on the treatment of organic waste, others focus on the generation of energy or biofertilizer.

For environmental treatment, the focus is mainly on the reduction of organic carbon. For energy treatment, the units use substrates with the specific purpose of producing biogas and applying it in their processes.

Biodigester models are adapted to different economic realities and climatic conditions with different purposes and technological levels.

As for the supply of technologies for biodigestion systems, equipment for the application of biogas and monitoring of the plants in Paraná, it is important to note that local suppliers have been developing increasingly, and already hold 67% of the market, while regional and national suppliers account for 28% and international suppliers for 6% of the market.

These technologies need incentives and facilitation for their implementation, including economic compensation for the adoption of treatment systems with less environmental impact, and for the use of biogas as a renewable energy source to replace non-renewable energy, as this source has been growing and gaining space in the world transition process of the Brazilian energy matrix. This movement tends to be boosted, as institutions and public authorities promote and implement incentive and support strategies.

1.1.3. BENEFICIATION: VALUE AGGREGATION

Biogas is a mixture of 50 - 70% methane (CH4) and 30 - 50% carbon dioxide (CO_2) and, in smaller concentrations, water in the form of steam, hydrogen sulfide (H2S) and other elements (Fagerström et al, 2018). Among the components, methane is the one that presents the highest percentage in relation to the others.This enables biogas to be used for energy applications such as generating electricity, thermal energy, biomethane and digestate - a product from the process of anaerobic digestion that can be used as a soil conditioner and that, depending on the its characteristics, has fertilizer value. Although the commercialization of digestate is little practiced by the biogas plants observed in the state, most producers use the substance for external use (donation or commercialization to third parties) and/or internal use (in the production unit itself).

As already mentioned, biogas provides renewable energy suitable for use in several applications: electrical energy, thermal energy, thermal and electrical energy, mechanical energy, biomethane, and digestate. Compared to other renewable energies, biogas has advantages and can be produced, stored and used as needed by the enterprise.


Credit: Getty Images

1.1.4. MONETIZATION FORM

Biogas is economically important from the point of view of those who produce it. If evaluated in a systemic way and integrated to the productive processes from which it originates, it relates the energy use to income generation and cost reduction, transforming organic waste from an environmental liability into an energy asset.

Adding value to the biogas energy conversion increases the efficiency of the process, reducing costs and improving the biogas plant's bottom line.

According to the PNBB - Proposed National Biogas and Biomethane Program (2018), biogas has economic value as an energy product. The conversion of biogas into energy enables the insertion of economic input in the processes from which it originates, with income generation to meet investments and operating costs in biogas production and energy conversion.

However, monetization is possible either directly or indirectly. For example,
the sale of electricity can be marketed through remote generation or the free market;
the bottled biomethane in cylinders, at gas stations or in pipelines;
the CO_2 through the sale of carbon credit and the digestate as biofertilizer.

Given these considerations and with the support of partners from the GEF Biogas Brazil Project, business opportunities were identified in Paraná in several activities, illustrated below.

EXAMPLE OF A BUSINESS MODEL IN PARANÁ

COMPANY/INSTITUTION	Ingredion	Klabin	Castrolanda	SIMP
ACTIVITY	Ingredient Manufacturing	Pulp & Paper	Agroindustrial Cooperative	Union of Cassava Industries of Paraná
BUSINESS OPPORTUNITY	Use of produced biogas	Social Forest Project Use of biogas in landfill	Development of biogas clusters among cooperative members	Systematization and modernization of the production and utilization arrangements of biogas.

The business models approached in the scope of the GEF Biogas Brazil Project have the purpose of showing different investment opportunities, creating scenarios from simple performance to the insertion of advanced technologies, giving the necessary support in the decision making of the companies in the agribusiness sector.

Demonstrating viability through technical and economic-financial modeling, these opportunities will demand from the companies interaction with financial agents to foment investments for the biogas sector, one of the goals of the GEF Biogas Brazil Project.

BUSINESS MODEL STRUCTURE

EXECUTIVE SUMMARY

1 PROJECT PRESENTATION

2 DATA SURVEY
- 2.1. Substrate
- 2.2. Flows and masses
- 2.3. Organic load and waste composition
- 2.4. Company process data
- 2.5. Existing Infrastructure
- 2.6. Requirements, objectives, project constraints

3 BUSINESS MODELING
- 3.1. Client
- 3.2. Way(s) of valorization of biogas
- 3.3. Cost structure
- 3.4. Key Resources
- 3.5. Strategic Partners

4 TECHNOLOGY MODELING
- 4.1. Definition of the technologies
- 4.2. Description of process steps
- 4.3. Flowchart

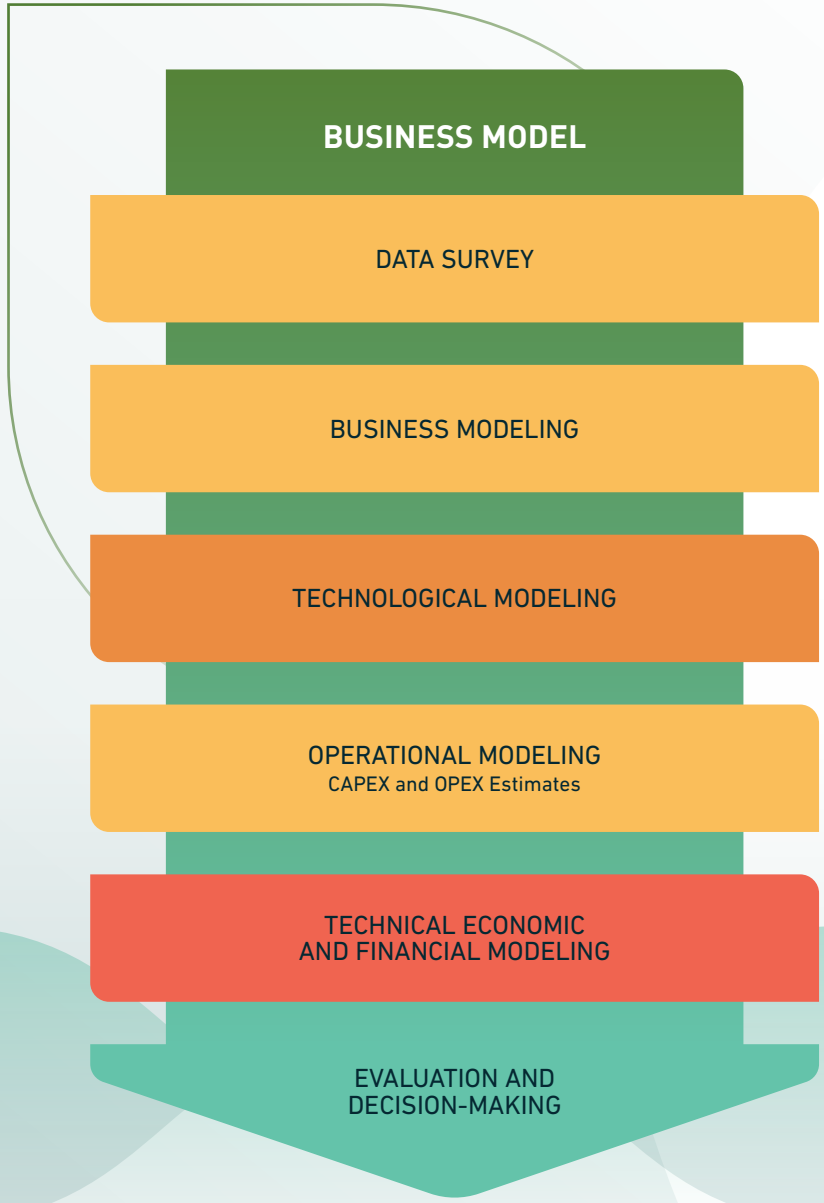
5 OPERATIONAL MODELING
- 5.1. Process Efficiency
- 5.2. Mass Balance
- 5.3. Sizing of the systems
- 5.4. Operational and analytical monitoring

6 CAPEX ESTIMATE
- 6.1. Infrastructure
- 6.2. Equipment and Systems
- 6.3. Materials and electromechanical assembly
- 6.4. Supplier Proposals

7 OPEX ESTIMATE
- 7.1. Labor costs
- 7.2. Variable operating costs
- 7.3. Other expenses

8 REVENUES AND TAXES
- 8.1. Prices
- 8.2. Taxation
- 8.3. Avoided costs
- 8.4. Project Revenues
- 8.5. Taxes levied on the activity

9 ECONOMIC AND FINANCIAL MODELING
- 9.1. Modeling Assumptions
- 9.2. Projections of economic and financial results
- 9.3. Sensitivity Analysis
- 9.4. Conclusions and recommendations



PHASE 3

STEP 2

BUSINESS MODEL STRUCTURE

Considering the particularities of the biogas sector, the structuring of the **Business Modeling** process by the **GEF Biogas Brazil Project** follows its own five-step roadmap, according to the illustration that gathers all the necessary elements, starting from the **business identification**, which enables the evaluation and decision making of the investment. The steps of the business model applied in Paraná are described below.

2.1. DATA SURVEY

The data gathering step involves a number of components that generate inputs for the following steps of the **Business Model**.

The amount of waste and/or effluent generated for each type of substrate, its characteristics, flow rates and masses, organic load and waste composition, company processes, logistics data contemplating the location of the plant, substrate transportation, destination of the energy generated, compliance with legal and operational requirements are essential at this step.

TABLE STEP 2

2.2. MODELING AND BUSINESS

From the combination of the data collected, **several arrangements** can be elaborated, making each biogas business modeling unique, as they are influenced by several factors such as:

1. **Location of substrates that can determine centralized or decentralized biogas production;**
2. **Choice of energy application, that is, you must analyze whether the demand is for electricity, heat, or fuel, and whether the regime of this demand is daily, monthly, or yearly;**
3. **Forms of energy consumption or sale that can generate economic or financial resources;**
4. **Integration of more than one energy application.**

The analysis of these factors is crucial in defining the customer, monetization of biogas, structuring costs, key resources, and strategic partners.

In summary, business modeling for the biogas sector determines the direction of the enterprise and the necessary investments.

Credit: Getty Images

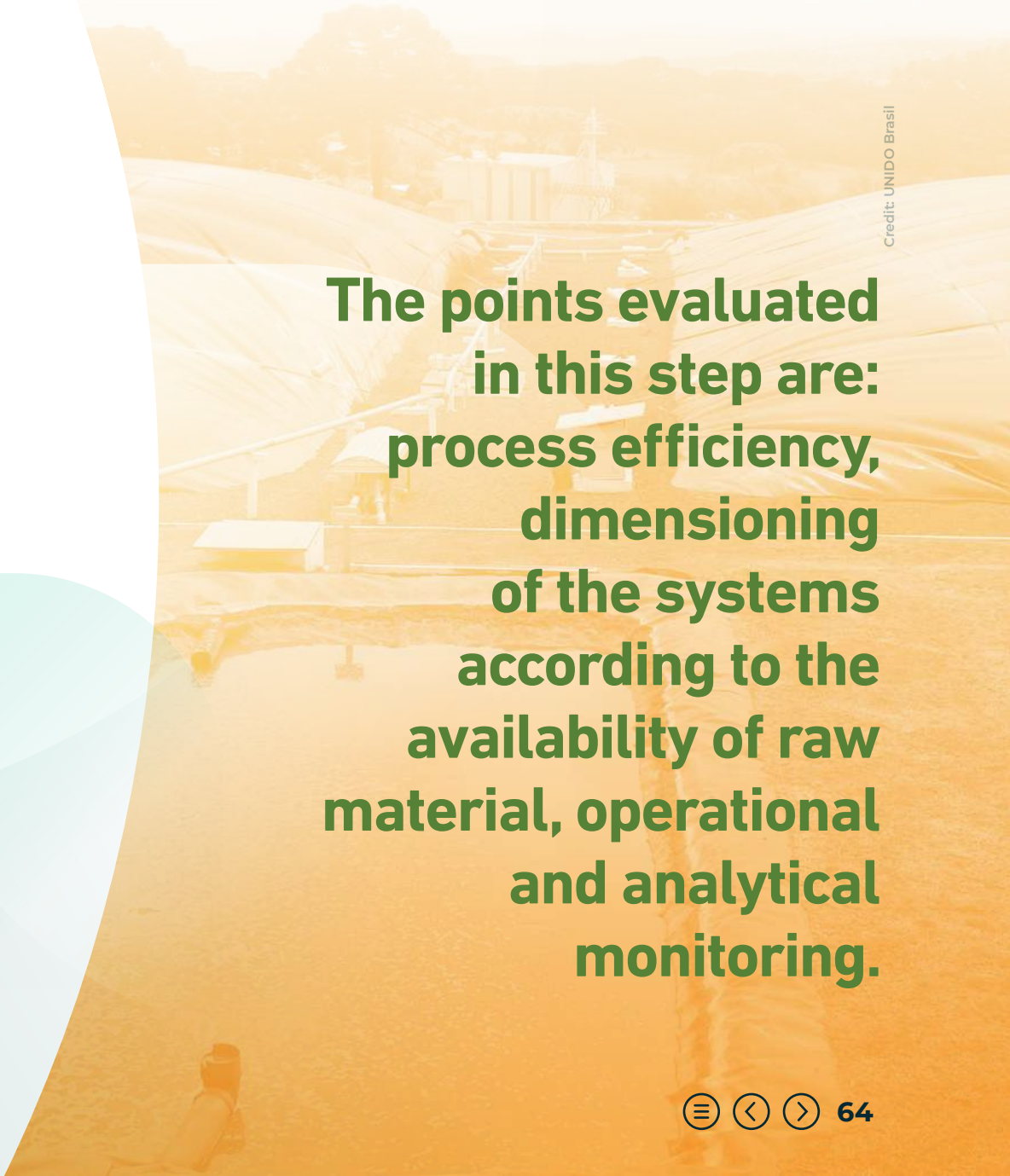
2.3. TECHNOLOGY MODELING

Biogas is an energy source that can be produced by means of several technologies, varying its composition and productivity according to its size, the temperature required for the process, the temperature of the external environment of the biodigester, and the expected efficiency, among other factors.

In this sense, it is fundamental to know the technologies available in Brazil for the production of biogas, and even compare them with technologies used in other countries, mainly the European ones, the most advanced in the world in the use of biogas on a commercial scale. This comparison helps in defining the most suitable technology for the project needs, in describing the processes and flowcharts.

2.4. OPERATIONAL MODELING

In the operational modeling step of the project, the focus was on the evaluation of process efficiency, system sizing according to raw material availability, operational and analytical monitoring, followed by estimates of CAPEX (infrastructure, equipment, systems, materials, assembly among others), OPEX (labor costs, variable operating costs among others) and revenues and taxes (prices, taxation, avoided costs, project revenues and taxes levied on the activity).



Credit: UNIDO Brasil

The points evaluated in this step are: process efficiency, dimensioning of the systems according to the availability of raw material, operational and analytical monitoring.

2.5. MODELING ECONOMIC AND FINANCIAL MODELING

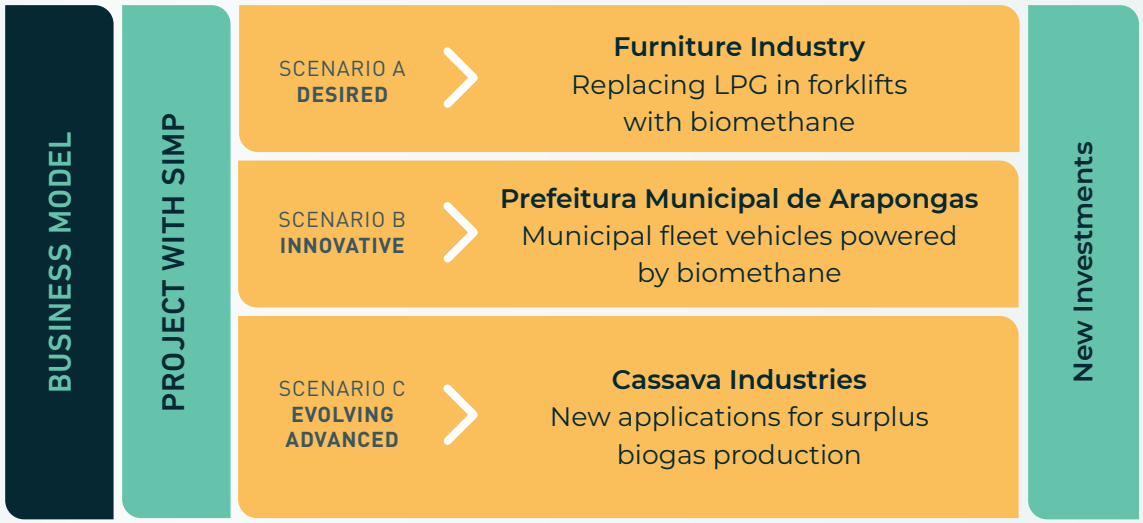
Economic and financial modeling allows projections to be made for an enterprise in order to find out the feasibility of investing or not, from the premises of modeling, which allows the sensitivity analysis in view of the results presented.

Just like all business modeling cases for biogas are unique, due to the factors already mentioned, the economic and financial modeling must also be analyzed individually, because there are significant variations for each business opportunity. Electric power generation, for example, has very different components compared to heat generation, just as biomethane production has higher costs than biogas production due to the refining process.

BUSINESS MODEL CONCLUSION

The GEF Biogas Brazil Project in the state of Paraná acts with a vision of the future, allowing the competitiveness of the territory with the participation of several players. In this sense, the business opportunities identified in Paraná, such as the projects developed in partnership with the Union of the Cassava Industries of Paraná (SIMP), glimpse promising results through a shared and inclusive Business Model, where companies and institutions are present in a synergistic way, committed to the new concept of circular economy, contributing to structural changes in the renewable energy environment, oriented to economic, social and environmental sustainability and, above all, fostering and encouraging new investments, the central objective of the Business Model in the Project.

EXAMPLE OF A BUSINESS MODEL IN PARANÁ



Credit: Leão Energia

PART 04

MULTIPLICATION OF GOOD PRACTICES

Credit: Getty Images

Knowledge guides practice; however, practice increases knowledge.

Thomas Fuller

4.1.1. MULTIPLICATION OF GOOD PRACTICES AND THE PIBIOGÁS (BIOGAS INFORMATION PLATFORM ANDREA FARIA)

Multiplying the Best Practices of a project means, in essence, to recognize that the project generates knowledge, and that one can learn with its results, in a continuous cycle of growth.

·Thus, the process of changes promoted by the GEF Biogas Brazil Project in the economic and social environments, although capable of having long-term impacts, also provides the means to reach important short- and medium-term results to its direct beneficiaries - rural producers, public sector, agribusiness, equipment and service suppliers, large centers urban - in the solution or mitigation of problems of energy generation from biogas, GHG emission reduction and management of municipal waste in the country.

With the application of the Foresight Methodology in its three phases - Definition of the Local Technological Scenario; Organization of the Ecosystem and Business Model - it was possible to organize the biogas value chain in state of Paraná, with the result of identifying the knowledge needed to boost investments, transfer the necessary technologies to companies to increase competitiveness and respond to new market demands, signaled by the business opportunities identified and ratified by the business models.

In addition, these results have generated an important body of knowledge available to the biogas sector at a national level, contributing to the Multiplication of Good Practices, such as the Biogas Information Platform Andrea Faria (PiBiogás), an initiative of the GEF Biogas Brazil Project, coordinated by the Secretariat for Entrepreneurship and Innovation - SEMPI - of the **Ministry of Science, Technology and Innovations - MCTI** - to facilitate access to digital tools, institutional sites and information related to biogas, as well as to foment new actions and partnerships in the sector.

The table below shows the "Best Practices" produced by the GEF Biogas Brazil Project.

ACCESS HERE

4.1.2. DEMONSTRATION UNITS

One of the objectives of the GEF Biogas Brazil Project is to support Demonstration Units (DUs) of technologies and processes for energy generation through biogas. To be incorporated by the GEF Biogas Brazil Project as DUs, the biogas plants selected through public bidding had to be located in the Southern Region of Brazil and to generate biogas from organic agricultural, farming, and agro-industrial waste, or from distribution and/or storage of agricultural commodities. For demonstration purposes, these biogas plants also had to present high replicability and innovation implemented in a real situations.

The biogas plants chosen through a selection process received incremental investments for the acquisition of more efficient and safer equipment or services. Projects from the following four thematic lines were supported:

- **Generation of electric energy from biogas, in distributed generation modals;**
- **Production and use of biomethane;**
- **Digestate valorization;**
- **Utilization of energy for self-supply or supply in a closed loop, whether in thermal, electrical, or mobility applications.**


Credit: Getty Images

Credit: Getty Images

The criteria evaluated were:

SOCIAL IMPACT

Ability to promote gender equality in the workplace.

ENVIRONMENTAL IMPACT

Amount of CO_2 equivalent avoided.
Economic and financial impact: proportion of the amount requested to the amount contributed by the bidder, discounted payback and step of the biogas plant.

TECHNICAL ASPECTS

Characteristics of replicability, technical innovation, and/or proposed improvements were evaluated. For this evaluation, on-site visits were made to verify the declared information.

In the criteria evaluation step the proposals were evaluated and compared according to the thematic line.

The overall value of the proposal submitted by the applicants was composed of an economic counterpart, a financial counterpart and the incremental investment. The economic counterpart refers to all the investment already made by the proponent in the biogas plant, such as the investments made in infrastructure and in equipment in use related to the biodigestion system and to the energy applications.

Credit: Getty Images

The financial contribution, on the other hand, refers to all the investment that will be made by the selected unit, during the period of implementation and execution of the project. The economic and financial counterparts, which were a responsibility of the proponents, should represent at least 80%. of the global value of the proposal, and the financial counterpart should be at least 20% of this global value. Finally, the incremental investment requested by the proponent may represent up to 20% of the proposal's global value, limited to a request of up to R$800,000.00 (eight hundred thousand reais) per proposal submitted.

After the announcement of the pre-selected plants, there were visits to the Demonstration Units to obtain additional information about the bidders selected by the preliminary analysis of the call. In this step, bidders should demonstrate their eligibility, including with verifications and measurements during the visit. After this step was completed, the final results of the selection were published on the GEF Biogas Brazil Project website.

Analysis and regulation proposal of Law 19,500/2018

Paraná accounts for 63% of national production of cassava, one of the industry's by-products. Due to the energy potential of cassava, the production of biogas from the residues of its production process is far above that used to supply the boilers. Therefore, to improve the results of this asset, **new alternatives for biogas utilization were modeled**.

The Legislative Assembly of the State of Paraná and the then acting Governor gave freedom in article 6 of State Law 19,500/2018 for any kind of promotion of the biogas and biomethane chain.

They also gave freedom for technological innovation companies to be considered, not only those legally constituted ordinarily, but also the productive enterprises and arrangements that fit the provisions of State Law 19.500/2018, including in the consortium, condominium, cooperative, and public-private partnership modalities, to be benefited with the concession of tax incentives, financial resources, economic subsidy, materials, or infrastructure.

The Paraná Thematic Committee on Biogas and Biomethane discussed and focused its efforts on the development of promotion policies through the Competitive Paraná Program to attract new investments in Paraná.

In this sense, the adjustments in terms of differentiated tax regimes, special regimes for transfer, assignment and use of tax credits, partnership, agreements or specific contracts, aimed at supporting research activities and development in Paraná territory, in our opinion, can (and should) also be used for the implementation of any other public policies for development, such as the use of tax credits already belonging to the sector for investment in permanent assets in the same sector.

Taking advantage of this freedom, the Paraná Thematic Committee on Biogas and Biomethane discussed and focused its efforts on the elaboration of promotion policies via the Competitive Paraná Program to attract new investments in Paraná, properly manageable, and including not only the announcement of investments in Biogas Plants, but also in vehicle factories and infrastructure of the biogas chain and agriculture 4.0.

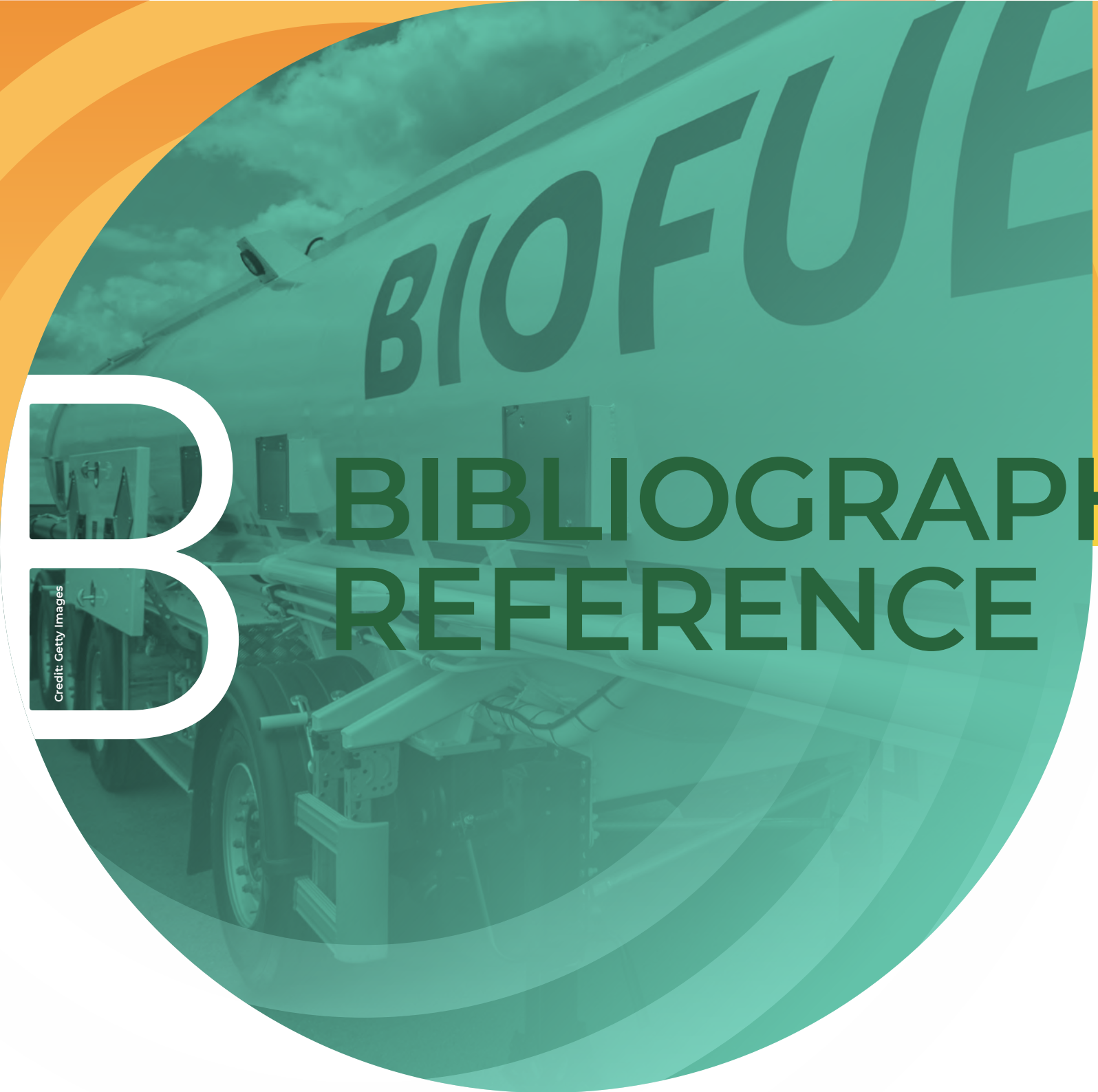
Among the policies suggested was the reduction in the limitation of ICMS credit compensation for the biogas chain, taking care that, when referring the subject to the Competitive Paraná Program, the Paraná State Government maintains total control of projects and with relative security against the eventual allegation of isonomy of other sectors, since the environmental and health safety extrafiscality and energy is quite consistent.

The Thematic Committee also identified the possible equivalence of incentives granted to electric cars and cars powered by biomethane/GNV, such as the IPVA exemption instituted in the state of Minas Gerais.

It was also suggested the policy of encouraging the separation of urban solid residues by types - so that the organic waste is directed to biodigesters (increase in the volume of available biomass). The issue of synergies with various tax entities and legislations, such as tax benefits, was also addressed, with special emphasis on state universities and technological institutes (ICT: Science and Technology Institution, such as CIBiogás, PTI, LACTEC and TECPAR) that

could join efforts to generate the maximum efficiency of the chains already existing in Paraná (automotive, for example). To avoid problems with the LRF - Fiscal Responsibility Law - as well as CONFAZ, the mechanics used was to guarantee the transfer of credits accumulated in the Paraná Agribusiness beyond exports, as well as how to make possible the increase of the limit for the use of credits to be negotiated in the Competitive PR's Protocol of Intentions, which will have the ability to limit in absolute numbers and/or encourage projects that have greater adherence to Public Policy without harming Isonomy.

Regarding the regulation by AGEPAR of what was negotiated in Complementary Law 211/2018, especially the right of first refusal to the Concessionaire, with a short period of 120 days, related to the construction of pipedgas networks, due to the lack of in-depth debates on the subject, we suggest using the guidelines provided by AGEPAR to ensure legal security; it is also suggested to harmonize the biogas legal framework with the Compagás concession contract.



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B BIBLIOGRAPHICAL REFERENCE

ANDERSON, Andrea A. The community builder's approach to Theory of Change: A practical guide to theory development. New York: The Aspen Institute Roundtable on Community Change, 1995.

BARBUTO, Cristian Technology Foresight e sostenibilità: strumenti e metodi per un'efficace gestione proattiva delle incertezze tecnologiche del mercato. Tesi di Master. Scuola universitaria professionale della Svizzera italiana Dipartimento economia aziendale, sanità e sociale. Manno, gennaio 2016

BLUMENSCHEIN, R. N.; FERRARI, F.; VALENÇA, M.; DADAMOS, R.; LONGUI, F.; MAURY, M. B. Resiliência Urbana no Brasil - Levantamento de Dados e Ferramenta de Diagnóstico. Relatório de Projeto e Pesquisa. Universidade de Brasília (UnB), FAU/CDS/FGA/LACIS, Building Research Establishment – BRE, Brasília, Brasil, 2016.

BRAZIL ENERGY Programme: Draft ToC Diagram and Narrative. São Paulo: Adam Smith International, 2020

CARE Defining Theories of Change. London: CARE International UK, 2012.

CENTER FOR Theory of Change. 'What is Theory of Change? Disponível em http://www.theoryofchange.org/what-is-theory-of-change/

CHANG, C.Y. Risk-bearing capacity as a new dimension to the analysis of project governance. International Journal of Project Management. Volume 33, Issue 6, Pages 1195-1205, August 2015.

EMBRAPA. Ciência que transforma. Disponível em https://www.embrapa.br/grandes-contribuicoes-para-a-agricultura-brasileira/agroindustria.

IBGC - Instituto Brasileiro de Governança Corporativa. Código das melhores práticas de governança corporativa. 5ª. ed. São Paulo: IBGC, 2015.

IEA/IBRD. Energy Efficiency Governance. OECD/IEA, Paris, 2010.

JAMES, C. Theory of Change Review: A Report Commissioned by Comic Relief'. London: Comic Relief, 2011.

LATORRACA, Tássia Fonseca. O mapeamento da governança do setor de energia elétrica no Brasil para a eficiência energética. Dissertação de Mestrado. Universidade de Brasília, Faculdade de Arquitetura e Urbanismo Programa de Pós-Graduação em Arquitetura e Urbanismo: Brasília, agosto, 2017.

MALERBA, F. Economia dell'innovazione. Roma: Carocci, 2000.

MILES, Ian; SARITAS, Ozcan and SOLOKOV, Alexander, Foresight for Science, Technology and Innovation. Springer Switzerland 2016, p.12

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÕES (Brasil); UNIDO, ORGANIZAÇÃO DAS NAÇÕES UNIDAS PARA O DESENVOLVIMENTO INDUSTRIAL; CIBIOGÁS, CENTRO INTERNACIONAL DE ENERGIAS RENOVÁVEIS; UTFPR, UNIVERSIDADE TECNOLÓGICA FEDERAL DO PARANÁ. Potencial de produção de biogás no Sul do Brasil. MCTI. Brasília-DF. Projeto Aplicações do Biogás na Agroindústria Brasileira: GEF Biogás Brasil 2020.

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÕES (Brasil); UNIDO, ORGANIZAÇÃO DAS NAÇÕES UNIDAS PARA O DESENVOLVIMENTO INDUSTRIAL. O que é biogás? MCTI. Brasília-DF. Projeto Aplicações do Biogás na Agroindústria Brasileira: GEF Biogás Brasil. Disponível em https://www.gefbiogas.org.br/sobreoprojeto

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÕES (Brasil); UNIDO, ORGANIZAÇÃO DAS NAÇÕES UNIDAS PARA O DESENVOLVIMENTO INDUSTRIAL. COSMOB, CENTRO TECNOLÓGICO ITALIANO. Projeto Foresight, Metodologia de previsão de cenários: Fase 1 - Análise dos indicadores de incerteza e relevância, classificação tecnológica e competitiva das empresas. MCTI. Brasília-DF. Projeto Aplicações do Biogás na Agroindústria Brasileira: GEF Biogás Brasil.

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÕES (Brasil); UNIDO, ORGANIZAÇÃO DAS NAÇÕES UNIDAS PARA O DESENVOLVIMENTO INDUSTRIAL; CIBIOGÁS, CENTRO INTERNACIONAL DE ENERGIAS RENOVÁVEIS. Panorama de tecnologias aplicadas no agronegócio de biogás e biometano. MCTI. Brasília-DF. Projeto Aplicações do Biogás na Agroindústria Brasileira: GEF Biogás Brasil 2019.

MOIOLI, Camilla. Trategic foresight come declinare le macrotendenze in strategie aziendali. Tesi di Bachelor. Scuola universitaria professionale della Svizzera italiana Dipartimento economia aziendale, sanità e sociale (DEASS) Manno, settembre, 2015.

ORGANIZAÇÃO DAS NAÇÕES UNIDAS - ONU. Os Objetivos de Desenvolvimento Sustentável no Brasil. Disponível em https://brasil.un.org/pt-br/sdgs.

PETERS, Brainard Guy. O que é Governança. Revista TCU, Mai/Ago 2013. Disponível em: http://www.revista.tcu.gov.br

POPPER, R. The handbook of technology foresight. Edward Elgar Publishing, Inc., 2008.

PORTER, E. MICHAEL - Competição – Estratégias competitivas essenciais, 26a ed. Rio de Janeiro: Editora Campus, 1989.

PRICE, S.; CONWAY, P.; PALMER, P.; SUMMERS, R. Technology roadmapping: a new perspective. In: EU- US Seminar: New Technology Foresight, Forecasting & Assessment Methods, Seville: 13-14 May. 2004.

PROJECT MANAGEMENT INSTITUTE – PMI. Guia Prático "Governança de Projetos, Programas e Portfólios". Project Management Institute, 2016.

ROGERS, P.J. Methodological Brief No.2: Theory of Change. UNICEF, 2014. Disponível em: https://goo.gl/ykcgpT

SCHENATTO F. J. A. et al. Análise crítica dos estudos do futuro: uma abordagem a partir do resgate histórico e conceitual do tema. Gestão da Produção, São Carlos, v. 18, n. 4, p. 739-754, 2011.

STEIN, D. and Valters, C. 'Understanding "Theory of Change"', in 'International Development: A Review of Existing Knowledge'. JSRP Paper 1, London: JSRP and The Asia Foundation, 2012

THE PM2 PROJECT Management Methodology Guide – Open Edition. Luxembourg: Office of the European Union, 2016. Disponível em: https://op.europa.eu/en/publication-detail/-/publication/0e3b4e84-b6cc-11e6-9e3c-01aa75ed71a1

UNDP – Global Centre for Public Service Excellent. Foresight Manual Empowered Futures for the 2030 Agenda. Singapore, 2018

VALTERS, Craig. Theories of Change: Time for a radical approach to learning in development. London: Overseas Development Institute, 2015

VOGEL, Isabel. Review of the Use of "Theory of Change" in International Development'. London: DFID, 2012.

VOROS, Joseph. A generic foresight process framework. Australia: Faculty of Business and Enterprise, Swinburne University of Technology, 2005.

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A ANNEXES

ANNEX 1 - RELEVANCE AND UNCERTAINTY QUESTIONNAIRE MODEL

	RELEVANCE AND UNCERTAINTY INDEXES	RELEVANCE Indicate on a scale of 0 to 3	UNCERTAINTY Indicate the 3 most uncertain topics
1	**Strategic Theme - Technological Development:** The technological development is based on the following different aspects: characteristics of the structures, environmental control, quality of the raw material, equipment for process improvement, use of technology in the production and transformation of energy, intelligent communication systems		
1.1	Production and quality management of raw materials		
1.2	Equipment and machinery; biogas production technology		
1.3	Technology for safety in biogas production		
1.4	Technological level of equipment suppliers		
1.5	Biogas storage, conservation and distribution		
1.6	Biogas transformation process and use		

The questionnaires should be filled in with all the strategic themes and sub-themes defined previously.

ANNEX 2 - QUESTIONNAIRE MODEL - CONCORDANCE INDEX

	INDEX OF ACCORDANCE	I agree	I agree partially	I agree little	I disagree
1	**Strategic Theme - Technological Development**				
	Subtheme: 1.2 - Equipment and Machinery, Biogas Production Technologies				
1	The purchase of innovative equipment and machinery in production processes will be supported by public incentives over the next 5 years.				
2	The diffusion of technological innovations in the context of the production and distribution of energy derived from biogas will contribute to a significant increase in production over the next 5 years.				
	Subtheme: 1.5 - Biogas Storage, Preservation and Distribution				
3	Innovative technologies will impact in particular on storage, conservation and distribution of biogas				
4	Public policies will aim to promote the use of alternative energies (for example, biogas), favoring their distribution				

Each question is formulated with the objective of evaluating the impact of the most significant competitive drivers in relation to each sub-theme considered most uncertain by the stakeholders (2 sub-themes for each of the 6 strategic themes totaling 24 questions).

ANNEX 3 - QUESTIONNAIRE MODEL - COMPETITIVE LEVERS

	COMPETITIVE DRIVERS These are strategic factors that may determine improvement in the company's competitiveness with future impacts on the six strategic themes	LOW	MEDIUM	HIGH
1	**Strategic Theme - Technological Development:** The technological development is based on the different aspects: characteristics of the structures, environmental control, quality of the raw material, equipment for process improvement, use of technology in the production and transformation of energy, intelligent communication systems			
1.1	Adoption of technological innovation: Technological innovation, products and processes			
1.2	Business organization: highly qualified in the different areas of specialization and presence of technical personnel			
1.3	Public policy adoption: impact of regulatory adoption, licensing on the company			
1.4	Quality seal and communication: the use of the quality seal is a differential to be communicated with a marketing strategy			

The questionnaires should be filled in with all the strategic themes and sub-themes defined previously.

DRIVER A - MARKET COMPETITIVENESS

A1. HIGH COMPETITIVENESS

In this market condition, although there is the possibility of the introduction of regulatory elements, competition is characterized by the race that will allow only the company that is able to supply differentiated and quality products and services to remain in the market.

A2. LOW COMPETITIVENESS

In this market condition, although companies are able to define common and shared rules, supply is regulated by restrictive rules.

DRIVER B - INNOVATION CAPABILITY

B1. LOW TECHNOLOGICAL INNOVATION CAPACITY

There is a large supply of technology available for the biogas industry related to automation of production processes, ICT integration, improved corporate management, supplier and clients relations, to the improvement of the infrastructure, among others.

Although these technologies have a positive impact on the companies' results, there is a set of restrictive factors centered on the lack of strategic vision, professional qualification, financial resources, and credit lines that hinder the insertion of technological innovation.

This context leads most companies to act in a traditional way, resulting in low performance in productivity, profitability, and profitability indicators, spreading the low capacity to invest in innovation.

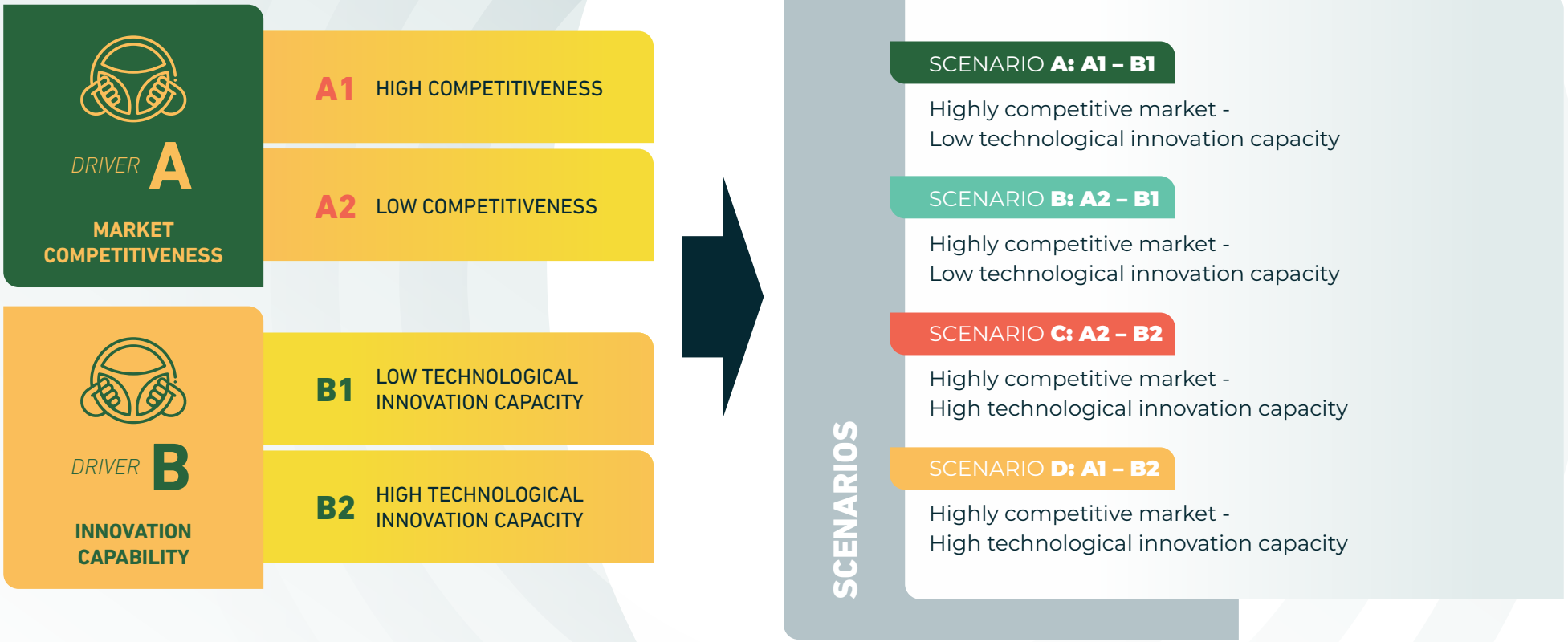
B2. HIGH TECHNOLOGICAL INNOVATION CAPACITY

Most companies in this sector act with strategic vision and proactivity, investing heavily in new technologies.

This way of acting determines significant benefits in the quality, productivity, and profitability indicators of the business, enabling a continuous innovation process in the companies, which characterizes them as companies with high innovation capacity.

In this sense, for the biogas sector in Paraná, the scenarios are constituted by the possibility of combinations of one of the four possible configurations of the drivers of Driver A - Market competitiveness and Driver B - Innovation capability, as shown in the picture below.

Scenarios of the biogas sector in Paraná



The following considerations are made for each of these scenarios, which made it possible to determine the positioning of the companies in the biogas sector and thus to design convergent strategies for the expansion of renewable energy supply and the reduction of greenhouse gas emissions.

SCENARIO **A • A1-B1**

Highly Competitive Market - Low Technological Innovation Capacity

In this scenario, the highly competitive market presents a demand greater than supply, which causes price decreases and negative effects on the results of the companies in the sector, compromising the ability to innovate and establishing a vicious circle.

As a consequence, many companies outsource production in an attempt to improve results. Others, in turn, in the face of difficulties, decide to sell or rent to other more efficient companies, or, most importantly, close down the activities, creating space so that only the most competitive companies that are likely to invest in technological innovation and new markets remain.

The individualistic approach of most companies in the industry to market challenges is a reflection of the lack of cohesion between them, which makes them fragile, limiting possible actions to influence the low competitiveness of the market, in an attempt to mitigate the negative effects of the high competitiveness of the market.

This posture results in low innovation capacity in the biogas sector, limits access to credit and makes it unattractive to investors, which worsens the situation for companies due to limited financial resources, making the scenario pernicious.

SCENARIO **B • A2-B1**

Highly Competitive Market - Low Technological Innovation Capacity

In this scenario, the businesspeople in the biogas sector share common rules for structuring the supply, gaining negotiation power in the market, thus avoiding the fluctuations and tendency to reduce prices, which are kept at levels that guarantee positive results.

The cohesion of the sector's entrepreneurs allows them to exercise articulation power in the elaboration of public policies to support the development of the industry and the enactment of laws and regulations that improve day-to-day operations.

In markets with low competitiveness, restrictive competitive forces are established that allow companies to operate without significant investment in innovation. However, protection of the political and economic environment is a factor that can leverage technological innovation, when considering a new generation at the head of companies.

On the other hand, many small innovative companies prefer to focus on maintaining their traditional models of business, directing resources to methodologies, processes, among other factors of limited effectiveness, which reflects negatively on the results. Thus, as in scenario A, these companies lose efficiency and competitiveness, in many cases forcing the company out of the market.

SCENARIO **C • A2-B2**

Highly Competitive Market - Low Technological Innovation Capacity

In this scenario, the businessmen in the biogas sector share common rules for structuring the supply, gaining negotiation power in the market, thus avoiding fluctuations and tendencies to reduce prices, which are kept at levels that guarantee positive results.

The cohesion of the sector's businessmen allows them to act in favor of the elaboration of public policies to support the sector's development and the enactment of laws and regulations that improve day-to-day operations.

The companies adopt strategic management, operate with qualified professionals with a high level of technical knowledge, invest in technological innovation, and advance in partnerships with research centers for the development of solutions that allow for a good market positioning sedimented the image of eco-sustainability, safety, and efficiency.

Even in markets with low competitiveness, where forces restricting competition are established, in contrast of scenario A, here favorable conditions are created for investment in technological innovation, enhancing competitive conditions, thus attracting new investors interested in the sector.

SCENARIO **D • A1-B2**

Highly Competitive Market - Low Technological Innovation Capacity

In this market situation, competitiveness is the driving force for companies in the biogas industry. The scenario presents technological innovation as a central strategy, driven by the high capacity to design, implement, and manage innovative technologies made available by the technology provider and also by the technical-scientific research centers.

This way of acting is due to the innovation-oriented management profile with a good level of technical and management expertise and investment capacity.

In this scenario, companies acting in the opposite direction are forced to withdraw from the market, making room for more efficient companies with the capacity to promote economies of scale, grow, and conquer markets.

TECHNOLOGICAL SERVICES OFFER - STRATEGIC THEMES

SERVICES OFFERED	CURRENT SITUATION
1 **Training**	The four modalities of capacity building services presented are widely used. However, the training services in their own structure and in that of the target audience used by all companies stand out, followed by the distance training service and training in another type of structure, used with less intensity and equally by the companies.
2 **Technology Services**	Listed a set of technological services: commercial support; communication and marketing; production technologies digitalization; training; consulting for obtaining certifications; consulting in waste management, energy transformation and use of biogas; support in plant management; analysis of biogas and livestock waste and crop biomass. The results of this scenario point to a low demand for services.
3 **Factors restricting innovation**	There are hardships to introducing innovation in the companies themselves. Among the main causes are organizational problems, competitiveness, qualified partnerships, high costs, and lack of financial support from public entities.
4 **Competitiveness Factors**	There is unanimity in two factors by the companies: participation in international projects and industrial research, followed at the equity level by consultancies in management, product, market, production, and certifications, among them processes, equipment, and human resources.

Credit: UNIDO Brasil

TABLES

APPLICATION OF THE THEORY OF CHANGE IN THE BIOGAS VALUE CHAIN IN THE PARANÁ AGRIBUSINESS

INPUTS

Relationships;
Resources: human, technological, financial resources, material resources;
Information.

ACTIVITIES

Awareness-raising of stakeholders;
Establishment of local governance;
Strategic partnership with an international institution;
Benchmarking of international technology platforms;
Meetings, workshops, seminars, and technical visits for mapping and validating the territory's data.

OUTPUTS

Definition of the local technological scenario - Organization of demand;
Organization of the local ecosystem - Organization of supply;
Organization of the value chain;
Creating a favorable environment for new investments through business models.

RESULTS

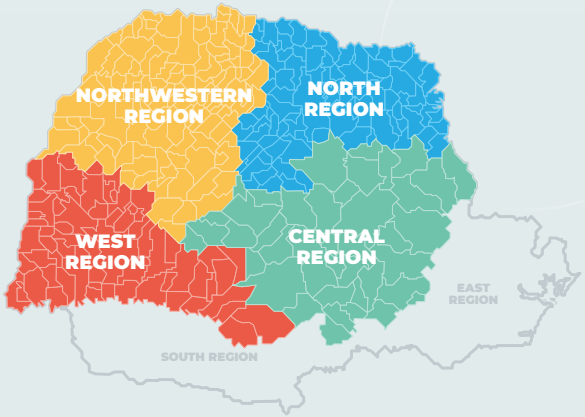
Creation of innovative technological packages, validated by the sector's agents and adapted to the Brazilian reality;
Modernization of public policies and regulation of the sector;
Support for technology demonstration units and processes for energy generation through biogas;
Availability of business arrangements and specific financial services for the sector, with national and international funding for investment;
Offering services and resources for technical and professional training.

IMPACTS

Reduction of GHG emissions;
Reducing dependence on fossil fuels by promoting energy based on biogas produced along the agro-industrial value chain in the Southern Region of Brazil;
Strengthening the biogas technology supply chains;
Increased investment in technologies for biogas and biomethane.

THEORY OF CHANGE IN THE BIOGAS VALUE CHAIN IN THE PARANÁ AGRIBUSINESS - CONCLUSIONS

Taking advantage of the synergy of the facilitators participating in the GEF Biogas Brazil Project, a series of activities were carried out over six months in the Western, Central, and Northwestern regions of Paraná, mostly together with the project's stakeholders . These activities were essential to define outputs and thus organize the entire biogas value chain. Among them were international benchmarking , workshops with local leaders, definition of competitive positioning in the production chain, elaboration of the technological business classification, analysis of the technological scenario, supply scenario analysis, and business identification.



- Technological scenario of the biogas production chain - Demand organization;
- Organization of the local ecosystem - Organization of Supply;
- Value chain organization;
- Creation of a favorable environment for new investments, by means of a business model.

With the outputs defined and anchored in the business model, it is possible to advance in the changes proposed by the project and consolidate the expected results:

- Creation of innovative technological packages, validated by the sector's agents and adapted to the Brazilian reality;
- Modernization of public policies and regulation of the sector;
- Support to the Demonstration Units of technologies and processes of energy generation through biogas;
- Availability of business arrangements and specific financial services for the sector, with national and international funding for investment; and international investments;
- Offering services and resources for technical and professional training.

The consolidated results establish the following structural impacts:

- Reduction of greenhouse gas emissions - GHG;
- Reducing dependence on fossil fuels by obiogas-based energy promotion from the agro-industrial value chain in the Southern Region of Brazil;
- Strengthening biogas technology supply chains;
- Increased investment in technologies for biogas and biomethane.

And, thus, consolidate the proposal of the GEF Biogas Brazil Project.

	TERMINOLOGY	APPROACHES
1	**Future studies**	The technological development in the production chain of future studies must encompass all the studies and methods previously elaborated in an attempt to anticipate or build a future scenario.
2	**Anticipation and Forecast**	Anticipation and forecasting see the future as a future trend, which can be analyzed through historical series, applying mathematical tools. The more reliable the databases and the broader the time period over which they contain records, the more reliable the extrapolation. In any case, it is worth pointing out that exercises of this nature do not necessarily guarantee a good approximation of the future that will come true, just a probable vision.
3	**Prospection**	Methods in this category are those that prioritize a qualitative approach in the analysis of the future, having as its main objective the cohesion of effort of those involved in defining the desired future and in joining efforts to make it feasible. They aim to identify elements for better decision making, taking into consideration economic, social, environmental, scientific, and technological aspects, and are often associated with great temporality. Thus, they have an exploratory or normative bias, in which collective reflection on future challenges leads to the definition of strategic options.
4	**Technology assessment**	Technology assessments are more focused on analyzing the impacts of current and future technologies, adopting a “radar” rather than an “action” posture. To do this, they follow the technological trajectory, anticipating alternatives and consequences.
5	**Scenarios**	They concern the possible or probable futures, constituting tools in the process of investigating the future. Thus, they should not be confused or taken to the same extent as other concepts.

Adapted: SCHENATTO et all (2011).

About ISID Inclusive and Sustainable Industrial Development

The Lima Declaration, adopted by the Member States of the United Nations Industrial Development Organization (UNIDO) in December 2013, laid the foundation for a new vision of inclusive and sustainable industrial development (ISID) and highlighted the role of industrialization as a driver of development.

The actions of UNIDO's office in Brazil are focused on the implementation of technical cooperation projects that have as priority the promotion of a circular economy that encompasses productivity, economic growth, environmental sustainability and gender equality, guided by ISID.

UNIDO aims to achieve inclusive and sustainable industrial development (ISID) in all its member countries.

ISID MEANS THAT:

- Each country achieves a higher level of industrialization in their economies and benefits from the globalization of markets for industrial goods and services.
- No one is left behind when it comes to benefiting from industrial growth, and prosperity is shared among women and men in all countries.
- Broader economic and social growth is supported within a sustainable environmental framework.
- The specific knowledge and resources of all relevant development factors are combined to maximize

SOURCE: https://www.unido.org/inclusive-and-sustainable-industrial-development , PROFILE DESCRIPTION OF UNIDO ON FACEBOOK: https://www. facebook.com/unido.brasil AND DESCRIPTION ABOUT UNIDO'S OFFICE IN BRAZIL https://www.unido.org/brasil

In the following tables, each of the six steps of **Phase 1 - Definition of the Local Technological Scenario considering** "what it is, why do it, how to do it and who does it".

PHASE 1	DEFINITION OF THE LOCAL TECHNOLOGICAL
E1	**STEP 1** - ALIGNMENTS
WHAT IS IT?	Preliminary step in the application of the Foresight Methodology to present the project and its operationalization.
WHY DO IT?	Essential for alignment and initial presentation of the project and methodology to strategic partners, governance stakeholders, and international partners to establish engagement through the GEF Biogas Brazil Project.
HOW TO DO IT?	**1.** Hold meetings online to present the project and its operationalization in partnership with Sebrae;
	2. Map the stakeholders;
	3. Schedule meetings online or face-to-face meetings with stakeholders;
	4. Prepare, send, and acknowledge receipt of electronic meeting invitations,
	5. Sensitize the stakeholders;
	6. Promote the coordination and constitution of governance;
	7. Build and formalize partnerships;
	8. Define and perform the alignment with the international partner for the following steps.
WHO DOES IT?	General project coordination (7);
	Coordination of institutional engagements in the states (1), (3), (5), (6), (7), (8);
	Area of marketing and communication (4);
	Sebrae (2), (3), (5).
PERIOD OF IMPLEMENTATION	Month 1

PHASE 1	DEFINITION OF THE LOCAL TECHNOLOGICAL
E2	**STEP 2** - DEFINITION AND CONSOLIDATION OF THE STRATEGIC THEMES
WHAT IS IT?	Definition and consolidation of priority themes for competitiveness and construction of scenarios for the biogas sector.
WHY DO IT?	Having references at the international level in relation to the main areas of interest
HOW TO DO IT?	**1.** Define the strategic themes and sub-themes for the biogas sector, by means of data survey referenced in studies, documents, methodologies adherent to the sector, benchmarking in international technology platforms and definition of indicators of the Sustainable Development Goals - SDGs of the United Nations - UN;
	2. Mobilize local leaderships for the realization of face-to-face or online workshops to define and consolidate the strategic themes and sub-themes;"
	3. Perform workshops with in loco participants in the territory to consolidate the strategic themes and sub-themes for input Step 3.
WHO DOES IT??	International Partner (1);
	Coordination of institutional articulations in the states (2), (3);
	Area of marketing and communication (2), (3);
	Sebrae (2), (3).
PERIOD OF IMPLEMENTATION	Month 1

PHASE 1	DEFINITION OF THE LOCAL TECHNOLOGICAL
E3	**STEP 3** · DEFINITION OF RELEVANCE AND UNCERTAINTY INDEXES
WHAT IS IT?	Definition of the levels of influence that each indicator can have on the sector in the near future and of difficulty in predicting all the changes in the sector.
WHY DO IT?	Obtain essential information for the definition of future strategic scenarios for the biogas sector and contribution to the decision making process along its production chain;
	Identify the most relevant technical aspects to meet the biogas industry's demand for knowledge and innovation;
	Identify the technical aspects with the highest level of uncertainty, contributing to mitigation and improvement of decisions in the development process of the biogas sector.
HOW TO DO IT?	**1.** Create a questionnaire to define the relevance indexes. Establish the level of influence and uncertainty that each indicator may cause on the industry in the near future. Ascertain the level of difficulty to predict all changes in the sector, based on the strategic themes defined in the previous step (ANNEX 1);
	2. Perform workshop face-to-face or online for application of the questionnaire only with stakeholders of the biogas sector;
	3. Analyze the results and select two sub-themes for each strategic theme,based on the average between uncertainty and relevance index, serving as an input input for the next step.
WHO DOES IT??	International Partner (1), (3);
	Coordination of institutional engagements in the states (2);
	Area of marketing and communication (2);
	Sebrae (2).
PERIOD OF IMPLEMENTATION	Month 2

PHASE 1	DEFINITION OF THE LOCAL TECHNOLOGICAL
E4	**STEP 4 ·** DEFINITION OF AGREEMENT INDEX
WHAT IS IT?	Step for defining the level of difficulty in making forecasts inherent to each strategic sub-theme defined previously and defining competitive levers to assist in the definition of future scenarios.
WHY DO IT?	Determine the relevant impacts of the Strategic Themes on future scenarios.
HOW TO DO IT?	**1.** Draw up a questionnaire to define the Accordance indexes (ANNEX 2), containing two questions for each of the two sub-themes selected from the six strategic themes;
	2. Perform workshop face-to-face or online to apply the questionnaire only with companies in the biogas sector;
	3. Analyze the results and define the most relevant and most uncertain strategic themes;
	4. Prepare a questionnaire to, based on the Concordance Indices, identify the Competitive Leverage (ANNEX 3),
	5. Perform workshop face-to-face or online to apply the questionnaire only with companies in the biogas sector;
	6. Analyze the results and define the competitive drivers.
WHO DOES IT??	International Partner (1), (3), (4), (6);
	Coordination of institutional coordinations in the states (2), (5);
	Marketing area marketing area and communication area (2), (5);
	Sebrae (2), (5).
PERIOD OF IMPLEMENTATION	Month 2

PHASE 1	DEFINITION OF THE LOCAL TECHNOLOGICAL
E5	**STEP 5** · TECHNOLOGICAL CLASSIFICATION OF COMPANIES
WHAT IS IT?	Definition of the technological level of the companies in the biogas sector, to establish the drivers of future scenarios.
WHY DO IT?	Classify local companies in relation to their level of technological and strategic development.
HOW TO DO IT?	**1.** Elaborate questionnaires for technology classification, methodological references and activities benchmarking in international technological platforms; **2.** Perform workshop face-to-face or on-lineto apply the questionnaires to the sector's entrepreneurs; **3.** Analyze the results to establish the drivers drivers that serve as input for Step 6.
WHO DOES IT??	International Partner (1), (3); Coordination of institutional engagements in the states (2); Area of marketing and communication (2); Sebrae (2);
PERIOD OF IMPLEMENTATION	Month 3

PHASE 1	DEFINITION OF THE LOCAL TECHNOLOGICAL
E6	**STEP 6** · DEFINITION OF THE TECHNOLOGICAL SCENARIO
WHAT IS IT?	Definition of elements that can become more real in the long term to improve decision making, taking into account economic, social, environmental, scientific aspects and technology, and are often associated with great temporality.
WHY DO IT?	Identify the impacts on the value chain of the biogas sector considering technology, services and certifications.
HOW TO DO IT?	**1.** Configure the future scenarios of the biogas industry through a systematic process of information about the industry's demand for knowledge;
	2. Positioning the companies in the sector based on the new scenarios.
	3. Present results to the partner network.
WHO DOES IT??	International Partner (1);
	Coordination of institutional articulations in the states (2), (3);
	Sebrae (3).
PERIOD OF IMPLEMENTATION	Month 3

In the following tables, each of the six steps of **Phase 2 - Local Ecosystem Organization** are described in detail, considering “what it is, why do it, how to do it, and who does it”.

PHASE 2	ORGANIZATION OF THE LOCAL
E1	**STEP 1** · ANALYSIS OF THE TECHNOLOGICAL SCENARIO AND INDICATORS
WHAT IS IT?	Analysis of the Technological Scenario defined in Phase 1 and indicators definition to identify the technological offer for the biogas sector with the institutions.
WHY DO IT?	To define indicators for the supply of technological services
HOW TO DO IT?	**1.** Analyze the scenarios defined in Phase 1 for the selection of technology supply indicators;
	2. Map institutions with knowledge in technological innovation convergent with the biogas sector.
WHO DOES IT??	Coordination of institutional engagements in the states (1);
	Technical project team: (1)
	Sebrae (2);
PERIOD OF IMPLEMENTATION	Month 4

PHASE 2	ORGANIZATION OF THE LOCA
E2	**STEP 2** ·ELABORATION OF THE TECHNOLOGICAL OFFER
WHAT IS IT?	Elaboration of a questionnaire to be applied to knowledge institutions that can meet the demands identified in Phase 1.
WHY DO IT?	Identify the supply of knowledge to contribute to the organization of the production chain.
HOW TO DO IT?	**1.** Prepare a specific questionnaire structuring it into three parts - technological classification, technological services offer of the strategic themes, and the most relevant strategic themes - to define the technological services offer based on studies, methodological references and benchmarking activities in international technology platforms, considering the strategic themes defined in Phase 1;
WHO DOES IT??	Coordination of institutional engagements in the states (1); International Partner (1).
PERIOD OF IMPLEMENTATION	Month 4

PHASE 2	ORGANIZATION OF THE LOCAL
E3	**STEP 3** · VALIDATING THE INDICATORS
WHAT IS IT?	Workshop in person or online with the institutions mapped in Step 1, to validate the indicators for the supply of technological services.
WHY DO IT?	Validate the indicators needed to identify the supply of technological services.
HOW TO DO IT?	**1.** Carry out face-to-face or online workshops with the institutions mapped in Step 1
WHO DOES IT??	Coordination of institutional engagements in the states (1); Area of marketing and communication (1); Sebrae (1).
PERIOD OF IMPLEMENTATION	Month 4

PHASE 2	ORGANIZATION OF THE LOCAL ECOSYSTEM
E4	**STEP 4** · TECHNICAL VISITS
WHAT IS IT?	Conducting technical visits or individual on-line meetings with the institutions mapped in Step 1 to apply the questionnaires on the supply of technological services.
WHY DO IT?	Identify the most relevant technical aspects of the technology service delivery indicators.
HOW TO DO IT?	**1.** Scheduling technical visits or individual on-line meetings with the institutions; **2.** Conduct the technical visits or individual on-line meetings with the institutions mapped in Step 1.
WHO DOES IT??	Coordination of institutional engagements in the states (1); Area of marketing and communication (1); Sebrae (1);
PERIOD OF IMPLEMENTATION	Month 5

PHASE 2	ORGANIZATION OF THE LOCAL
E5	**STEP 5 ·** - DEFINITION OF THE KNOWLEDGE OFFER SCENARI
WHAT IS IT?	Definition of the services offered by service providers in the focused biogas sector in the strategic themes with higher uncertainty identified in Phase 1, foreseeing an action plan articulated in three different elements: cluster, platform, and innovation projects.
WHY DO IT?	Set the supply of technological services in the context of the local ecosystem organization, with the opportunities of technological services offered in the territory to companies motivated to increase the competitiveness of the biogas sector.
HOW TO DO IT?	**1.** Analyze the results of the technological services supply indicators and define a proposal for the process of innovation, knowledge and technology transfer in the territory, taking into account the capacity of companies to absorb the technologies.
WHO DOES IT??	International Partner (1); Coordination of institutional engagements in the states (1).
PERIOD OF IMPLEMENTATION	Month 5

PHASE 2	ORGANIZATION OF THE LOCAL
E6	**STEP 6** · RESULTS PRESENTATION
WHAT IS IT?	Results presentation of the knowledge offer to the partner network.
WHY DO IT?	Contribute to the competitive growth of the biogas industry.
HOW TO DO IT?	**1.** Perform workshop face-to-face or online with the partners network.
WHO DOES IT??	Coordination of institutional engagements in the states (1). Sebrae (1).
PERIOD OF IMPLEMENTATION	Month 5

In the following tables are described, in details, each of the six steps of **Phase 3: Business Model considering** "what it is, why do it, how to do it, and who does it".

PHASE 3	PHASE 3 - BUSINESS MODEL
E1	**STEP 1** · BUSINESS IDENTIFICATION
WHAT IS IT?	It consists of evaluating the business opportunities observed in the sector, from the set of information obtained in the scenario definition phase.
WHY DO IT?	Support the structuring of the business model in step 3.
HOW TO DO IT?	**1.** Analyze the technological scenarios from the perspective of knowledge demand and supply.
WHO DOES IT??	Technical project team (1).
PERIOD OF IMPLEMENTATION	Month 6

PHASE 3	BUSINESS MODEL
E2	**STEP 2** · STRUCTURING THE WORK PLAN
WHAT IS IT?	Organization of the actions to be developed by the partners involved in the business identified in Step 1 for the structuring of the business model.
WHY DO IT?	Guide the actions of the business plan to make the activities more productive.
HOW TO DO IT?	**1.** Align with the partners involved in the identified business the operationality of the project; **2.** Define work plan template; **3.** Collect data and describe the tasks; **4.** Define assignments and timeline; **5.** Define responsibilities.
WHO DOES IT??	Technical project team (1), (2), (3), (4).
PERIOD OF IMPLEMENTATION	Month 6

PHASE 3	BUSINESS MODEL
E3	**STEP 3** · STRUCTURING THE BUSINESS MODEL
WHAT IS IT?	Business model structuring is the roadmap definition for creating and delivering business value oriented towards a sustainable future.
WHY DO IT?	Structure essential data and information to assess feasibility of business opportunities in order to foster and identify new investments.
HOW TO DO IT?	**1.** Data collection, by means of value chain analysis: **a.** Biomass **b.** Biogas production technology **c.** Beneficiation: value aggregation **d.** Forms of monetization **a.** Quantity and characteristics of waste generated for each type of substrate, process data; **b.** Infrastructure and logistics contemplating plant location, substrate transportation; **c.** Destination of the generated energy; **d.** Legal and operational requirements, objectives, project constraints. **2.** Draw up the business modeling, combining the data gathered and making the modeling tailored to the biogas business in question. **3.** Elaborate the technological modeling, considering the most appropriate technology available in the country, comparing it with advanced technologies abroad, to assist in the decision process. **4.** Elaborate the operational modeling, evaluating the efficiency of the processes to be elaborated, sizing the systems in accordance with the technology to be used, followed CAPEX and OPEX Estimates **5.** Develop economic and financial modeling to make projections for the enterprise in order to identify the feasibility of investing.
WHO DOES IT??	Technical project team (1), (2).
PERIOD OF IMPLEMENTATION	Month 6

TABLE: STRATEGIC THEMES AND SUB-THEMES FOR THE COMPETITIVENESS OF THE BIOGAS SECTOR IN PARANÁ

STRATEGIC THEMES	STRATEGIC SUBTHEMES					
1. DEVELOPMENT TECHNOLOGICAL	**1.1.** Production and quality management of the raw material;	**1.2.** Equipment, machinery, biogas production technology;	**1.3.** Technology for safety in biogas production of biogas;	**1.4.** Technological level of the equipment suppliers;	**1.5.** Storage, conservation and distribution of biogas;	**1.6** Process of biogas transformation and use.
2. LEVEL OF EFFICIENCY ENERGY AND SECURITY	**2.1.** Quality of electricity;	**2.2.** Quality of thermal energy;	**2.3.** Biogas storage;	**2.4.** Biogas plant monitoring;	**2.5.** Plant and worker safety;	
3. PRODUCT AND QUALITY	**3.1.** Obligations legal and standards techniques;	**3.2.** Access to certifications and certifiers;	**3.3.** Public programs to encourage biogas production;	**3.4.** Waste and carcass management and utilization;	**3.5.** Availability of qualified suppliers.	
4. GOOD PRACTICES ENVIRONMENTAL/ SUSTAINABILITY	**4.1.** Product Cycle sustainable;	**4.2.** Encouraging the use of alternative energies;	**4.3.** Environmental problem solving;	**4.4.** Greenhouse gas emission;		
5. INCREASE OF COMPETITIVENESS BUSINESS	**5.1.** Diversification market: gas for transport LPG, CO_2 Gas for slaughtering of pigs, biofertilizers;	**5.2.** Adoption of new business models and financing, feasibility, opportunity of income;	**5.3.** Family succession;	**5.4.** Working conditions and training of the management, organization and production system of the company;	**5.5.** Associative model and networks, cooperative enterprises and productive chain.	
6. INFRASTRUCTURES AND TERRITORY	**6.1.** Infrastructure for distribution and logistics;	**6.2.** Production infrastructure of the company;				

TABLE: TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES IN THE BIOGAS SECTOR

CLASSIFICAÇÃO TECNOLÓGICA DAS EMPRESAS		
1 Categorization of companies	Type of Institution	The largest representation is from the Public Universities. The other institutions (private research and technology institutes; parastatal institutes and mixed entities) were equally represented.
	Reference Market	There is a predominance of medium, **large companies and public administration** followed by **small and micro enterprises, public sector companies, and associations**.
	Communication Channels	Among six communication channels used by service providers to promote activities, **website and training activities** are predominant, followed in descending level of use by **events/ workshops** e **direct marketing**; **information activities** and **advertising in the specialized press**.
	Financial resources	The main source of financial resources is the public sector contribution, followed by own resources and a smaller portion of the federal budget.

CONTINUE

TABLE: TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES IN THE BIOGAS SECTOR

TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES	
2 **Innovation**	Companies place more importance on the certification of professional skills and less importance on processes, products and systems.
	Inherent in the degree to which certifications are used. Companies are unanimous in their perception that process/equipment certification related to professional skills, products, and systems is less used.
	There is a need for certification, standardization and technical regulation services in the six strategic themes, with emphasis **on increase in competitiveness** followed by the others: **good environmental practices, regulatory framework, energy efficiency and safety, and technological development**.

CONTINUE TOPO

TABLE: TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES IN THE BIOGAS SECTOR

TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES	
3 **Innovation**	On **the last two years,** the degree of innovation in the companies was oriented toward new product/service projects, new production technologies, and production process improvement. On the other hand, the areas of industrial waste reduction, energy efficiency, reverse logistics studies, and environmental performance by product received less attention.
	On the next two years, innovation should keep the focus on new production technologies and production process improvement, followed by new product and service projects. In the areas of industrial waste reduction, energy efficiency, reverse logistics studies, and environmental performance by product, there is a tendency for a small increase in the degree of innovation by companies.
	There are many difficulties faced daily by companies in the ten areas flagged, mainly those related to **costs to innovate**, **high risk** and bureaucracy e **lack of financial support**. Other difficulties such as lack of partnerships and information, qualified labor, lack of technical support and knowledge, and organizational problems present themselves with less relevance.
4 **Investments in technology**	On the **last three years** the investments in technology were emphasized in the **the acquisition of machinery and equipment** and in the **and in the enlargement or renovation of the structures**. In other areas, such as compliance with standards, research and development, certifications, external consulting, among others, although fundamental to competitiveness, they were very low or null.
	On the **next three years**, the trend of investments in technology emphasizes the **enlargement or renovation of the structures, acquisition of machinery and equipment, promotion and advertising**.

CONTINUE TOPO

TABLE: TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES IN THE BIOGAS SECTOR

TECHNOLOGICAL CLASSIFICATION OF THE COMPANIES	
5 **Investments in the six strategic themes**	In the **last two years** the investments related to the strategic themes were significant, with special attention to **increasing competitiveness**, followed by **good environmental practices/sustainability, adoption of regulatory framework, energy efficiency and safety, infrastructure and technological development.**
	In the next two years, the investment trend is to remain stable at around 40% in all areas.
6 **Resources for new investments**	The indicators signal the tendency of companies willing to invest in the next three years to use resources from private **banks private** banks and, in the largest amount **own resources**.
7 **Need for services in the six strategic themes**	There is a need for **certification services, standardization and technical regulation** in all strategic themes, with special attention to **increasing competitiveness**.
	The need for **industrial and intellectual property** is imperceptible, since most people consider this service unnecessary.
	There is a need for **process and product services** in all strategic themes.
	As for **information technology services, strategic consulting and development** likewise, they are needed in all the strategic themes.

TOPO

TABLE: "GOOD PRACTICES" PRODUCED BY THE GEF BIOGAS BRAZIL PROJECT

MULTIPLICATION OF GOOD PRACTICES	
1 **Biogas Information Platform Andrea Faria**	**PiBiogás** is a network for digital collaboration between institutions for the joint dissemination of activities on the biogas theme and the sharing of information and results. LEARN MORE
	Coordinated by the Secretariat of Entrepreneurship and Innovation (SEMPI) of the **Ministry of Science, Technology and Innovations (MCTI)**, the PiBiogás has as its goals to increase user traffic of web pages and digital tools offered by the sector, add public to initiatives related to the theme, optimize the dissemination of information and expand the exchange of results between the participating institutions.
2 **Urban Waste**	Technical Cooperation Agreement with the Federal District Government aims to develop projects for biogas production from the management of Urban Solid Waste (USW) collected in the capital city. The agreement intends to give a sustainable destination to all organic waste in the Federal District.
	The agreement structures a concession program for Mechanical Biological Treatment Units (MBTU) of urban solid waste for private initiative.
3 **BiogasInvest**	BiogasInvest is a **free** digital tool that allows producers, entrepreneurs, financing agents, and public administrators to independently conduct a customized analysis of the feasibility of new biogas **projects**.

CONTINUE

TABLE: "GOOD PRACTICES" PRODUCED BY THE GEF BIOGAS PROJECT BRAZIL

MULTIPLICATION OF GOOD PRACTICES	
4 **Digital Community**	Virtual space for the dissemination of articles and news relevant to the biogas sector. The community is a collaborative blog dedicated to the circulation of information among key players in the industry.
5 **DataSebrae Biogas**	Digital platform that interactively gathers relevant information about the production of biogas in Brazil.
6 **Business Model**	Structuring data and information to assess the feasibility of opportunities of business in order to foster and identify new opportunities.
7 **Biogas Plant Design**	The selected projects will be linked to the GEF Biogas Brazil Project as **Demonstration Units** and will receive **incremental investment** for the acquisition of more robust equipment or services that promote efficiency and security gains.
8 **Tropicalization Program**	Its purpose is to promote cooperation between Brazilian and foreign companies to identify opportunities that meet the demands of the local market. The objective of the Program is to engage national and international stakeholders to implement incentive actions for economic development and technological innovation aimed at the biogas value chain in Brazil.
9 **Capacity Building Track in Biogas**	**Six individual courses, online and free** that could be taken separately or together, as steps in a learning trajectory.

TOPO

Credit: UNIDO Brasil

POP-UP

THEORY OF CHANGE DIAGRAM - BIOGAS VALUE CHAIN IN THE PARANÁ AGRIBUSINESS

Adapted from Mid-term Review (MTR) of the Biogas Brazil Project, 31Mar 2021 - ITPEnergised.technical and professional.

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Theory of Change enables the detailing how the GEF Biogas Brazil Project will be able to promote changes in the sector.

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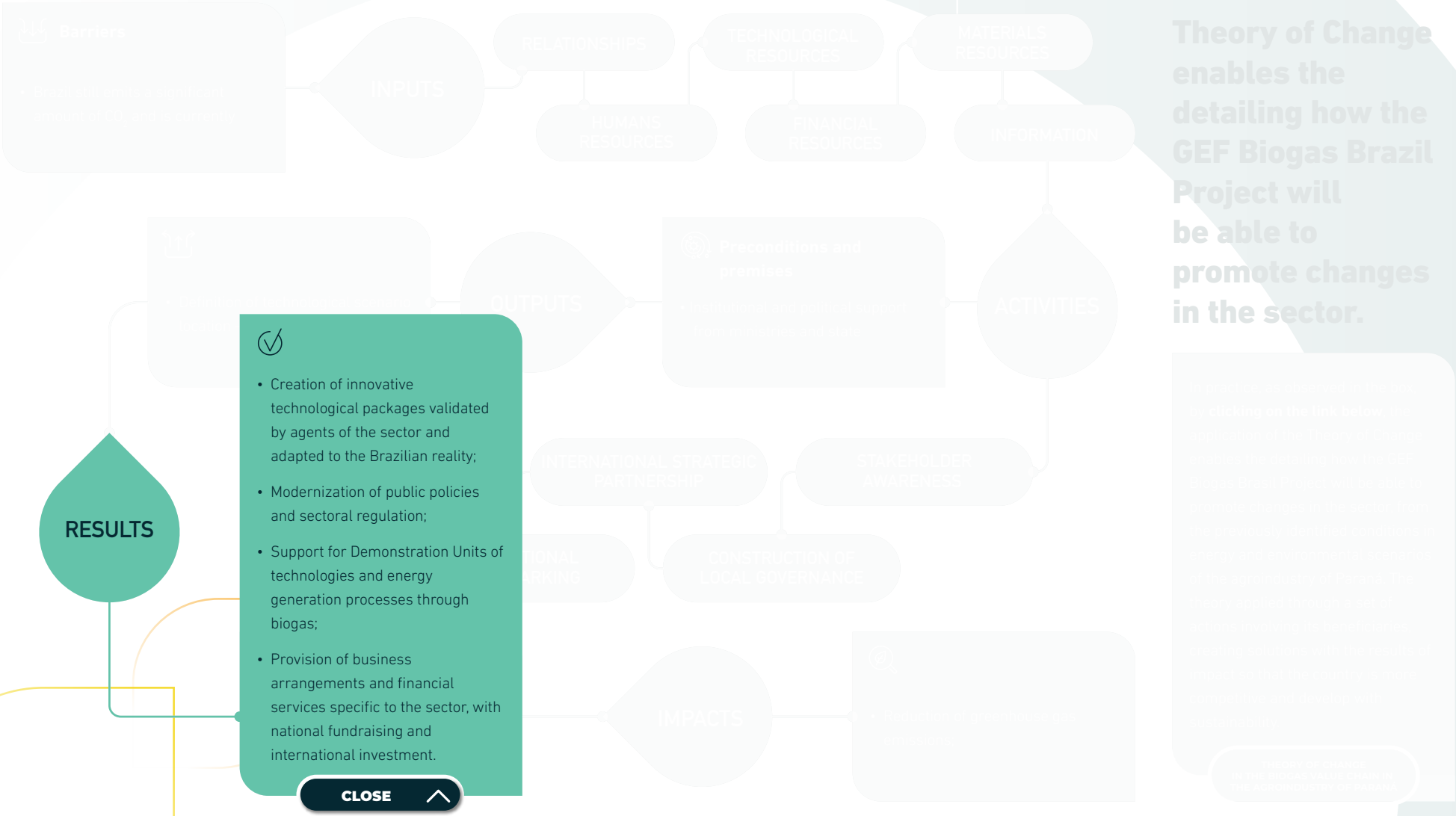

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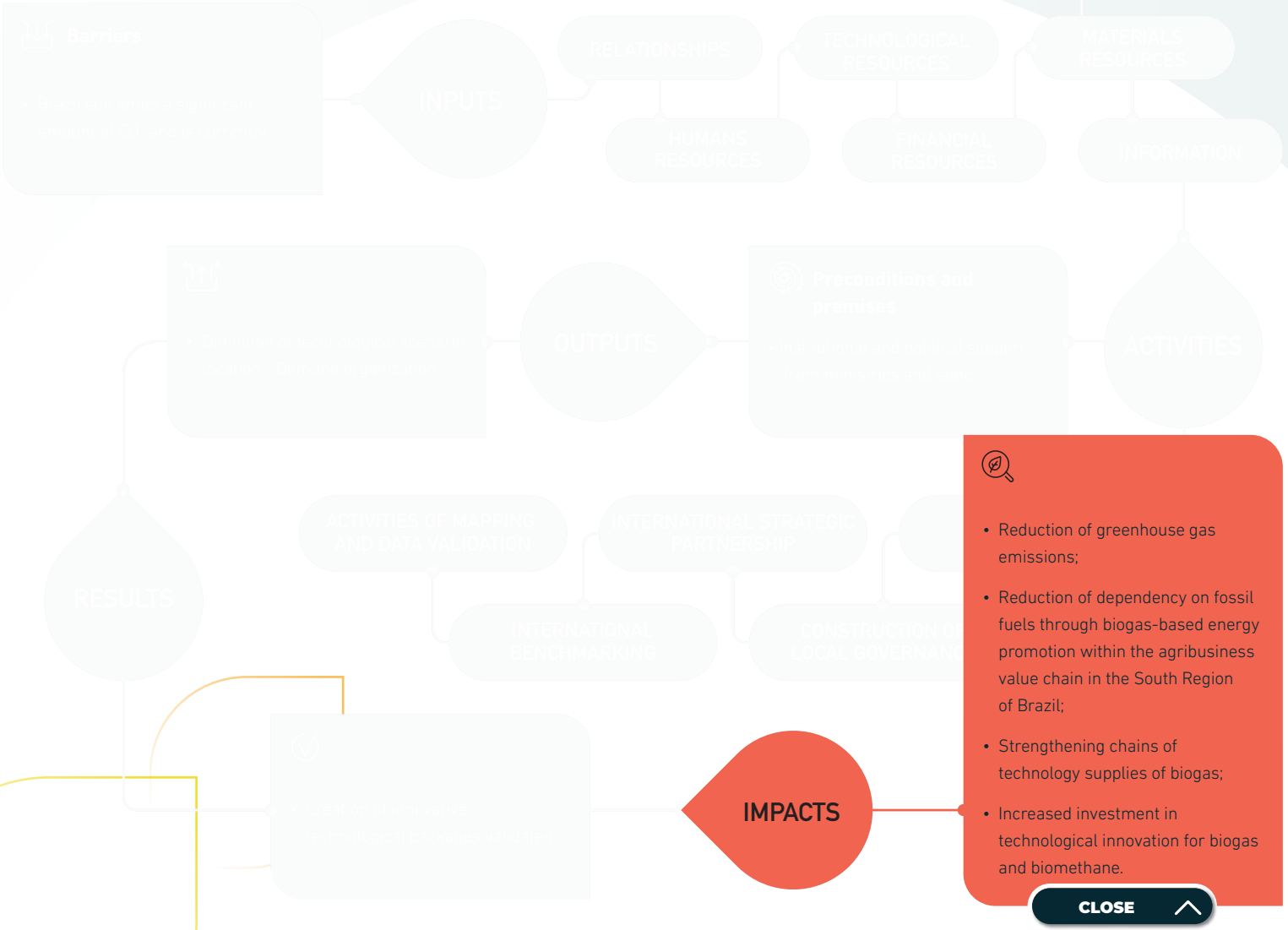

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Biogás
BRASIL

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