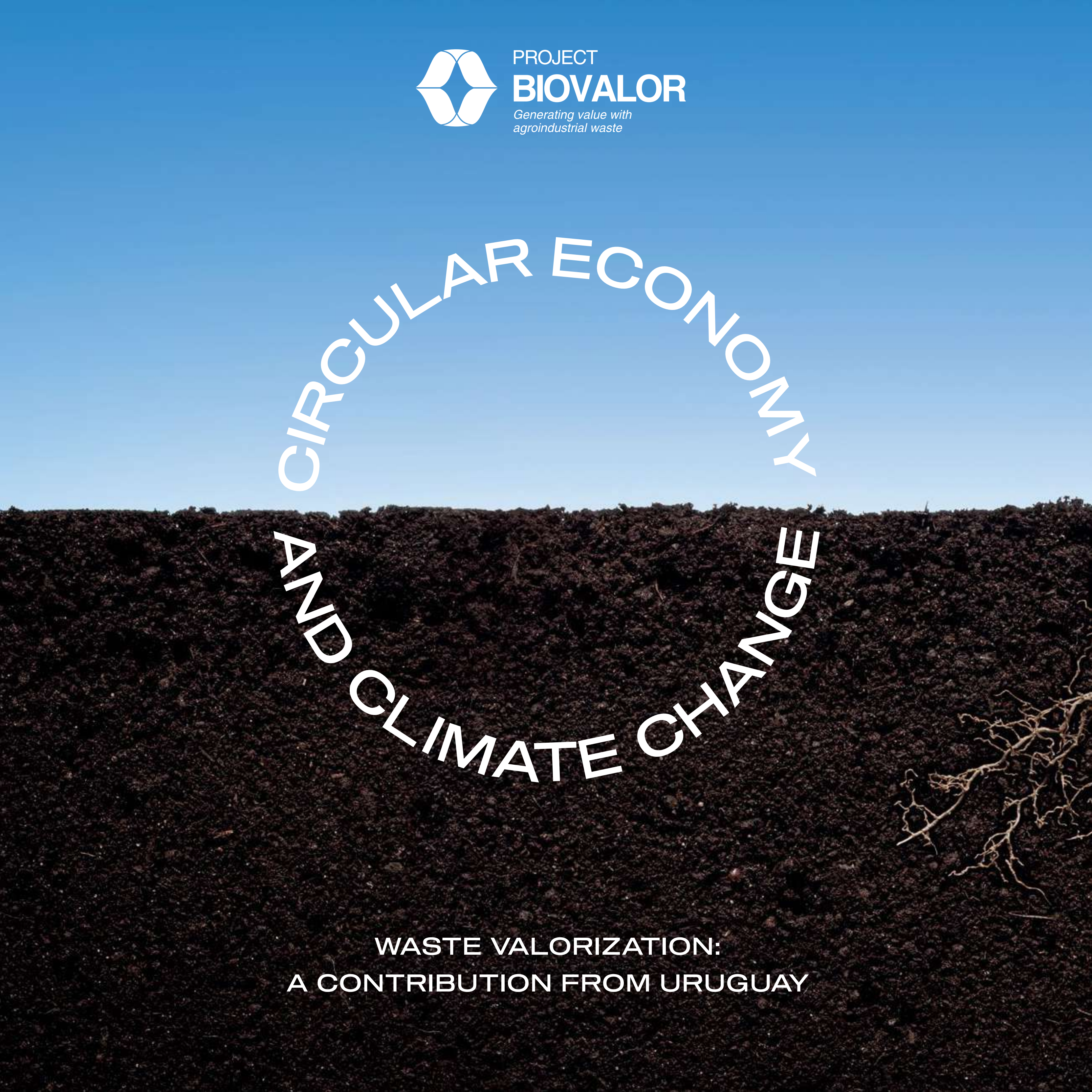

PROJECT **BIOVALOR**

Generating value with agroindustrial waste

CIRCULAR ECONOMY AND CLIMATE CHANGE

WASTE VALORIZATION: A CONTRIBUTION FROM URUGUAY

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December 2020

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A CONTRIBUTION FROM URUGUAY

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PROJECT
BIOVALOR
Generating value with agroindustrial waste

Biovalor Project Steering Committee
The Steering Committee is composed of Directors of the MIEM's Energy Division, the MA's National Directorate for Environmental Quality and Assessment, and the MGAP's International Cooperation Division, together with UNIDO's Regional Representative for the Southern Cone.

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The Technical Committee is composed of the MIEM Renewable Energy Area Manager, Wilson Sierra; the Area Manager of Information, Planning and Environmental Quality of MA, Marisol Mallo; the MGAP Project Management Unit Manager, Jorge Marzaroli; and UNIDO Program Officer for the Southern Cone, Mateo Ferriolo.

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This publication was developed as part of the Biovalor Project *'Towards a Green Economy in Uruguay: Stimulating Sustainable Production Practices and Low-Emission Technologies in Prioritized Sectors.'* implemented between 2014 and 2020 by the Ministry of Industry, Energy and Mining of Uruguay, in partnership with the Ministries of Environment, and Livestock, Agriculture and Fisheries, with support from the United Nations Industrial Development Organization and funding from the Global Environment Facility. This publication presents the progress made by Uruguay in integrating the concept of circular economy and the response to climate change, as well as to show Biovalor's strategic contribution to this integration.

How to cite this publication:
Ministry of Industry, Energy and Mining; ***Circular Economy and Climate Change***. WASTE VALORIZATION: A CONTRIBUTION FROM URUGUAY. The Biovalor Project; (2020). MIEM-MA-MGAP-UNIDO-GEF. Uruguay

'This report has been prepared paying special attention to the use of expressions and concepts that do not exclude people by gender. In some cases, in order to avoid grammatical overload, the generic masculine has been used on the understanding that it indiscriminately designates men and women, without therefore being interpreted as a sexist use of language.'

Biovalor's impact on the SDGs

CONTENTS

ACRONYMS

AFOLU	Agriculture, silviculture and other land uses
ANDE	National Development Agency
ANII	National Agency for Research and Innovation
ANTEL	National Telecommunications Administration
BEN	National Energy Balance
BUR	Biennial Update Report (BUR3 Third Biennial Update Report)
CH_4	Methane
CO_2	Carbon dioxide
COP	Conference of the Parties to the UNFCCC
CTCN	Climate Technology Center and Network
DCC	Climate Change Directorate
DGDR	General Directorate for Rural Development
DGSA	General Directorate for Agricultural Services
DIGEGRA	General Directorate for Farms
DINAMA	National Environment Agency
DNE	National Directorate of Energy
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEI	Greenhouse Gases
Gg	Gigagram
GIS	Geographical Information System
GTP	Global temperature change potential
GWP	Global Warming Potential
INALE	National Dairy Institute
INGEI	National Inventory of Greenhouse gases
INIA	National Agricultural Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IVA	Value Added Tax
KP	Kyoto Protocol
LATU	Technological Laboratory of Uruguay
LTS	Long-Term Low-Emission Climate-Resilient Development Strategy
MA	Ministry of Environment
MEF	Ministry of Economy and Finance
MIEM	Ministry of Industry, Energy and Mining
CDM	Clean Development Mechanism
MGAP	Ministry of Livestock, Agriculture and Fisheries
MVOTMA	Ministry of Housing, Territorial Planning and Environment
MW	Megawatt
NDC	Nationally Determined Contribution to the Paris Agreement
N_2O	Nitrous Oxide
NPCC	National Policy on Climate Change
OAN	National Environment Observatory
PEEU	Uruguay Wind Energy Program
PROBIO	Uruguay Biomass Electricity Production Project
PTP	Pando Technology Hub
SDG	Sustainable Development Goals
SNRCC	Climate Change National Response System
ton	Tons
UDELAR	University of the Republic
UNFCCC	United Nations Framework Convention On Climate Change
UNIDO	United Nations Industrial Development Organization
UTCUTS	Land Use, Change in Land Use and Silviculture
UTEC	Technological University
UTU	Vocational School of Uruguay
°C	Celsius Degrees

PROLOGUE

OMAR PAGANINI
Minister of Industry, Energy and Mining

Through the implementation of several public policies and alliances with the private sector, Uruguay has committed to an environmental sustainability strategy to promote the transformation of its energy matrix and develop environmental improvement policies. Major challenges remain, but there is no doubt about Uruguay's institutional commitment in the past, present and future.

The circular economy forms part of the national agenda as a strategy to rethink our production processes by analyzing the environmental impact throughout the life cycle of products and services consumed. The Biovalor Project is a first milestone that, through specific cases, shows the possibility of reducing greenhouse gases and producing in a sustainable fashion.

Inter-ministerial articulation with the United Nations has been one of the key components to define cross-cutting actions and achieve results that transcend political and personal circumstances. The circular economy requires this approach to integrate productive and environmental issues in a coherent and economically sustainable way. The work with the academic sector is to be highlighted since it has allowed the topic to be incorporated in the contents provided to future decision-makers and in new areas of research.

I would like to highlight the promotion of demonstration projects at the commercial level, a partnership between the public and private sectors, sharing the risks associated with innovation and capitalizing on the lessons learned for the collective benefit. The commitment of the private sector was evidenced by significant investments after the support received, confirming the ability to work together toward the same objectives.

There are many other lessons learned from this process, but I would like to focus on the steps to come. We are now working on the use of energy surplus, seen as 'energy waste,' that has a very strong potential for productive transformation and for improving national competitiveness (please, read the epilogue). We will continue promoting strategies to reduce waste generation and to enhance the potential to capture the value that lies in waste through new technologies and innovation.

I would like to finish by thanking the experts and professionals of the various institutions who were part of the project and who today challenge us to continue sharing knowledge for the common good.

MANUEL ALBALADEJO
UNIDO Representative for Uruguay, Argentina, Chile and Paraguay

In 1955, the American Life Magazine celebrated Throwaway Living. A somewhat sinister vision that in its day was synonymous with progress and mastery over nature. Today, 65 years later, we are paying the consequences of this culture of waste. We have been witnesses and collaborators of this aberrant and irrational way of interacting with the planet, our home. Today there is irrefutable evidence that we are living above our possibilities and, even worse, mortgaging the future of generations to come.

The circular economy is not the panacea, but it is a key pillar in that paradigm shift to reverse, or at least minimize, the impact of human activity on the environment. It must help us redesign our ways of producing and consuming so that we can decouple economic growth from the indiscriminate use of resources. The Ellen MacArthur Foundation argues that the current production and consumption methods account for 45% of the greenhouse gas emissions. This alters the discourse on who is responsible for climate change: it is no longer only associated with large fossil-fuel companies, it also involves us all, ordinary citizens and our consumption patterns.

Uruguay has not been indifferent to this debate. Moreover, Uruguay, through the Biovalor Project, has become a leader in Latin America showing how the circular economy can be the cornerstone of a new model of productive development. There is much talk about circular economy, but apart from press headlines, we have little evidence of its practical application.

The Biovalor Project fills this gap with empirical cases on the technical applicability and economic viability of circular models. One of the great lessons is that systemic change (institutional, regulatory, corporate, and citizen) is the element needed for the circular economy to stop being a beau ideal and become an accepted and practiced development model.

This study is the perfect ending for an unprecedented project that will mark a turning point in the debate on circular economy in Latin America. There are, in fact, other projects already following Biovalor's footsteps. Documenting the lessons learned (positive and negative), challenges and impact of the project is our responsibility and obligation. It would not be fair to deny such a source of inspiration to those who did not know about or could not be part of the project.

From the United Nations Industrial Development Organization (UNIDO), we feel privileged to be part of Biovalor. Our appreciation to all the government officials and experts who, for years, have contributed to the success of the project; to the Uruguayan institutions that have shown that together we can achieve more; and to the entrepreneurs who have taken on the challenge of change.

I will take with me the human stories, those of incredible people working hard to make a small country in territory, a great country in spirit. In fact, the legacy of Biovalor remains present in human capital and the commitment to build a better country.

ABOUT THIS PUBLICATION

This publication presents the progress made in the integration of the concepts of circular economy and climate action in Uruguay, with a special focus on the experience developed during the implementation of the Biovalor Project between 2014 and 2020.

01

Chapter 1 develops the emerging concept of circular economy, which implies the transition from a traditional linear economic system, where the production model is based on *extraction, production, use and disposal*, to a new design aimed at eliminating waste and maintaining continued use of resources. This chapter also describes how the circular economy can be a robust strategy to address the challenges of climate change towards CO_2 neutrality by 2050. It also covers some key lessons learned in Uruguay in the integration of the circular economy and climate change in the area of urban solid waste management, nutrient circularity in agricultural production, and energy transformation based on renewable supply: hydraulic, biomass, wind and solar.

02

Chapter 2 makes reference to Uruguay's institutional and public policy framework regarding sustainability, including: climate policy, aimed at adapting and reducing greenhouse gas emissions and building a long-term climate strategy that includes reaching CO_2 neutrality by 2050; energy policy, aimed at the rapid uptake of renewable energy sources, including the use of waste from the productive sector (renewable-based electricity generation reached 98% in 2019); sustainable agricultural production policy that strategically includes the environmental and ecosystem dimensions in the production of food of global quality; and the integrated waste management policy, which among other strategies, incorporates the notion of waste valorization, including energy valorization. This chapter also delves into the coordinated development of sustainability policies by several government agencies.

03

Chapter 3 introduces the theory of change and the main results of the Biovalor Project, whose objective is: *'To transform the different types of waste generated in the agricultural sector and in agro-industrial production chains in Uruguay into different types of energy and/or byproducts to reduce greenhouse gas emissions, contributing to the development of a sustainable low-carbon model, supported by the development and transfer of appropriate technology.'*

04

Chapter 4 briefly describes the implementation and impact of demonstration projects. These projects were supported by Biovalor and involved the search for technological solutions that promoted circularity in business models. The projects were jointly developed with the private sector, based on co-financed investment and coordinated technical development. The demonstration projects allow treatment of nearly 100,000 tons of waste per year, as well as an annual reduction of more than 2,500 ton CO_2 eq of greenhouse gas emissions.

05

Other areas of the transformational impact of the Biovalor Project are mentioned in chapter 5, specifically the development of inter-agency partnerships, and specific public policies; among them, support and coordination for a circular economy action plan , generation of information for decision-making, and the strengthening of domestic networks and alliances, this specifically focused on the joint work with the private and the academic sector.

06

Chapter 6 presents the main conclusions and lessons learned from the interaction between the concept of circular economy and climate action in Uruguay, as well as the specific knowledge acquired during the project's implementation.

The actions, examples and lessons learned contained in this publication make it possible to understand how the strategic development of the circular economy concept increases climate ambition and promotes progress to achieve the Sustainable Development Goals, implementing innovative mitigation actions that generate value and positively impact not only on the economy and society, but on other environmental areas, such as the reduction of organic waste and soil and water pollution.

These actions also contribute to a neutral CO_2-world by 2050.


01

CIRCULAR ECONOMY AND CLIMATE CHANGE IN URUGUAY

THE URGENT CHALLENGE OF CLIMATE CHANGE AND THE SUSTAINABLE USE OF RESOURCES

In December 2015, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) signed the Paris Agreement, which entered into force less than a year after its adoption. The Agreement's goal is *'to hold the temperature increase to well below 2°C and to pursue efforts to limit the increase to 1.5°C.'*

Limit the temperature increase to 1.5ºC

After five years, global emissions continue increasing; furthermore, the current level of ambition of the aggregated mitigation efforts would lead to a global temperature rise of approximately 3.5ºC[1], with devastating social, economic, and environmental effects, and with a greater impact on the most vulnerable communities and ecosystems.

According to the special report by the Intergovernmental Panel on Climate Change (IPCC) in order not to surpass 1.5°C, emissions must stop their increase, and decrease rapidly, achieving emissions neutrality, no later than 2050.

Emissions neutrality by 2050

1. https://unfccc.int/resource/docs/2015/cop21/eng/07.pdf

Bearing in mind the 26th Conference of the Parties (COP) to be held in Glasgow at the end of 2021, countries are called upon to increase the ambition of their National Determined Contributions (NDC) submitted prior to Paris, so that they present progressive, short-term efforts, that, together, result in a global effort toward emissions neutrality by 2050.

Also, the annual consumption of resources is equivalent to more than one and a half planets[2]; with rich countries consuming between three to ten times more per person than developing countries. If this trend continues, the world will be annually consuming the equivalent of three planets by 2050[3].

If we don't change, by 2050, we will be consuming 3 times the resources generated by the planet in 1 year

The overall consumption of biomass, fossil fuels, metals and minerals is expected to double in the next 40 years[4], while waste generation is projected to increase 70% by 2050[5].

Global consumption of materials is expected to double in 40 years, and waste will increase 70% in 30 years

Keeping the temperature increase below 1.5ºC and maintaining resource consumption within the planet's biocapacity imply urgent structural transformations in the way humans consume and produce energy, food and materials.

2. https://www.footprintnetwork.org/

3. https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

4. OECD (2018), Global Material Resources Outlook to 2060.

5. World Bank (2018), What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050.

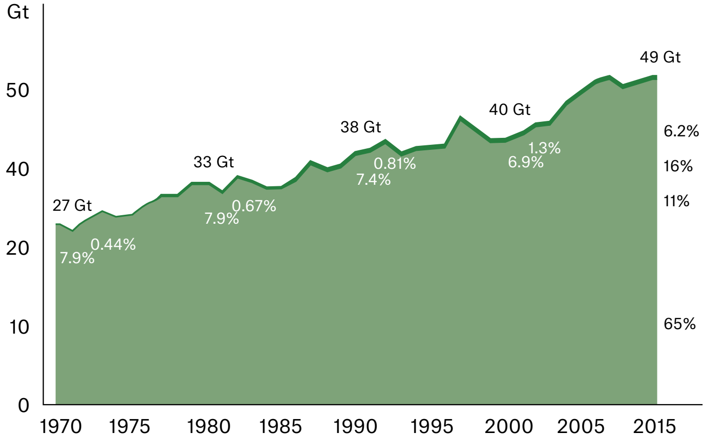


Image 1: Estimated global emissions in CO_2 eq between 1970 and 2015 (Source IPCC AR5).

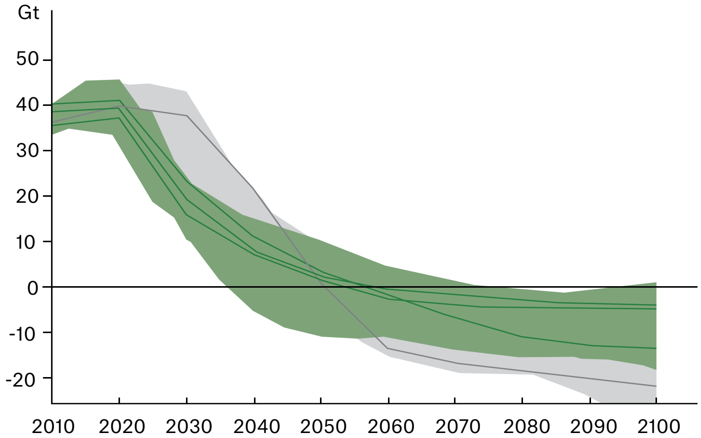
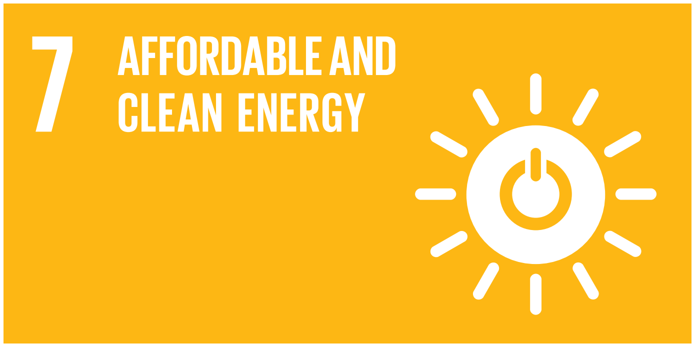
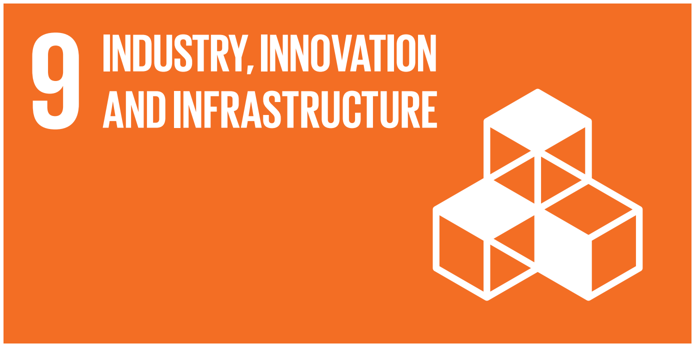


Image 2: Emissions trajectory 2020-2100 to avoid global warming above 1.5ºC
(Source: IPCC SR 1.5ºC)

Also, in September 2015, the United Nations General Assembly adopted the 2030 Agenda with its 17 Sustainable Development Goals (SDGs), which propose a structural transformation of our societies and economies by 2030 to focus on sustainability. More specifically, goals have been set taking into account climate, production and consumption aspects, including: *7. Affordable and clean; 9. Industry, innovation and infrastructure; 12. Responsible production and consumption; and 13. Climate action.Action for Climate.*





CIRCULAR ECONOMY AS AN EMERGING STRATEGY FOR CLIMATE ACTION

The circular economy is an emerging concept, which implies the transition from a traditional linear economic system, where the production model is based on *'extraction, production, usage and disposal'*[6] to a new regenerative economic system aimed at eliminating and valorizing waste and maintaining a continued use of resources. Circular systems implement several actions including *'reuse, sharing, repair, renovation, remanufacturing, and recycling to develop closed systems, minimizing the use of new resources and the creation of waste, pollution, and carbon emissions.'*[7]
Eighty percent of the environmental impacts of products are determined in the *'design phase'*[8]. The linear 'take-make-use-dispose' path does not provide those who produce and consume sufficient incentives to make their production processes and consumption patterns more circular. Many products stop working very fast, they are not easily reusable, are not repaired or recycled, and many are simply designed for single use[9] and in many cases with planned obsolescence.

The circular economy positively impacts on business, society and the environment, while it decouples economic growth from the consumption of finite resources and greenhouse gas emissions, building economic, natural and social capital. Underpinned by a transition to renewable energy sources and an increase in the use of renewable materials, the concept acknowledges the importance of making the economy work for all and at all levels[10]. Applying the principles of the circular economy to change the way we produce and use goods, materials and services can result in a significant reduction of greenhouse gas emissions. This strategy can be summarized as *'to redesign value chains to prevent waste and pollution and reduce greenhouse gas emissions'; 'to keep using products and materials to retain the energy used in their production'; and 'to regenerate the natural systems to sequester carbon in soils and products'.*[11].

Recent studies show that strategies based on the circular economy would reduce emissions related to the production and consumption of materials in 45% by 2050 (considering that these represent 45% of total global emissions). These strategies can contribute to a 40% reduction in emissions associated with the production of four key materials (steel, aluminum, plastics and cement), 38% in the construction and use of buildings, 70% in mobility, and 49% in food production[12].

The Circular Economy can help reduce emissions by 40% in material production.

Some countries and economies have embarked on the path toward combined strategies of circularity and climate action, the European Union, for example, adopted in 2020 its European Green Deal to achieve carbon neutrality by 2050 and a post-COVID 19 green recovery, including a new Circular Economy Action Plan, launched as a *'concerted strategy for climate neutrality, resource efficiency, and competitive economy'*[13].

6. Towards the Circular Economy: an economic and business rationale for an accelerated transition. *Ellen MacArthur Foundation. 2012. p. 24..*

7. Geissdoerfer, Martin; Savaget, Paulo; Bocken, Nancy M. P.; Hultink, Erik Jan (2017-02-01). "The Circular Economy – A new sustainability paradigm?". Journal of Cleaner Production. 143: 757–768.

8. https://op.europa.eu/en/publication-detail/-/publication/4d42d597-4f92-4498-8e1d-857cc157e6db Ecodesign your Future

9. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN Nuevo Plan de Acción de la UE sobre Economía Circular, 2020

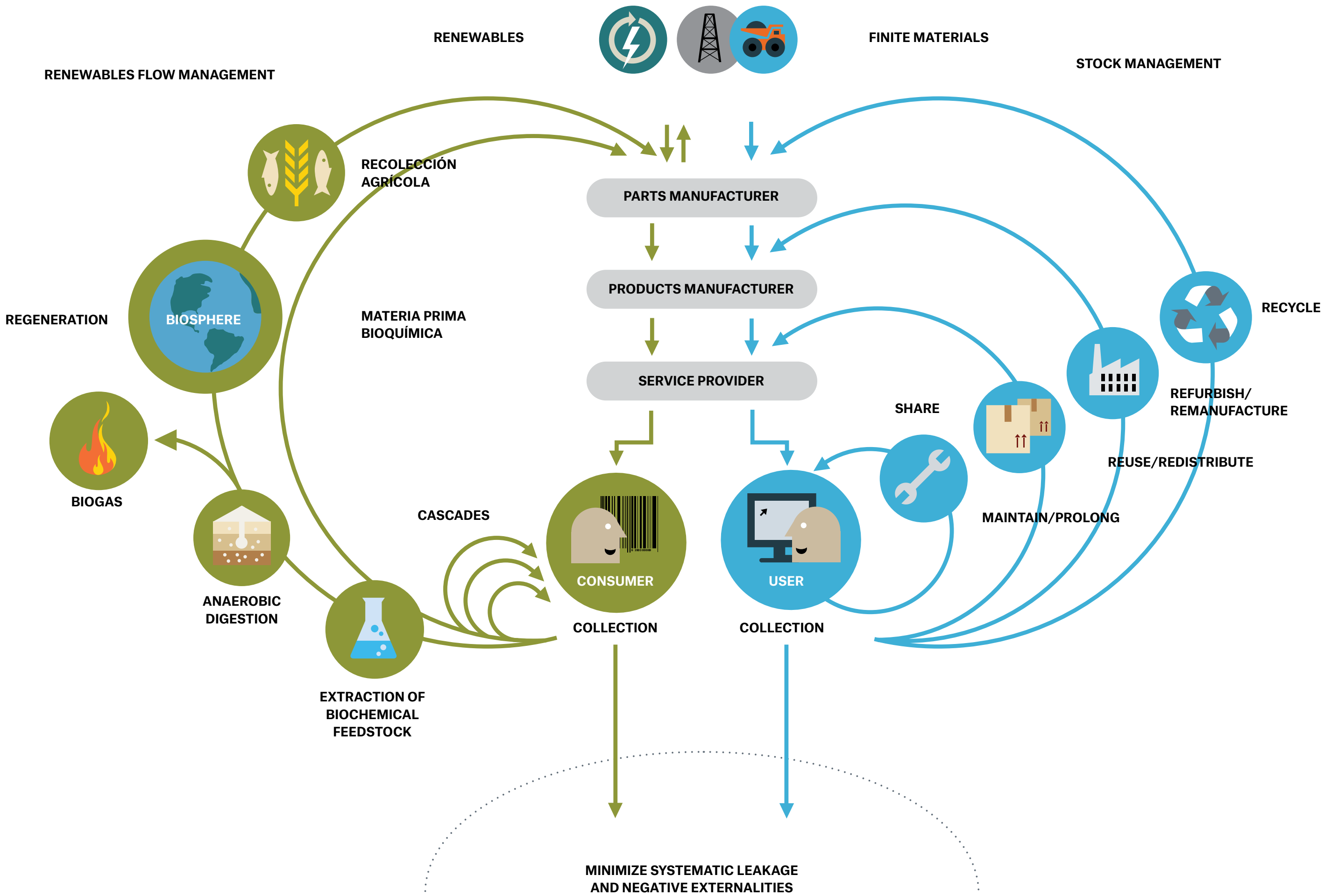
10. https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf p19

11. Elaborado en base a: https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf

12. https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf

13. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN Nuevo Plan de Acción de la UE sobre Economía Circular, 2020

CIRCULAR ECONOMY SYSTEM DIAGRAM



1 Hunting and fishing
2 Can take both post-harvest or post-consumer waste as an input

SOURCES:
Ellen MacArthur Foundation
Diagram of circular economy systems (February 2019)
www.ellenmacarthurfoundation.org
Illustration based on Baungart & McDonough,
Cradle to Cradle (C2C)

Infographic 1: Circular Economy Butterfly Diagram ***https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf***

LESSONS LEARNED - THE INTEGRATION BETWEEN CIRCULAR ECONOMY AND CLIMATE CHANGE IN URUGUAY

It should be noted that the implementation of the Biovalor Project takes place in the context of a strong positioning of environmental policies in Uruguay and where previous lessons learned, that were key to successful implementation, were catalyzed and developed.

The following are some of the lessons learned regarding circular economy and climate change that will serve as a framework for the subsequent action of the Biovalor Project.

Between 1990 and 2015, Uruguay managed to reduce the intensity of its greenhouse gas emissions by 46% compared with its economic growth[14]. This shows that it is possible to decouple economic growth and development from emissions, based on robust public policies and more sustainable production practices, generating employment and greater social inclusion.

14. SNRCC, 1990 -2015

GHG EMISSIONS IN MT OF CO_2EQ (GWP $_{100}$ AR2)

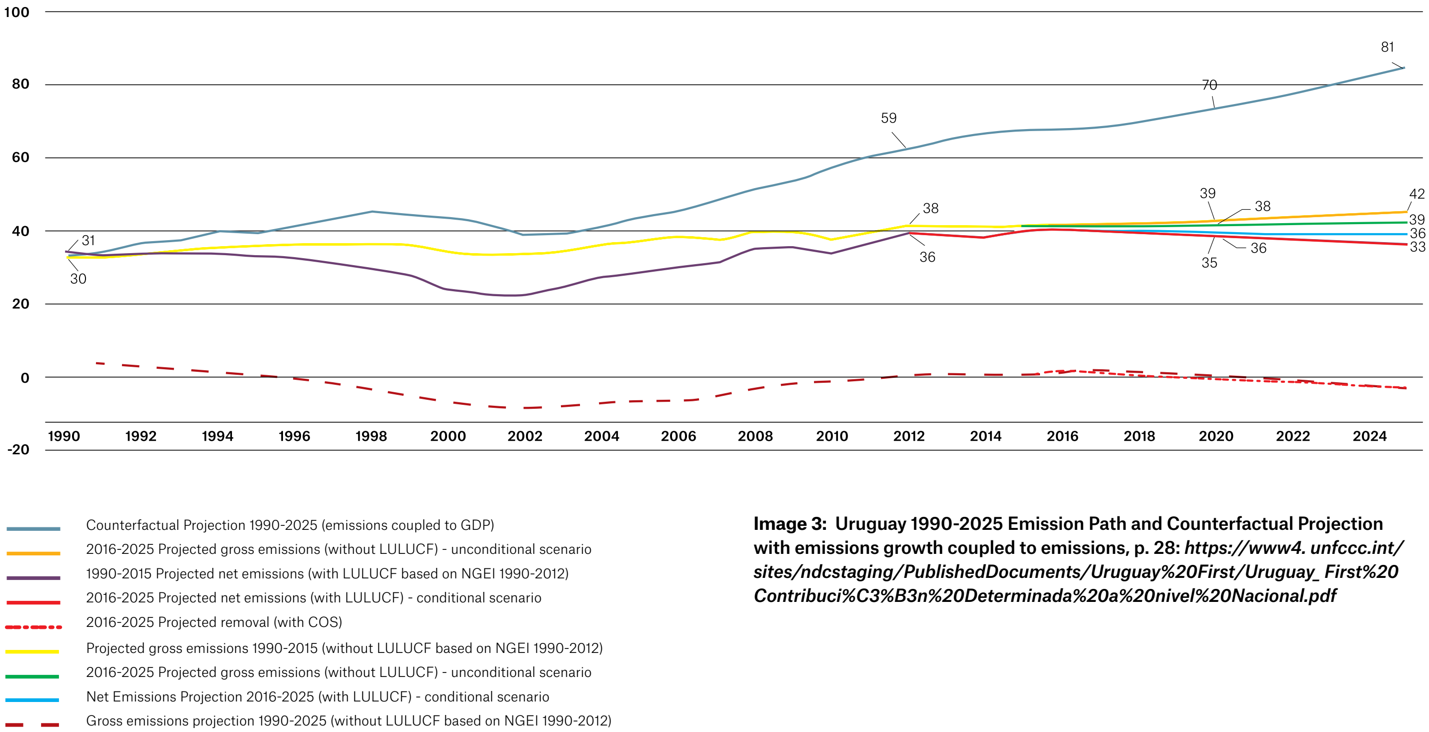


Image 3: Uruguay 1990-2025 Emission Path and Counterfactual Projection with emissions growth coupled to emissions, p. 28: *https://www4. unfccc.int/sites/ndcstaging/PublishedDocuments/Uruguay%20First/Uruguay_ First%20 Contribuci%C3%B3n%20Determinada%20a%20nivel%20Nacional.pdf*

Since 1990, Uruguay has reduced emissions intensity in relation to GDP by 46%

One of Uruguay's main strategies regarding circular economy and climate action was a transformation in power generation, which is the main source of emissions at the international level. Uruguay achieved 98% of renewable power generation in 2019[15], based on the rapid uptake of non-traditional renewable energy sources such as biomass, wind and solar.

Uruguay achieved 98% power generation based on renewable sources

This first contemporary energy transition in Uruguay to non-traditional renewables allowed electricity sector from USD 1,100 million in 2012 to USD 600 million annually in 2018; the cost of risk (associated with drought and oil prices, among others) in the same period dropped from USD 2,500 million to USD 700 million per year (UTE, 2019[16]). Also, Uruguay received, between 2011 and 2018, US$ 4,500 million in clean energy investments from commercial banks (national and international) and from multilateral development banks, with 75% of foreign investment (Climascopio, 2019 and Uruguay XXI 2020[17]).

This transformation also allowed the generation of new jobs that for the construction phase and 20 years of operation were estimated in 33 people-year/MW of direct employment and 132 people-year/MW of indirect employment every 50MW in biomass generation, 10 people-year/MW of direct employment and 29 a reduction in costs in the people-year/MW of indirect employment every 50 MW of solar generation, 7 people-year/MW of direct employment and 31 people-year/MW of indirect employment every 50MW of wind generation (KPMG-SEG, 2015[18]).

The minimum levels of GHG emissions in the electricity sector, given the rapid change in the matrix, combined with the economic importance of agricultural production, means that Uruguay's emissions are currently concentrated in this sector, mainly in cattle farming. However, Uruguay has also managed to reduce emissions per kilogram of beef produced by 27%[19], based on better rodeo management and sustainable intensification practices. Also, Uruguayan beef is based on circular economy strategies including sustainable use of natural grassland ecosystems, protecting biodiversity, promoting carbon capture in soils and preventing deforestation of native forests. This way of producing beef meets the highest environmental and animal health and welfare standards, while achieving the highest price per kilogram of beef worldwide.

Beef production decreased CH_4 and N_2O emissions by 27%

These strategic examples in Uruguay show that it is possible to transform economies and ways of production to incorporate circularity aspects, while at the same time improving the economy, generating employment, and achieving new opportunities for citizen welfare. Uruguay is committed to expanding its circular and climate policies. In this regard, at the Climate Action Summit, convened by the UN Secretary-General in 2019, Uruguay, together with 60 other countries, announced its intention to present a low-carbon, climate-resilient development strategy with an aspirational goal of CO2 neutrality by 2050.

15. BEN https://ben.miem.gub.uy/

16. https://www.ute.com.uy/sites/default/files/noticias/BALANCE%20Y%20FUTURO%20SECTOR%20EL%C3%89CTRICO.pdf

17. https://www.uruguayxxi.gub.uy/uploads/informacion/cc8975afd04dcec9210407b1ff1b8c2212bb9bcc.pdf

18. https://www.gub.uy/ministerio-industria-energia-mineria/sites/ministerio-industria-energia-mineria/files/documentos/publicaciones/Resumen%20Ejecutivo.pdf

19. http://monitorcdn.mvotma.gub.uy/

Uruguay is designing a long-term strategy to achieve CO_2 neutrality by 2050

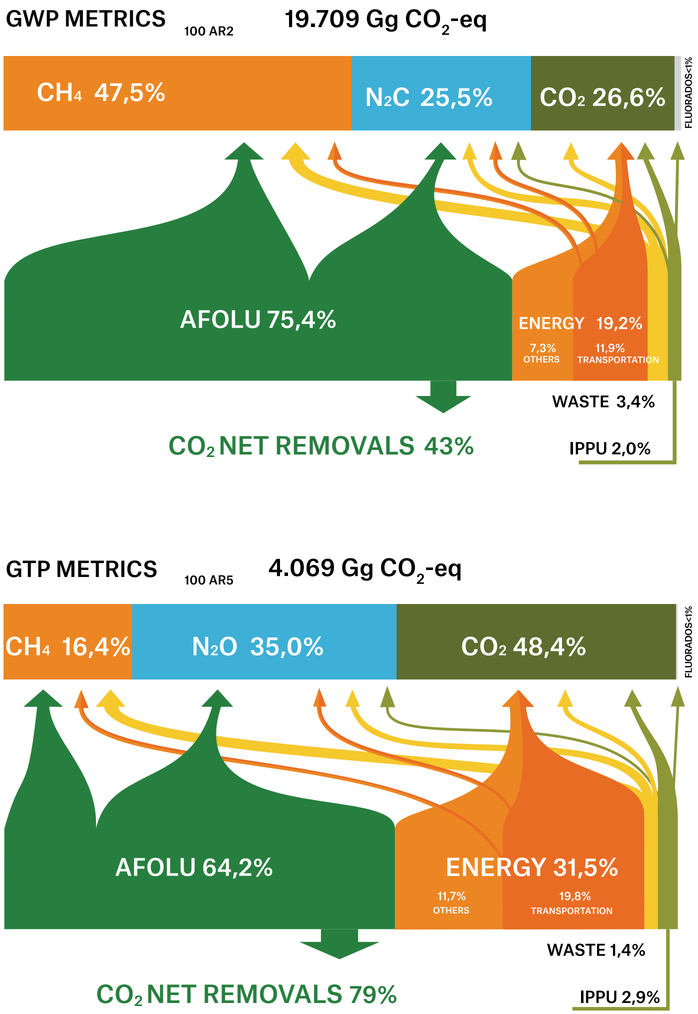


Image 4: Estimated 2017 emissions according to GWP and GTP metrics by key sectors and gases. (Source: MVOTMA-SNRCC BUR-3)

The long-term strategy and the successive and more progressive Nationally Determined Contributions under the Paris Agreement, which Uruguay presents every five years, will have to be supported by an intense identification of new options to increase the country's climate ambition.

The development of the concept of circular economy and, as it will be seen later, the lessons learned in the implementation of the Biovalor[20] project allow the country to increase its climate ambition and make progress toward the Sustainable Development Goals, achieving innovative mitigation actions that generate value and positively impact on other environmental areas, such as reducing organic waste and reducing soil and water pollution.

There are three areas in which Uruguay has made progress and that are of international interest: the capture of methane (CH4) at disposal sites, the circularity of nutrients and, as already mentioned, the very advanced development of renewable energies in the electrical system.

Regarding methane capture at final disposal sites, Uruguay had an early action agenda; the country's first methane capture and burning, and power generation landfill was implemented in 2004, at the Las Rosas final disposal site, in the department of Maldonado, with support from the Global Environment Facility (GEF). The second methane capture and burning process was established in Montevideo in the Felipe Cardozo landfill, through the issuance of emission reduction certificates under the Clean Development Mechanism (CDM) of the Kyoto Protocol (KP). Thanks to these two projects, Uruguay is able to dispose of 70% of urban solid waste in methane capture and burning sites.[21]

20. *'Towards a Green Economy in Uruguay: Stimulating Sustainable Production Practices and Low-emission Technologies in Prioritized Sectors',* called Biovalor, implemented between 2014 and 2020 by the Ministry of Industry, Mining and Energy of Uruguay, in partnership with the Ministries of Environment, and Livestock, Agriculture and Fisheries, with support from the United Nations Industrial Development Organization and funding from the Global Environment Facility.

21. http://monitorcdn.mvotma.gub.uy/images/medidas-cdn/28-FT-Residuos_SU.pdf

70% of urban solid waste is disposed of in CH_4 capture and burning sites

Regarding nutrient circularity, several actions, supported by the national government with international reimbursable and non-reimbursable funding, made it possible to develop circularity processes of effluents that reach more than 50% of the dairy farms in the Santa Lucia river basin with some process-improvement actions to minimize them.
These actions achieved a significant reduction in environmental liabilities in soil and water, while contributing to the reduction of greenhouse gas emissions.

Finally, the structural transformation of the power generation matrix allowed a 50% reduction in total power generation emissions compared to 1990.

The table below shows the sustained increase in electricity demand, which tripled between 1990 and 2017. On the other hand, there is a high and variable intensity of emissions in the 2004-2012 period, this is due to the fact that said increase in demand was covered with hydraulic sources in years of high hydrolicity (above average precipitation) and with fossil sources in years of low hydropower (below average precipitation), the latter having a very strong impact on emissions and generation costs. The sustained reduction in emissions from 2014 was achieved through the implementation of new measures promoting the incorporation of non-traditional renewable energies (wind, photovoltaic, biomass waste) in addition to generation based on traditional hydraulic sources.[22]

22. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Uruguay%20First/Uruguay_Primera%20Contribuci%C3%B3n%20Determinada%20a%20nivel%20Nacional.pdf

ELECTRICAL CONSUMPTION AND INTENSITY OF CO_2 EMISSIONS

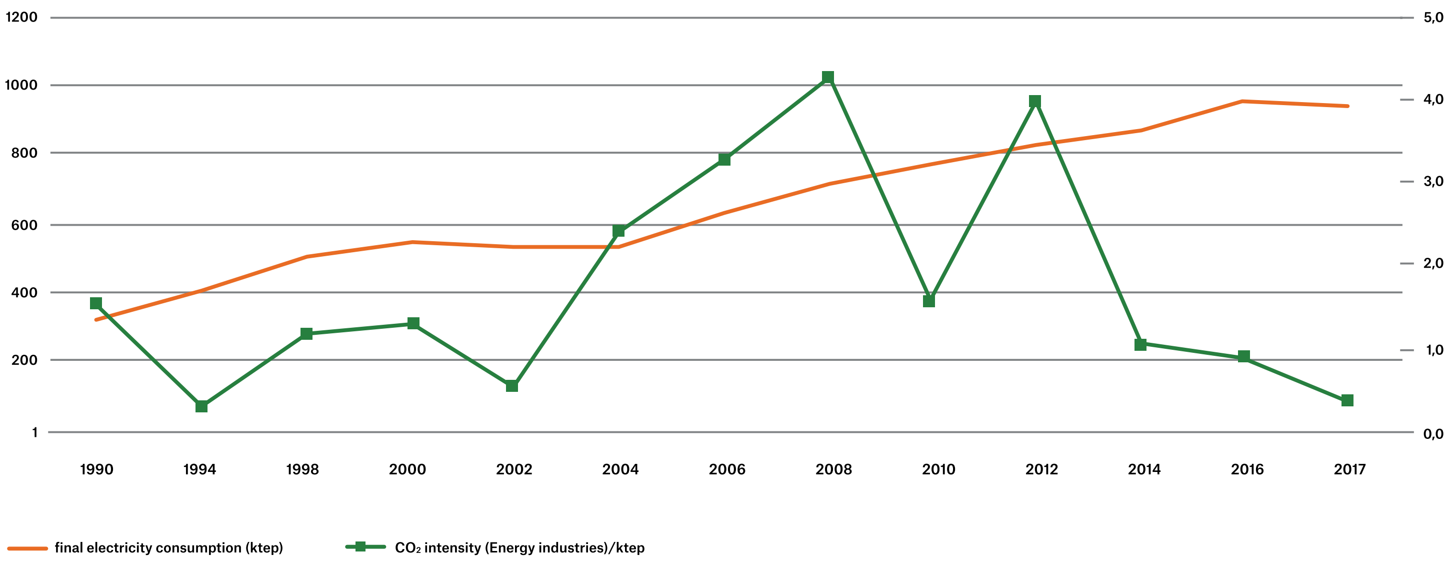


Image 5: Source: Own development based on 2017 NGEI in Third 2019 BUR and 2018 BEN.


02
URUGUAY'S PRIORITIES IN THE COMPRE


EHENSIVE DEVELOPMENT OF THE CIRCULAR ECONOMY AND CLIMATE ACTION

A COORDINATED AND ROBUST INSTITUTIONAL - POLICY FRAMEWORK

Uruguay is a republican country, based on the rule of law, that promotes the participation of civil society, the development of knowledge, and that is open to private national and international investment in a framework of clear and stable rules.

From this perspective, a wide and robust set of public policies for sustainable development has been developed in recent years; its main policies include climate action, energy, agricultural production and waste management.

Within the framework of these policies, effective and efficient State action is sought, as well as a proper coordination with the private sector to generate value and competitiveness in the national and the international market.

A coordinated institutional context is one of the keys to the design and implementation of public sustainability policies. In this sense, Uruguay has developed stable institutional arrangements for the coordination of environmental sustainability actions and policies, linking institutions in the production area with those working in environmental protection, enabling the creation of new integrative solutions.

An example of these institutional arrangements is the creation in 2009 of the National System for Climate Change Response and Variability (SNRCC), which has been the natural space for the coordination of climate policies, programs and action plans. The SNRCC gathers all relevant ministries, as well as provincial governments through the Congress of Mayors; it also includes other specialized public agencies. It has an advisory commission involving representatives of the academia, organized civil society and the business and production sectors.

The National Environmental System was created in 2016; this promoted the coordination of additional areas such as environmental protection, water and climate change to enable the joint work between ministries working on production and those involved in environmental protection and social action issues. More recently, in 2020, the Ministry of Environment was created, which is clear evidence of the importance given to the topic by the authorities.

In addition to these cross-cutting institutional arrangements, there is another relevant feature regarding sustainability policies at government level in Uruguay, and that is their almost unanimous acceptance by the political sector. Regardless of their connection to climate, energy, agriculture or waste, they receive broad support at the legislative level in the creation of laws, and at executive level through various multi-party agreements. This political-institutional reality makes it possible to state that environmental sustainability policies in Uruguay are State, long-term policies.

It is in this context that specific cross-cutting actions are developed, with the coordinated participation of various sectoral ministries, through a strong political and technical interaction. Since these actions are inspired in sustainability and include economic, social and environmental aspects, they cannot be carried out by a single ministry or sector, but require appropriate cross-cutting coordination.

There are several examples in Uruguay of previous international cooperation projects with environmental objectives based on these cross-cutting coordination processes; examples include: the Uruguay Wind Energy Program (PEEU), the Energy Efficiency Project, the Uruguay Biomass Electricity Production Project (PROBIO), the Towards an Efficient and Sustainable Mobility in Uruguay Project (MOVÉS) and more recently, the Biovalor Project, all funded by the GEF and showing tangible and strategic results regarding public policies.

The strategic strength of the Uruguayan public sector transformed these support actions, making them more than just scattered projects and activities; they became valuable tools to test real, strategic and lasting transformations in areas of opportunity for the sustainability of Uruguay in the medium and long term.

This idea to strategically direct these actions is based on Uruguay's strong commitment to being a leading and innovative country in the construction of sustainability solutions that generate results at the national level and also lessons at the international level, supporting the global environmental agenda, in climate, biodiversity, soils, waste, etc.

This approach also requires an appropriate partnership framework with international agencies to find new forms of cooperation and joint implementation based on local knowledge and capabilities, so as to maximize the effectiveness of funding, often scarce when compared to the magnitude of the global environmental challenges that developing countries must face.

In order to further analyze the link between circular economy and climate change, in the context of Uruguay's robust institutional framework, a summary of the main policies that frame and coordinate the actions carried out by the Biovalor Project is presented below.

URUGUAY'S INDICATORS

Rule of Law
***(Rule of Law Index 2018-2019)**:**
Uruguay ranks first in Latin America and 23rd in the world.

Democracy Index (2018):**
Uruguay is the first full democracy in Latin America and occupies position 15 regarding full democracies in the world.

Corruption Perception Index (2018)*:**
Uruguay ranks 23 out of 180 countries and ranks first in Latin America as a reliable country with the lowest corruption rates.

Human Development Index (2018)**:**
Uruguay ranked 55 out of 189 countries, with an index of 0.804.

Global Open Data Index
(Global Open Data Index)***:**
In 2015, Uruguay ranked No. 7 among 122 countries studied.

*Rule of Law Index. Produced by The World Justice Project. Available at http://worldjusticeproject. Org/sites/defaultfiles/documents/2019%20 WJP%20Rule%20of%20 LAW%2oIndex%20-%20GlobalESP_MR.pdf

**Democracy Index. Produced by The Economist Intelligence Unit. Available at http://www.eiu.com/topic/democracy-index

***Corruption Perceptions Index: Produced by Transparency International. Available at https://transparency.org/cpi2018

**** Human Development Index. Prepared by the United Nations available at https://www.uy.undp.org/content/uruguay/es/home/presscenter/articles/2018/09/Uruguay-actualizacion-IDH-2018.html

**** Global Open Data Index. Available at https//index.okfn.org/

Source: Fifth National Communication Uruguay, MVOTMA-SNRCC 2019

CLIMATE POLICY

Uruguay is committed to the full implementation of the United Nations Framework Convention on Climate Change, the Kyoto Protocol and its Doha Amendment, the Paris Agreement, and the Kigali Amendment to the Montreal Protocol. Uruguay supports a multilateral solution to the challenges of climate change, and in this regard, it has always been a leader in fulfilling its obligations under these international instruments.

At the domestic level, the National Policy on Climate Change (NPCC)[23] was adopted in 2017; this policy aims to *'promote adaptation and mitigation in Uruguay in the face of the climate change challenge.'* The NPCC designed a strategy to *'promote integrated solid waste and wastewater management to reduce greenhouse gas emissions based on the concept of management hierarchy and circular economy, and the participation of the different levels of government.'*

It also shows two lines of action regarding waste: *'i. To encourage comprehensive management models that promote circular economies and the concept of waste management hierarchy, taking into account the reduction in greenhouse gas emissions; and ii. To promote the inclusion of low-greenhouse-gas technologies into urban, industrial and agricultural solid waste treatment and disposal systems and into domestic, industrial and agricultural wastewater treatment systems.'*

Also in 2017, Uruguay adopted and presented the Paris Agreement with its first Nationally Determined Contribution (NDC), being one of the first countries to revise its planned NDC from 2015. In the first 2017 NDC, Uruguay sets several targets to reduce emissions intensity in Decree of the Executive Branch No. 310/017 approving the National Climate Change Policy and the first Nationally Determined Contribution https://www.impo.com.uy/bases/decretos-originales/310-2017 connection with the GDP and beef production, as well as the maintenance and expansion of carbon stocks in forests, soils and wetlands.

23. Decree of the Executive Branch No. 310/017 approving the National Climate Change Policy and the first Nationally Determined Contribution https://www.impo.com.uy/bases/decretos-originales/310-2017

The main aggregated mitigation targets will allow Uruguay to reduce its greenhouse gas emissions intensity by more than 49% by 2025 compared to 1990. The NDC also included specific waste management measures, such as *'zero discharge'* technologies preventing effluents from reaching water bodies; nutrient recovery and circularity, as well as capture and CH4 burning actions at urban solid waste disposal sites.

Finally, during the Climate Action Summit convened by the UN Secretary-General in 2019, Uruguay committed to presenting a long-term strategy (LTS) to increase the capacity to adapt to the adverse effects of climate change and to promote climate resilience and low-emission development including an aspirational goal of CO2 neutrality by 2050.

Visit Uruguay's National Climate Change Policy:

Visit the first Uruguay Nationally Determined Contribution to the Paris Agreement:

THE ENERGY POLICY

Uruguay has no proven reserves of oil, natural gas or coal; these are non-renewable sources which together account for almost 85% of the primary energy consumed in the world[24] and are responsible for an estimated 77% of global greenhouse gas emissions[25]. Also, the country has reached its maximum potential for medium- and large-scale hydroelectric power.

Energy consumption has grown steadily, specifically to meet the needs of industry, as well as the transport or the residential sector. In this context, a long-term Energy Policy[26] was adopted by the Executive Branch in 2008. This comprehensive strategy includes a multidimensional approach not only featuring economic and technological elements, but also environmental, cultural, ethical and social.

Two years after its adoption by the Council of Ministers, a committee, composed of representatives of all political parties with parliamentary representation, endorsed all the policy's fundamental components. This resulted in a long-term strategy, with very broad support at the national level, that became an international example. This policy is based on four major strategic axes, short-, medium- and long-term goals, and a set of lines of action that ensure the timely achievement of objectives. The strategic axes define the role of the different actors while emphasizing the role of the State in the design and implementation of the energy policy, the diversification of the energy matrix with special emphasis on the incorporation of renewable energy, the promotion of energy efficiency and the recognition of universal and safe access to energy as a human right. The energy policy also addresses waste issues setting as a medium-term goal *'to strike a balance in the use of waste to generate energy.'*

24. https://ourworldindata.org/grapher/fossil-fuels-share-energy?tab=chart&time=earliest..latest&country=~OWID_WRL

25. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/fossil-co2-and-ghg-emissions-all-world-countries-0 pg 12: Global fossil CO2 emissions in 2018 increased by 1.9% to a total of 37.9 Gt CO2, pg 6: Anthropogenic GHG emissions are dominated by fossil CO2 emissions, and also increased steadily over the period 1990-2015 from 32.8 to 49.1 Gt CO2eq/yr, an overall increase of approximately 50%

26. http://www.eficienciaenergetica.gub.uy/politica-energetica

Visit Uruguay's Energy Policy:

SUSTAINABLE AGRICULTURAL PRODUCTION POLICY[27]

The Uruguayan economy is strongly dependent on agro-industrial chains, being the vast majority of the territory dedicated to agricultural activities. The country has comparative advantages in food production at global level. Agro-industrial exports account for approximately 80% of national exports.

Beef production based on natural grasslands, without deforestation, is a key example of sustainable food production alternatives. Livestock activity generates high-value products in international markets, while allowing a harmonious use of the grassland ecosystem, the most widespread in Uruguay, by taking care of its biodiversity, and even, under certain practices, enabling carbon sequestration in soils.

On the other hand, it is estimated that the current area of native forest is 835 thousand hectares,[28] 4.8% of the country's surface area. This proportion has remained relatively stable over the last few decades as a result of the implementation of the Forestry Law 15,939 of December 1987, which prohibits felling activities (with some exceptions); this makes Uruguay the only country in the region without significant deforestation of its native forest. Uruguay has also developed a soil policy, where agricultural production facilities larger than a specified size should

27. Text based on Uruguay's Third Biennial Update Report to the Conference of the Parties to the United Nations Framework Convention on Climate Change.

28. DGF-MGAP (2018). Cartografía Forestal Nacional.

submit land use and management plans; these should include land rotation and other management measures so that soil loss from erosion does not exceed a reference rate. This action currently covers approximately 1.5 million hectares contributing to nutrient fixation and a more sustainable production system.

Finally, special attention has been paid to dairy production, in particular in those dairy regions in the Santa Lucia river basin where more than 50% of dairy farms have had their processes improved to minimize effluents and improve the water quality of the river, the main source of drinking water for the metropolitan region.

Find more about the Sustainable Agricultural Policy at:

WASTE POLICY

Uruguay, for more than two decades, and within the framework of its general environmental policies, has developed new public policy instruments for waste management. Several regulatory frameworks were defined, for packaging[29] in 2004, industrial waste[30] in 2013, and plastic bags[31] in 2018.

Then in 2019, a new law for the comprehensive management of waste[32] was implemented; this law acknowledges the possibilities of generating value from waste. In particular, it defines waste valorization as the *'set of actions whose objective is to recover one or more specific waste components, including their calorific value. Recovery includes preparation for reuse, recycling and energy recovery.'* More specifically, it refers to energy valorization as the *'use of a waste component in order to take advantage of its calorific value.'*

The law explicitly states that *'waste management plans should look into solutions to mitigate and adapt to climate change and the diversification of the national energy mix.'* It also gives priority, within public and private action plans, to *'the valorization of waste to be reused or reconverted into recycled raw material, or to replace traditional fuels in the generation of energy, compost, or other products, among other purposes.'*

The law also promotes recycling and sets guidelines for its implementation. Finally, it explicitly includes the possibility for a waste product to change categories when subjected to some recovery operation; it also creates a new category, byproduct, both essential concepts for circular economy schemes.

Learn more about the Comprehensive Waste Management Act:

29. https://legislativo.parlamento.gub.uy/temporales/leytemp5685410.htm

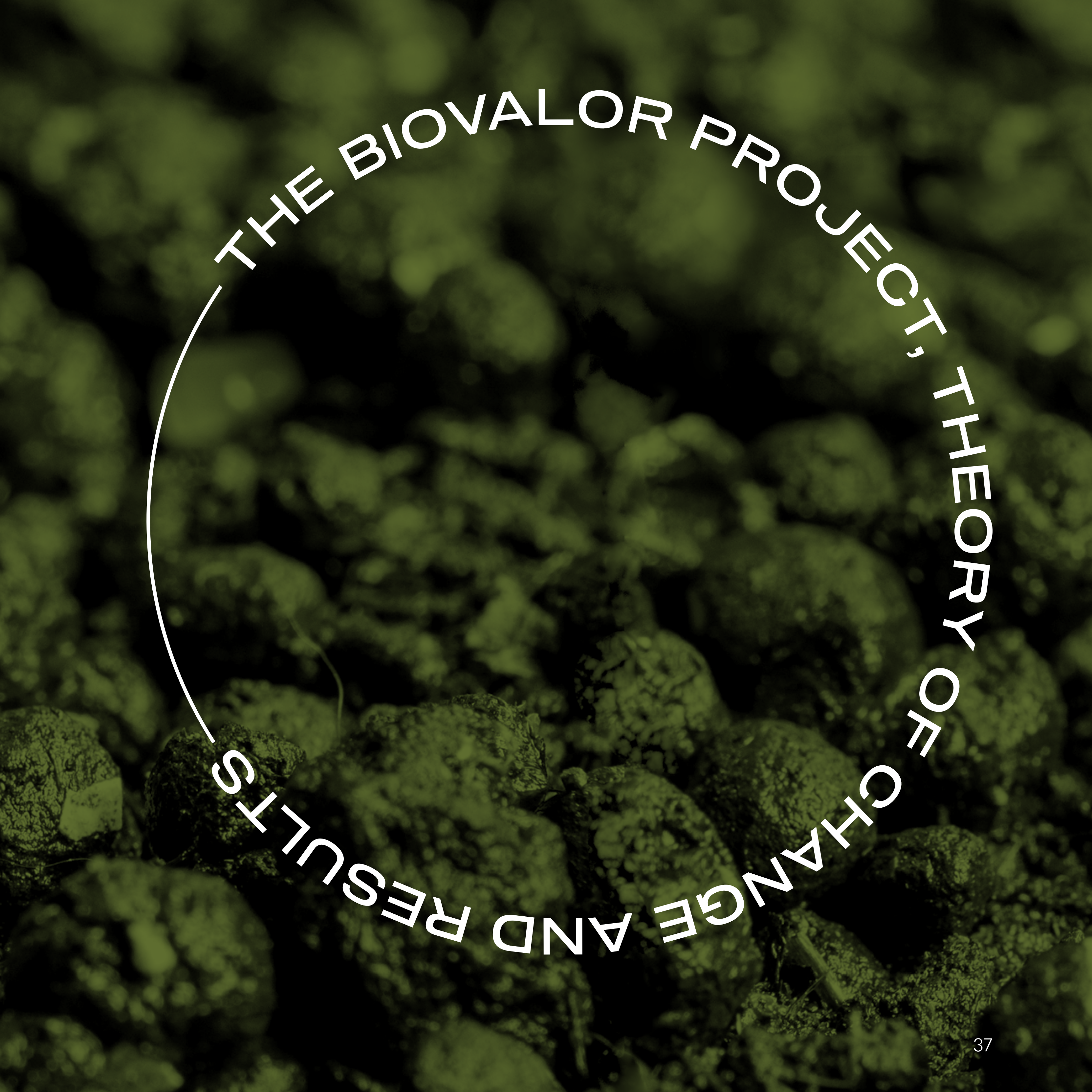
30. https://www.impo.com.uy/bases/decretos/182-2013

31. https://www.impo.com.uy/bases/leyes/19655-2018

32. https://www.impo.com.uy/bases/leyes/19829-2019#:~:text=%2D%20La%20presente%20ley%20tiene%20por,todas%20las%20etapas%20de%20gesti%C3%B3n


03

THE BIOVALOR PROJECT, THEORY OF CHANGE AND RESULTS



WHAT IS BIOVALOR?

The project *'Towards a Green Economy in Uruguay: Stimulating Sustainable Production Practices and Low-emission Technologies in Prioritized Sectors,'* called Biovalor, was implemented between 2014 and 2020 by the Ministry of Industry, Energy and Mining of Uruguay, in partnership with the Ministries of Environment, and Livestock, Agriculture and Fisheries with support from the United Nations Industrial Development Organization and funding from the Global Environment Facility.

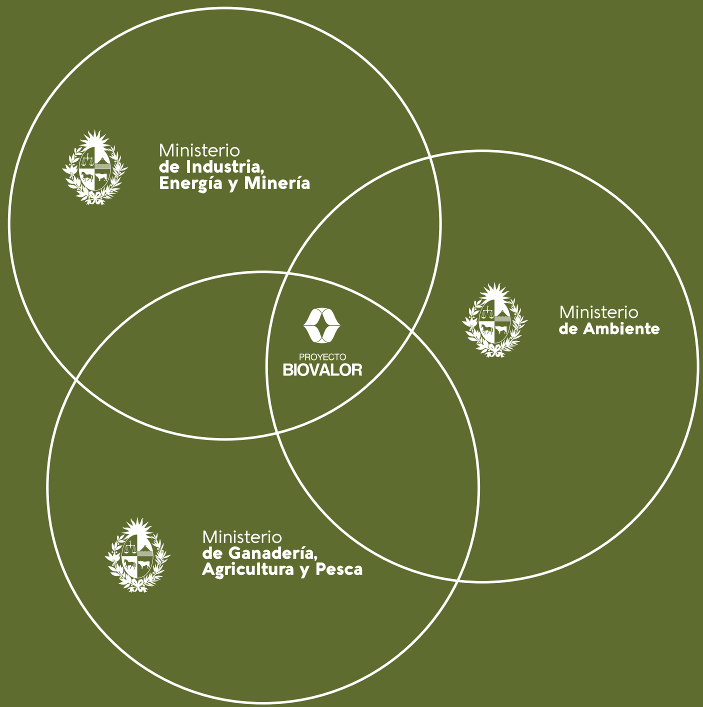
The project aims *'To transform the different types of waste generated in the agricultural sector and in agro-industrial production chains in Uruguay into different types of energy and/or byproducts to reduce greenhouse gas emissions, contributing to the development of a sustainable low-carbon model, supported by the development and transfer of appropriate technology.'*

The following is a diagram of the Theory of Change showing the links between the project's main objective, the Sustainable Development Goals, its components, and a justification for its implementation.

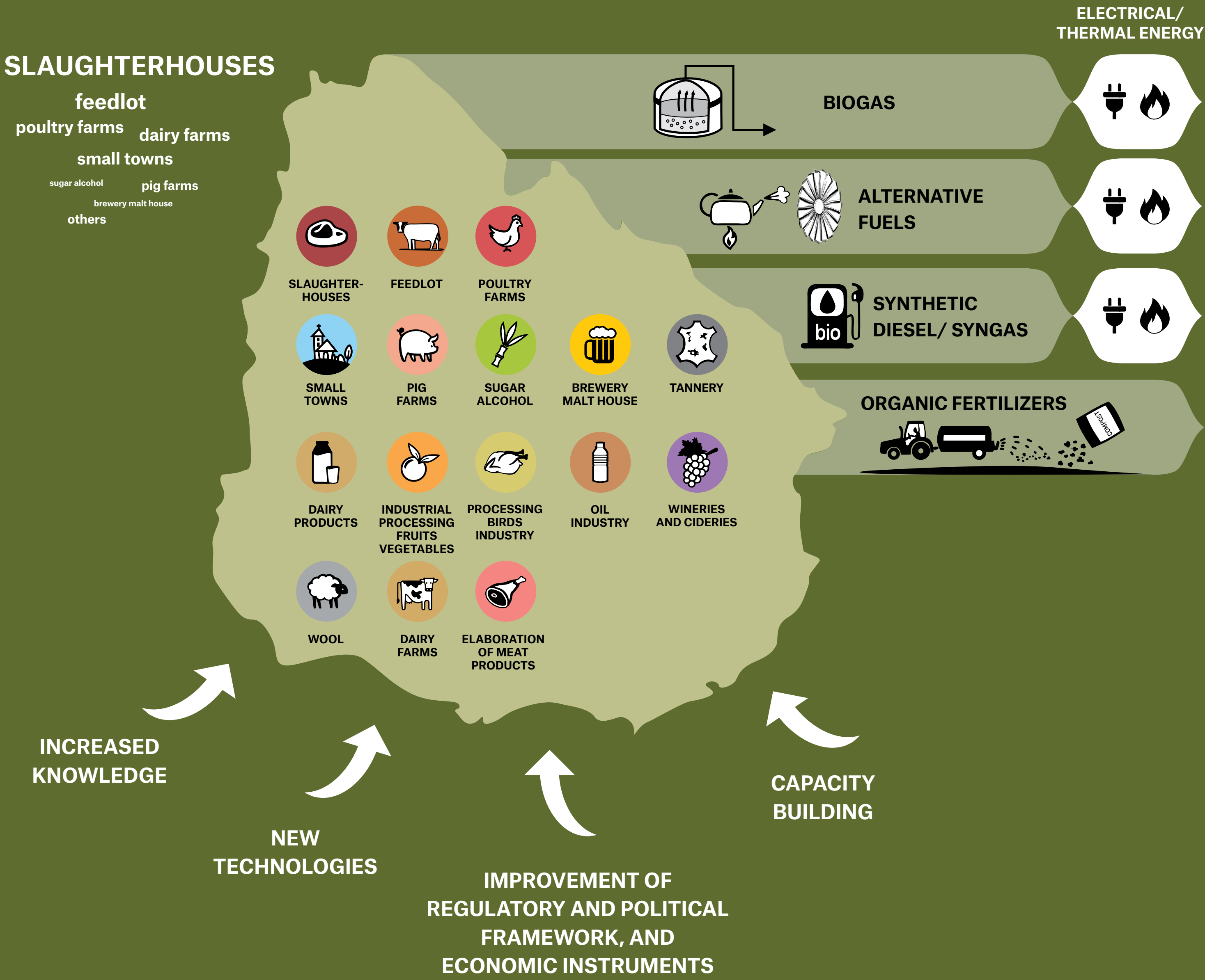
The project seeks to address the problem of agro-industrial waste generation and its impact on the environment. In this sense, Biovalor aims to demonstrate that waste valorization is a good environmental solution, and that it can provide business opportunities for the country's agro-industrial sector. The components of the project are designed to offer a comprehensive solution, both at the institutional and regulatory levels, and at the demonstration level with different pilots. The project's five components include: *'1. Strengthening policies and the regulatory framework;' '2. Strengthening the knowledge base (technological capabilities) in the field of waste-to-energy conversion, waste recovery and low-emission waste treatment;' '3. Demonstration of waste valorization and applications of renewable energy technologies;' '4. Capacity-building, training and dissemination campaign for the adoption of low-emission waste valorization initiatives;' and '5. Monitoring and assessment.*

Project actions were carried out considering the country's current needs and opportunities, strongly based on the strengths of local institutions, permanently seeking to generate and strengthen alliances between public institutions, business associations and academia. Apart from the objectives originally set, the Biovalor Project played an important role by pushing the topic of the circular economy up on the national agenda. Lastly, it is important to note that the project responds to the 2030 Agenda for Sustainable Development through SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure) and SDG 13 (Climate Action).

Visit the Biovalor Project site on the GEF page:



SECTORS GENERATING WASTE AND EFFLUENTS
Preliminary data



IMPACT

INCREASED SUSTAINABILITY IN AGRO-INDUSTRIAL PRODUCTION SYSTEMS IN URUGUAY

RESULTS

Increased competitiveness of the productive sector (SDGs 9 and 12)

→ Increased innovation in clean technologies for the productive sector

→ Increase in the number of companies specialized in organic waste management

→ Adaptation of the national regulatory framework to achieve sustainability of productive systems

Environmental Sustainability of Productive Systems (SDG7, SDG13)

→ Reduction of CO_2 emissions / 2,150 ton CO_2 eq/year

→ Reduction of ecosystem pollution by organic waste 100,000 ton/year of valorized waste

CATALYTIC PRODUCTS

Circular economy on the public and private agenda.

Promotion of valorization technologies for low CO_2 emission waste.

New regulations and incentives for companies adopting technologies.

The private sector co-financing clean technologies and new sustainable business models.

Network of technical and academic institutions with proven capabilities at the national level.

Low-emission technologies available and potentially adaptable to the reality of local production.

Private sector willing to improve productive systems sustainability.

The Uruguayan government’s commitment to promoting sustainability of productive systems Country brand: 'Uruguay Natural'.

COMPONENTS

Development of pilot projects, technology testing and promotion of new companies:

8 demonstration projects:
→ Biogas production.

→ Development of alternative fuels.

→ Composting and organic fertilizers plants.

→ Production of edible bones for pets.

Program support: + USD 600,000
Private Investment: + USD 1,700,000

Development of regulatory framework and institutional capacities:

→ Marketing registration for organic amendments.

→ VAT exemption to clean technologies.

→ Circular Opportunities Program (project implementation and validation of ideas, 48 projects).

→ Co-creation of Circular Economy National Plan.

Technical products and analysis:

→ +15 technical, and technical-economic feasibility documents for technologies.

→ 13 Data sheets characterizing waste and technology.

→ Geo-referenced waste viewer.

Training and shared knowledge:

→ Nutrient Circularity Program.

→ Academic Thesis Support Program.

→ First Latin American Forum on Circular Economy.

→ + 40 courses, training sessions and events in technical areas and circular economy.

→ Waste and emission potential valorization calculator.

CAUSES

Increased impact of organic waste in water courses and natural ecosystems Increased pressure on natural resources.
Intensification of production in the primary sector and agro-industrial chains.
Gradual increase in requirements by target markets for agricultural products.
To continue diversifying the national energy matrix using renewable sources.

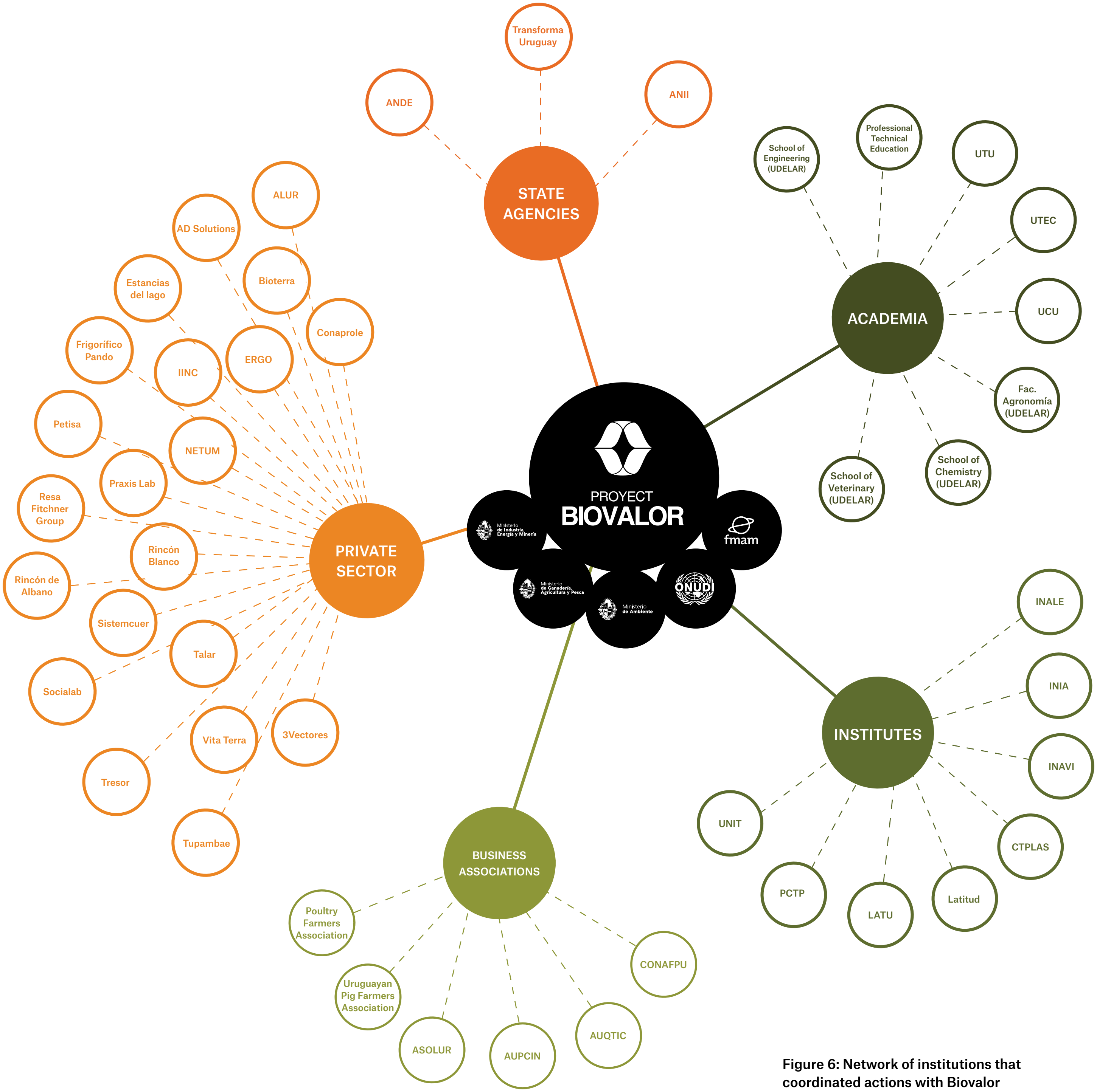


Figure 6: Network of institutions that coordinated actions with Biovalor

BIOVALOR TRAJECTORY AND ARTICULATION

PROJECT LAUNCH

NOV 2014

FIRST WASTE CHARACTERIZATION STUDIES

JAN 2015

OPEN CALL FOR DEMONSTRATION PROJECTS

MAR 2016

REGULATIONS FOR THE REGISTRATION OF ORGANIC AMENDMENTS AND EQUIPMENT TAX EXEMPTION

JAN 2018

AGREEMENT WITH THE ACADEMIA CIRCULARITY OF NUTRIENTS

OCT 2018

CIRCULAR ECONOMY FORUM

SEP 2017

FIRST DEMONSTRATION IN OPERATION

DEC 2017

PROGRAMA OPORTUNIDADES CIRCULARES

PROGRAM LAUNCH

APR 2018

Plan de acción en ECONOMÍA CIRCULAR en Uruguay

PLAN CO-CREATION WITH DIFFERENT SECTORS

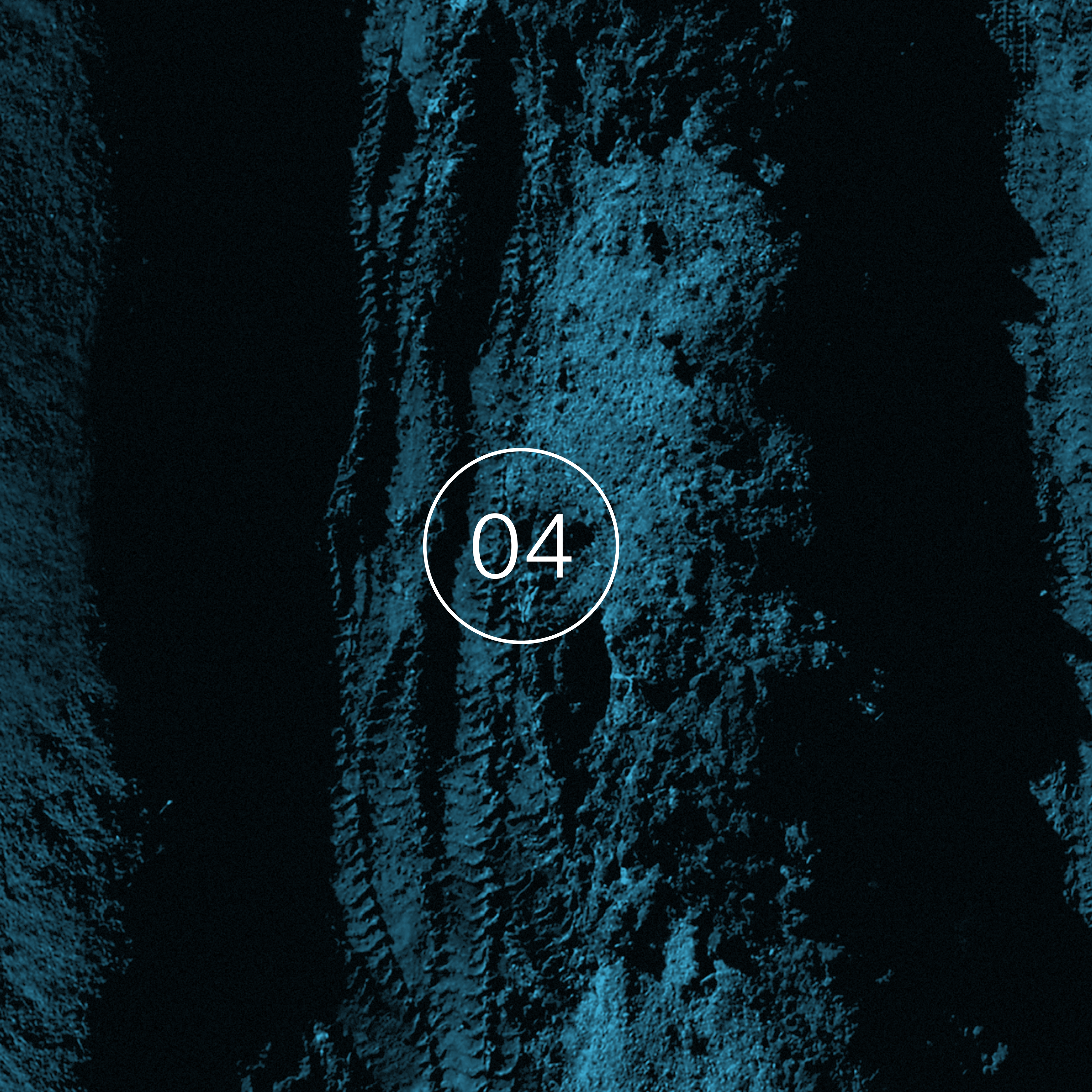
NOV 2019

YOUR THESIS WITH BIOVALOR

NOV 2019

7 DEMONSTRATION PROJECTS IN OPERATION

NOV 2019


04

IMPACT OF DEMONSTRATION PROJECTS

The development of demonstration projects is one of the main implementation strategies of the Biovalor Project. These initiatives, in addition to achieving direct emission reductions, made it possible to make substantial progress on the productive transformation agenda, generating evidence of new technologies and their possible local adoption. Several of these projects also involve a significant reduction in the technological risk perceived by local stakeholders.

The demonstration projects were identified in an open and competitive process. Relevant private-sector stakeholders identified opportunities for the technological improvement of their production processes in order to minimize and exploit agricultural waste, and minimize emissions. These competitive calls also made it possible to identify innovation leaders, as well as to empower and engage the participating private stakeholders.

Demonstration projects involve a full-scale test developed jointly with the private sector, based on co-financed investment and coordinated technical development. The project generated permanent technical support, which enabled the development of data, knowledge and alternatives to implement the most efficient solutions in various value chains.

In this regard, it developed an emission reduction calculator based on the experience to be used by other organizations in the sector.

Together, the demonstration projects allow the annual treatment of nearly 100,000 tons of waste, as well as a reduction of more than 2,100 ton CO2eq of greenhouse gas emissions. Biovalor contributed with more than USD 600,000, with the private sector doubling efforts and investing more than USD 1.7 million.

Some of the key lessons learned during the implementation of demonstration projects involved the identification of existing barriers in technology, marketing or public policies. These lessons are also important to accelerate the necessary changes in public policies regarding climate, energy, sustainable agricultural production, and waste management.

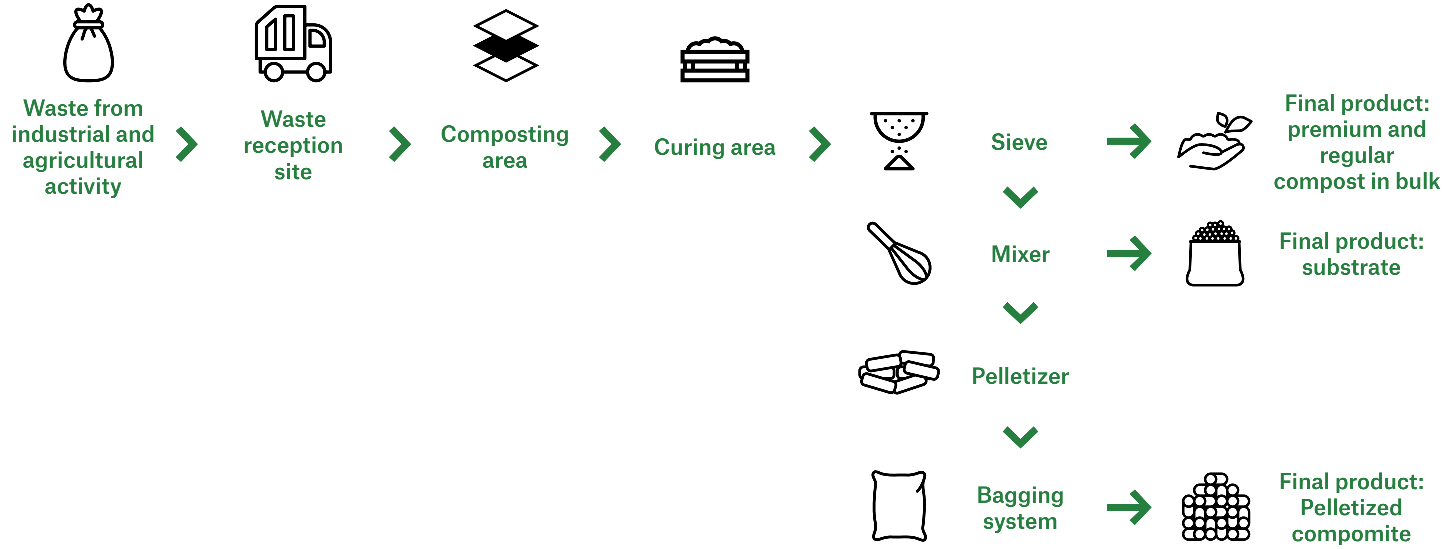
The following is a brief overview of some of the demonstration projects implemented, including their main technical features, lessons learned, and results in terms of emissions and waste reduction, as well as other key sustainability indicators.

WASTE OPERATOR - BIOTERRA

Production of compost and pelletized organomineral fertilizers from organic waste

Types of waste	Refrigeration waste, industry oilseed, municipal pruning and other agro-industrial waste.
Main investment	Compost pelletizing line and substrate formulation
Investment amount	USD 246,867 / 45% financed by Biovalor Project
Waste quantity	18,000 ton/year (wet base)
Emission reduction	555,853 kg CO2 eq/year
Number of employees	28
Green jobs created from project	2

Thanks to the demonstration project, the company was able to produce nutrient-enriched compost pellets and substrate. By adding value to the compost, it expanded its business portfolio supplying new markets and increased revenue.



Lessons learned from the three composting-related demonstration projects:

→ Composting plants generate revenue mainly from waste management services (65 to 97% of the total) and from the sale of compost.

→ The use of self-propelled turning technology greatly increases process efficiency, considering infrastructure, time, and volume of production.

→ Scaling-up poses challenges regarding the management of environmental aspects such as odor generation, which must be handled properly.

→ Value addition opens new markets for compost as the enriched pellet solves the issue of transportation to distant markets.

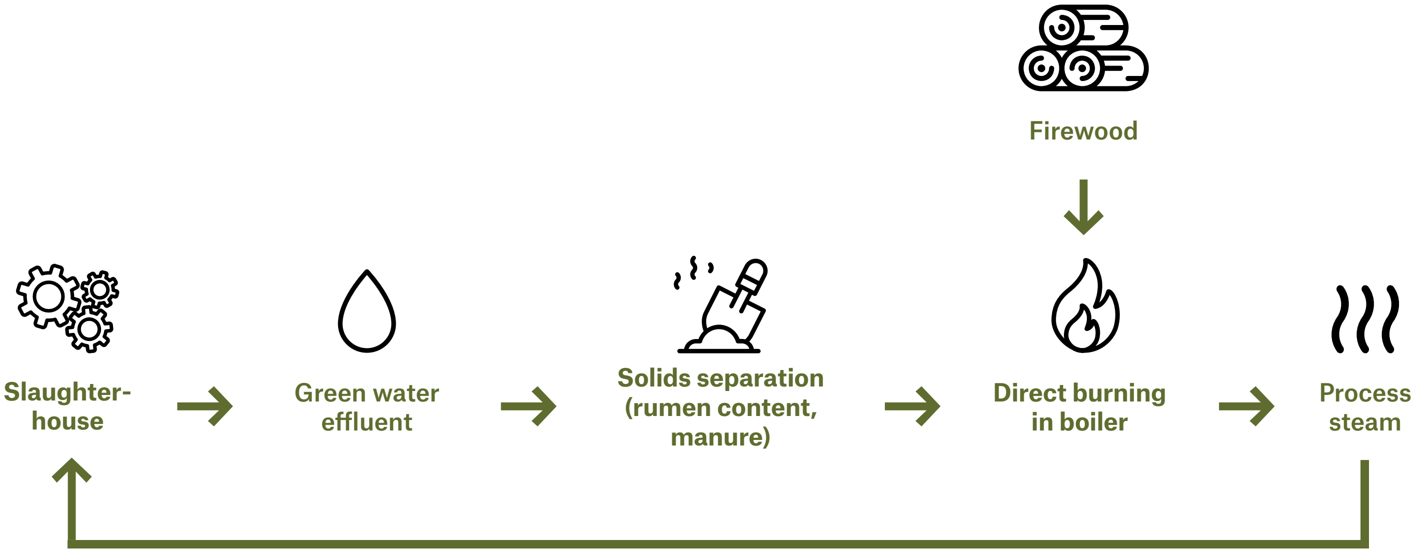
→ The compost market has potential to grow, but there is work to be done to drive demand for compost and show the benefits of its use on soil and production.

ONTILCOR SLAUGHTERHOUSE

Energy valorization of rumen content waste

Types of waste	Rumen contents
Main investment	Rumen boiler and feeding system.
Investment amount	USD 921,000 / 8% financed by Biovalor Project
Amount of waste managed by the project	5,280 ton/year (wet base)
Emission reduction	446,516 kg CO_2 eq/year
Number of employees	800 (own and outsourced)

After the demonstration project, the company managed to eliminate rumen waste by using it as an alternative fuel in its new boiler, this partially replaces the purchase of firewood for thermal use, lowering operating costs.



Lessons learned:

→ Rumen contents, a characteristic waste in slaughterhouse operations, can be incorporated into combustion systems for its thermal utilization, becoming an important replacement for firewood. This is a suitable way to manage and valorize waste; it saves firewood, and it increases waste use.

→ Of the more than 15,000 ton/year (dry base) of rumen content waste (green water solids) generated, approximately 5,000 ton/year (dry base) could be used as alternative fuels in direct burning systems, according to the characteristics of the existing facilities.

→ To successfully implement this type of system, it is important to have a comprehensive system design and not just a simple adaptation of existing capabilities.

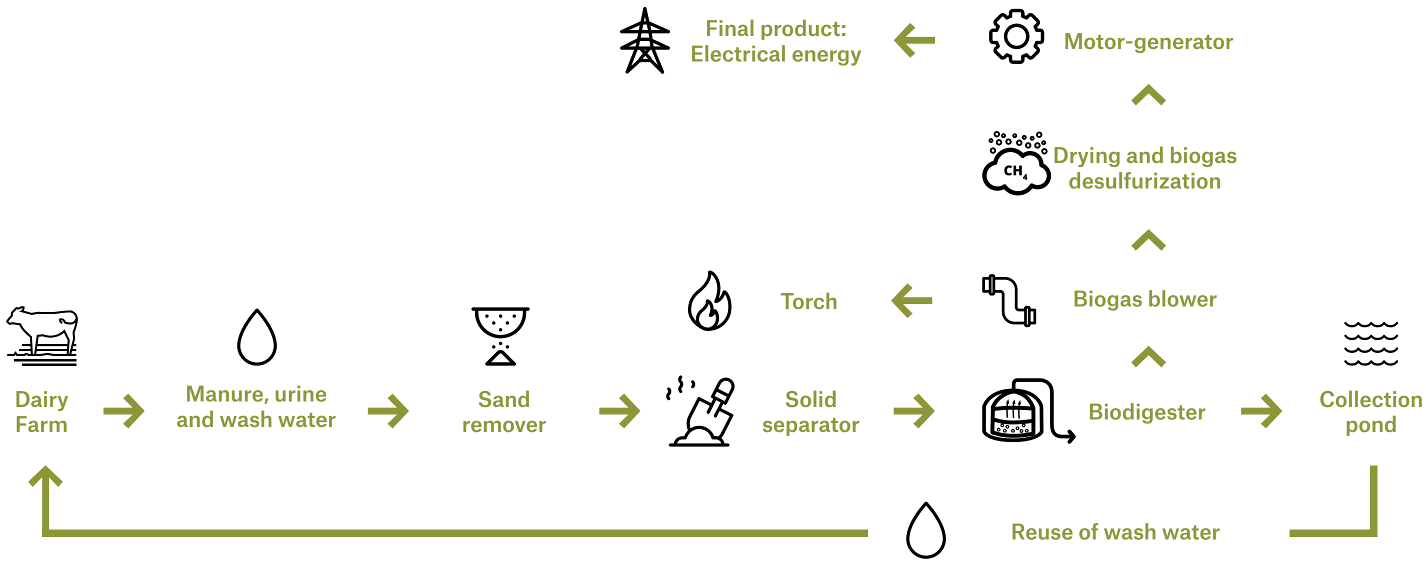
→ This project is of very high replicability, due to the large number of industries in the sector, their energy need, and the problems caused by the management of the rumen content waste.

DAIRY FARM RINCÓN DE ALBANO

Biogas electricity generation from dairy farm waste.

Types of waste	Manure, urine and wash water
Main investment	Biodigester and motor-generator
Investment amount	USD 290,000 / 38% financed by Biovalor Project
Amount of waste managed by the project	23,725 ton/year (wet base)
Emission reduction	276,389 kg CO2 eq/year
Number of employees	10

Through the demonstration project, the company managed to treat the effluents of its dairy farm. Dairy farm effluents are one of the main sources of water quality issues in the Santa Lucía river basin. Effluents are processed by methanogenic organisms in a temperature-controlled biodigester, generating biogas that is burned to generate electricity for dairy farm needs and providing surplus to the national electricity grid.



Lessons learned:

→ It is possible to have a 'circular' dairy farm model, in which all generated waste is used in the premises and electricity from biomass is generated in a micro-generation scheme. This allows the business model to diversify (by producing dairy products and energy) strengthening the sector and improving its resilience. It also promotes sustainable milk production which may represent a competitive advantage in the market.

→ The installation of biogas plants on dairy farms becomes attractive in large-scale production (+500 cows). In the industrial sector (i.e. dairy or beef) or in the intensive pig farming, the incorporation of this technology could be achieved in a feasible and more attractive way.

→ At the public policy level, encouraging investment in biodigesters is an interesting approach as it is one of the few options that reduces greenhouse gas emissions in pastoral-system dairy farms, being a good option for reducing the pollutant load to water bodies. Also, biogas, as a source of renewable energy, allows its easy storage and injection into the grid when most convenient for the system. This is an advantage compared to other renewable energy sources such as solar or wind energy that depend on climate factors.

SISTEMCUER TANNERIES

Production of leather dog toys from fresh leather scraps

Types of waste	Fresh leather scraps
Main investment	Industrial meat mincer, containers, working equipment
Investment amount	USD 65,000 / 80% financed by Biovalor Project
Waste quantity	30 ton/year (wet base)
Emission reduction	38,900 kg CO_2 eq/year
Number of employees	10
Green jobs created from project	3 (3 more projected)

The demonstration project encouraged the company to develop a new commercial product using its own leather waste. In this new line, previously-discarded, fresh leather scraps are now treated and bleached to manufacture toys that are then dried. The final product is competitive, allowing the company to diversify and increase revenues.

Lessons learned:

→ For very small companies, with few funding options and who cannot assume the risk of investing in innovation, having non-reimbursable financial support, as the one provided by the Biovalor Project, makes project implementation possible. This investment positively impacted on the company's turnover and the generation of employment.

→ While non-refundable financial support showed positive results in this case, it is important to develop other flexible financial instruments, such as collateral and concessional loans.


05

BIOVALOR PROJECT'S CROSS-CUTTING ACTIONS

The Biovalor Project simultaneously worked on three different areas: with the public sector in the institutional and regulatory framework, with academia in research and knowledge generation, and with the private sector in project development and support; specific examples are provided below.

INSTITUTIONAL, REGULATORY AND PUBLIC POLICY DEVELOPMENT

One of Biovalor's areas of action was the institutional, regulatory and public policy framework. Lasting and strategic transformations require specific examples of alternatives, such as demonstration projects, but at the same time they require a modernized, strengthened and developed *'enabling framework,'* especially in the public sector to bring about aggregated, profound and sustainable changes over time.

The project actively worked on the development of the circular economy institutional ecosystem, which included areas of the public sector and its specialized agencies and institutes, but also of the private sector and academia, generating new coordination spaces for innovation. Regarding the regulatory and policy framework, it contributed to the generation of technical knowledge and support for transformational practices, which could provide evidence for and accompany its development. More specifically, the project was actively involved in a new regulatory framework for organic fertilizers and accompanied the design of a circular economy national plan and second-generation measures for the Santa Lucia effluents action plan. The main transformations achieved in the institutional and regulatory enabling framework are presented below.

I. Strengthening the institutional ecosystem for the circular economy

The Biovalor Project was implemented in a context of strong inter-institutional coordination in environmental sustainability policies and actions. This context promoted a coordinated approach to the strategic and daily management of the project.

In this regard, the project promoted the creation of two specific areas of coordination, the first one represented by the project's Steering Committee and Technical Committee, where the political directors and technical officials of the three ministries involved in the project, MIEM, MA and MGAP, constantly interacted with UNIDO and the project coordinators to ensure not only a coordinated implementation based on the needs and objectives of the ministries involved, but also the development of new circular economy policies and actions.

Secondly, the project showed constant concern for increasing the circular economy public and private institutional ecosystem. More specifically, the project directly interacted with more than 35 public, private and academic institutions, all of which created a true network of knowledge and action in circular economy enhanced by Biovalor; this interaction was based on knowledge exchange, technical cooperation and sometimes even financial cooperation.

II. Transformation in the regulatory framework of organic fertilizers

Given the clear involvement of the Biovalor Project in the three ministries, one of its main areas of work and transformation was the development of regulatory frameworks. One experience to be highlighted is the introduction of regulations on organic inputs for agricultural use, a hoghly effective strategy for the reduction of organic waste, GHG emissions and improvements in other environmental aspects associated with agricultural production.

To this end, Biovalor and the MGAP's General Directorate for Agricultural Services (DGSA) actively worked in a technical definition based on the best available knowledge in the Uruguayan academia and the private sector. Support was provided for the drafting of a series of Ministerial Resolutions on the characterization, registration, control and marketing authorization for the agricultural use of new inputs developed from organic raw materials. The MGAP Resolution No. 97/018 prohibiting the marketing of organic inputs for agricultural use without MGAP's approval was passed in August 2018. It also included the definitions of *'composting,' 'compost,' 'organic amendment,' 'organic fertilizer,' 'organomineral fertilizer,'* among others. The resolution establishes the management of trademarks, registration administrative and technical requirements, as well as granting process and validity.

In October of that year, technical requirements and processing forms were developed for the *'organic amendments'* identified as Annex I through MGAP Resolution No. 141/018. Then, MGAP Resolution No. 536/019 approved technical requirements and processing forms for *'organic fertilizers'* identified as Annex II and *'organomineral fertilizers'* identified as Annex III. Furthermore, it is worth noting the support given to Executive Decree 11/020, by which companies involved in industrial or agricultural activities may be VAT-exempt in local purchases or machinery imports that mitigate or eliminate negative environmental impacts. In addition to being technically involved in the development of this particular regulatory framework, the Biovalor Project worked actively with the private sector to ensure that this framework was implemented, supporting the registration and compliance processes.

III. Contributions to the planning and programming of circular public policies

a. Circular economy action plan

Biovalor supported the implementation of the first plan of early actions on circular economy and waste valorization[33] within the Innovation component of the National Plan of Productive Transformation and Government-Driven Competitiveness. This early action plan brings together various public policy instruments, including training, technology and knowledge dissemination, seeking to boost companies and enterprises implementing circular initiatives and promoting waste valorization. Government agencies responsible for this project are: the former Ministry of Housing, Territorial Planning and the Environment, currently the Ministry of Environment, the Ministry of Industry, Energy and Mining; the Ministry of Livestock, Agriculture and Fisheries; and the Ministry of Economy and Finance.

Other partners participating in the project are: The National Agency for Research and Innovation (ANII); the Technological Laboratory of Uruguay (LATU), the National Development Agency (ANDE), Chambers of Business and Workers, the University of the Republic (UDELAR), the Technological University (UTEC), the Vocational School of Uruguay (UTU) and private universities, the National Agricultural Research Institute (INIA), the National Electric Utility Company (UTE) and the National Telecommunications Administration (ANTEL), among others.

During the project, the circular economy action plan[34] was formulated and validated in consultation with public, private and academic stakeholders. The plan is made up of seven lines of action that seek to boost circular economy in the country. The actions aim to improve the business climate, strengthen human and business capacities and develop innovation in different production chains with a focus on the circular economy. The actions identified are the following: *1. The Public procurement of food and food packaging with a sustainable perspective project; 2. Industry transition to the circular economy; 3. Design of a circular bioeconomics technological center; 4. Electric vehicles on demand for the public sector; 5. Nutrient circularity in dairy farms; 6. Capacity-building in circular economy; and 7. Material valorization.* Biovalor was key in the rapid preparation of the action plan and in the support provided to several of the proposed lines of action.

33. https://www.transformauruguay.gub.uy/es/visualizador-de-proyecto-detalle?id=7

34. Thanks to the country's significant progress in achieving an action plan in circular economy, Uruguay was invited, together with Brazil, Mexico and Chile to develop a regional project for the Climate Technology Center and Network (CTCN), with the support of the United Nations Industrial Development Organization, to strengthen regional capacities and support the creation of road maps in circular economy in these countries.

Find out more about Uruguay's circular economy action plan in the United Nations Partnership for Action on Green Economy (PAGE) initiative:

b. Alignment with the Environmental Protection of the Santa Lucia River Basin Action Plan:

In 2014, Uruguay experienced a critical event in its water treatment system for the metropolitan region; pollution levels increased in the Santa Lucia river's raw water source, raising concerns about water quality and productive and urban activities in the basin.

In response to this event, the action plan for the protection of the environmental quality of the Santa Lucia river basin was launched in 2015, and later updated with second-generation measures in 2019.

One of the main sources of nutrients reaching the river were those generated by dairy farms, which show a productive, economic and environmental fragility in relation to their effluents. New actions were established to reduce their effluent load; the MGAP developed a line of action by which support was provided to more than 50% of the dairy farms in the basin through internationally-funded projects. This support aimed to develop best practices and technological developments to reduce effluents and promote nutrient circularity within the farms, minimizing the impact on the environmental quality of the Santa Lucia river.

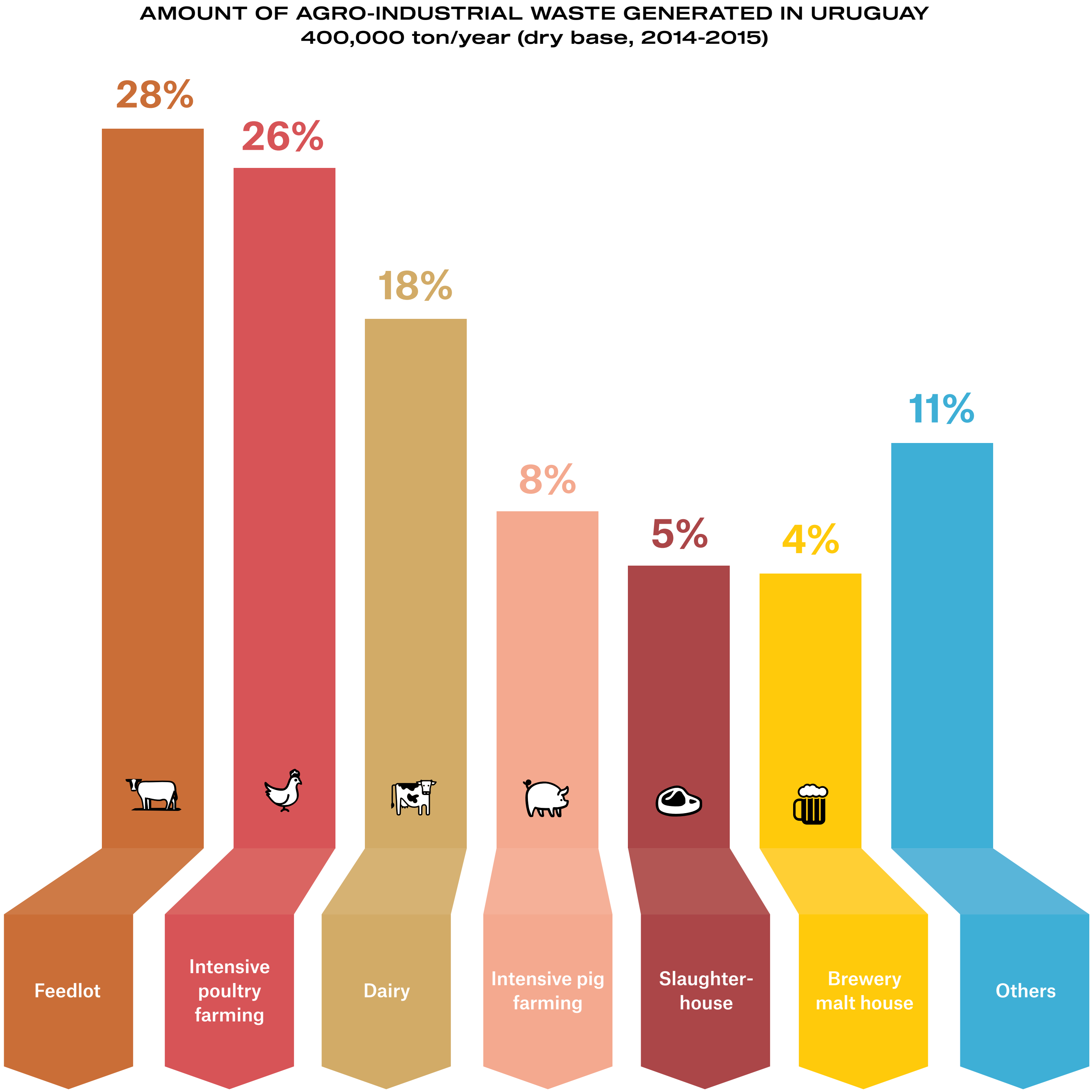
In addition to particular actions by some of Biovalor's demonstration projects (higher score awarded if implemented in some of the most affected basins), the project also provided knowledge for a technical and scientifically appropriate response to specific productive contexts. This coordination promoted the research project *'Circularity of Nutrients in Dairy Farms'* presented below.

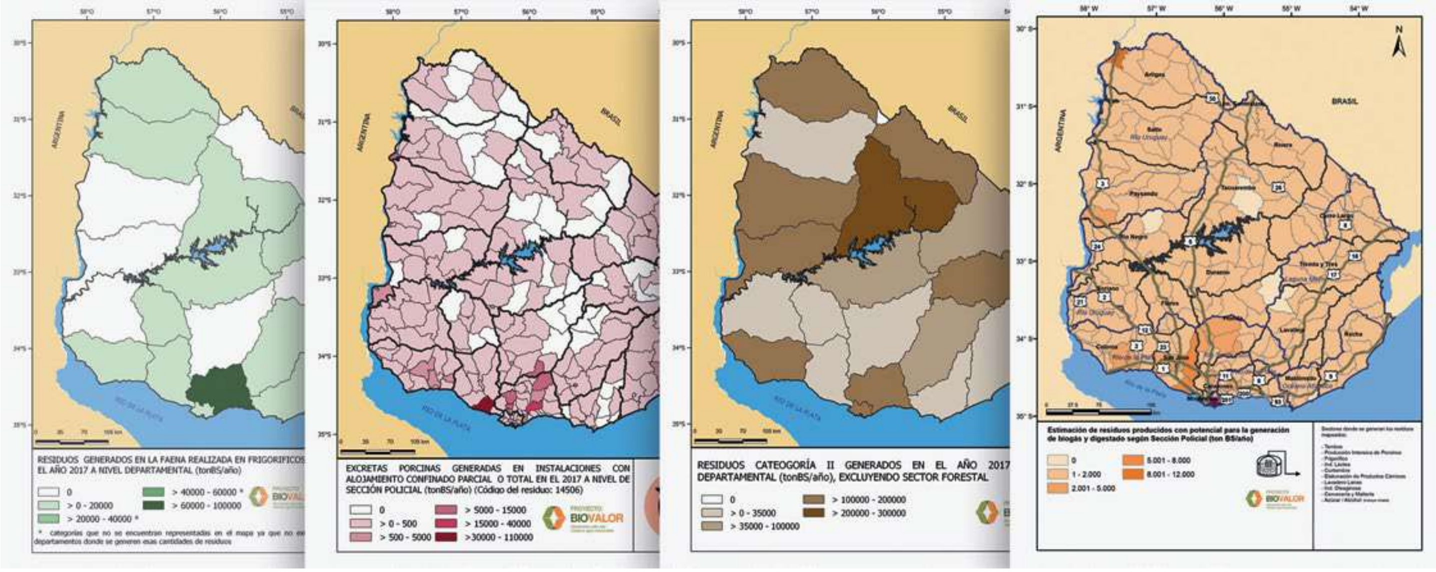
GENERATION OF INFORMATION AND KNOWLEDGE FOR PUBLIC AND PRIVATE DECISION-MAKING THROUGH ACTIONS COORDINATED WITH ACADEMIA

The generation of knowledge in coordination with academia was one of the pillars of the transformational process of the Biovalor Project. This allows not only the generation of new, relevant knowledge for decision-making and management, but also the development of national capacities and the improvement of the knowledge ecosystem and networks for public and private management.

Through a set of actions, members of the Uruguayan academia generated knowledge and at the same time acknowledged the value of the circular economy's approach to productive processes and environmental protection.
A fundamental aspect in the development of a policy framework is the generation of new information for decision-making, both at the public level for regulatory purposes and at the private sector level to set productive and investment objectives.

Biovalor developed high-quality information by working primarily with the academic and technical staff of the ministries and setting up an open data repository to generate new knowledge, as well as to improve management and decision-making in the public and private sectors.


AMOUNT OF AGRO-INDUSTRIAL WASTE GENERATED IN URUGUAY
400,000 ton/year (dry base, 2014-2015)
28%
26%
18%
8%
5%
4%
11%
Feedlot
Intensive poultry farming
Dairy
Intensive pig farming
Slaughter-house
Brewery malt house
Others



I. Agro-industrial Waste Geographic Information System

One of the project's outputs was the creation of a series of maps on agro-industrial waste in the country. These maps allow the improvement of the territorial management of such waste, for example, considering its impact on sensitive basins, or its relationship with logistics circuits, or as a basis for regional circular processes. Apart from making these maps available on its website, Biovalor incorporated their geographic information into the Geographic Information System (GIS) of the National Environment Observatory (OAN).

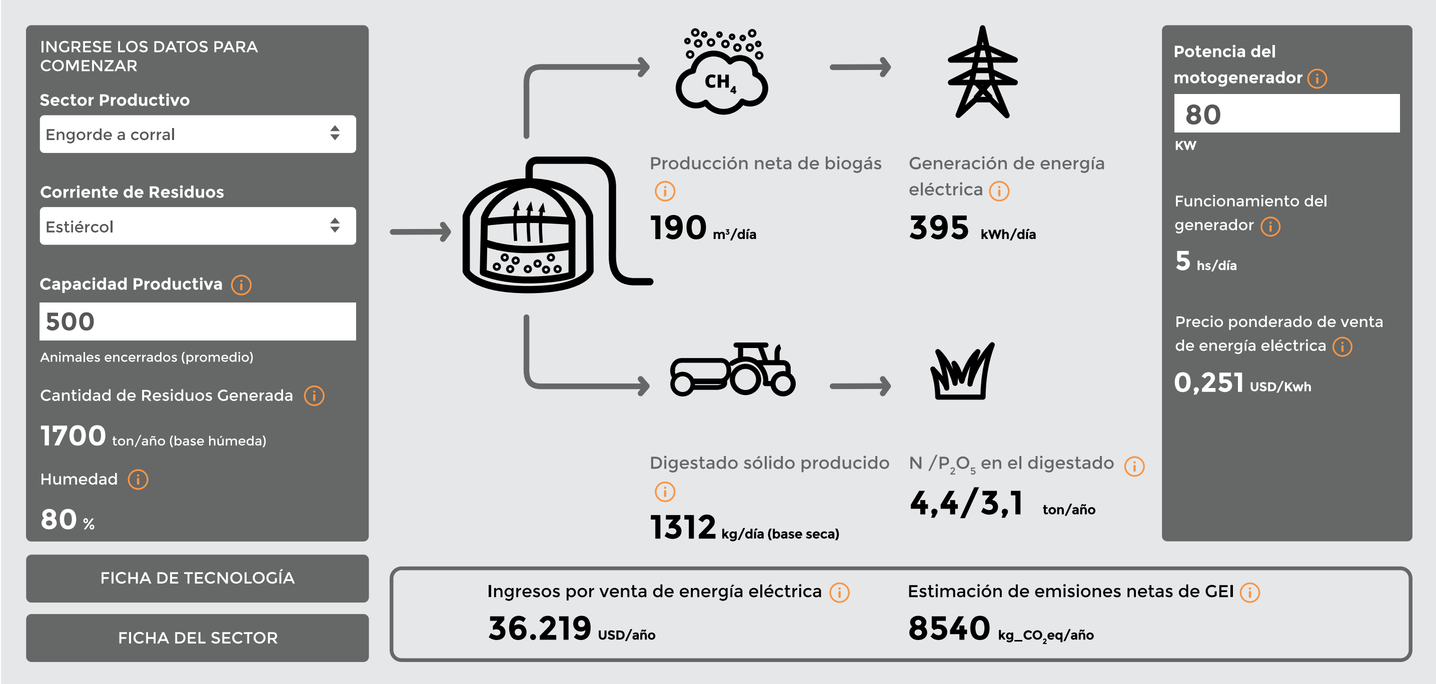
GIS, which is publicly accessible, allows users to perform environmental spatial analysis, allowing integration and comparison of several environmental variables, for example, the water quality of a particular river and the presence of certain types of agro-industrial waste in the area of influence.

Find out more about the Geographic Information System of the National Environment Observatory:

II. Waste valorization calculator

The waste valorization calculator is another strategic output for decision-making, especially in the private sector. The calculator, available on the web, allows the user to model four main valorization options: *electricity generation from biogas; thermal energy generation from biogas; composting; and alternative fuels based on agro-industrial waste.*

The calculator identifies GHG emissions, economic savings resulting from traditional fuel replacement, or revenue due to electricity generation. The estimates are made from 12 productive sectors and a series of possible waste streams and technological options.



Visit Biovalor Project's Calculator:

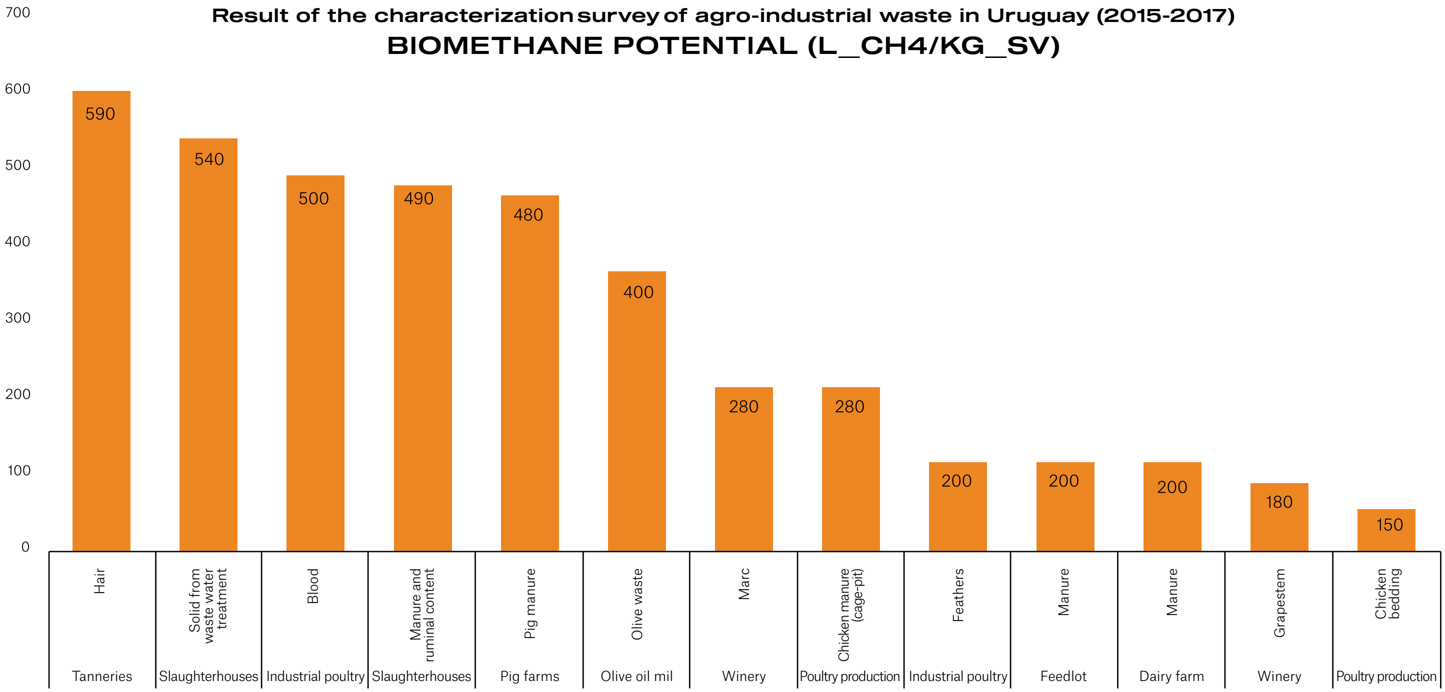
III. Technical data sheets and characterization of agro-industrial waste

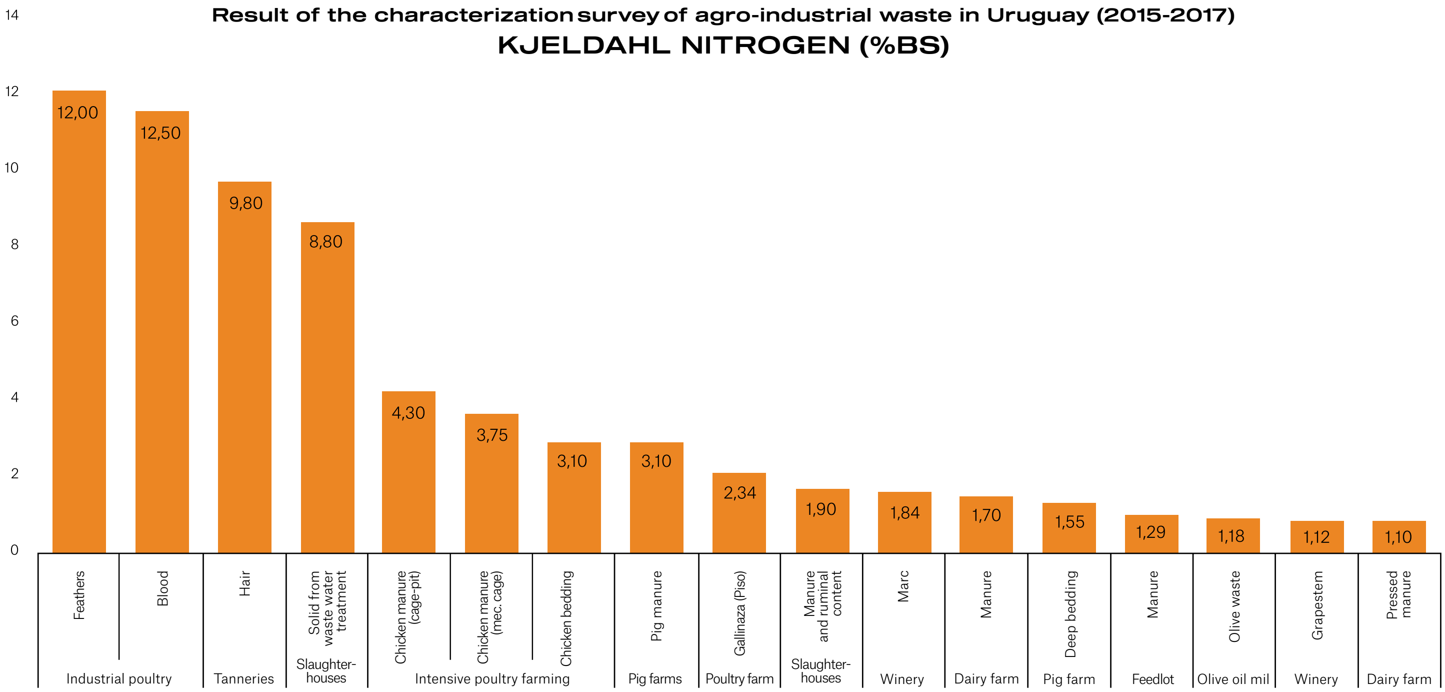
One of the main actions of knowledge generation was to diagnose the condition and sources of agro-industrial waste through an in-depth characterization study.

All waste characterization studies were jointly carried out with the academic sector to generate information to be included in the curricula of different academic courses.

Waste characterization includes the physicochemical description through 38 parameters of 18 waste types in the following productive sectors: *intensive pig farming; intensive poultry farming; dairy farms; feed lot; industrial poultry processing; olive oil production; wineries, tanneries and slaughterhouses.*

This information, together with the characteristics of each productive sector and the technologies used, is included in Technical Data Sheets that organize and identify waste recovery opportunities.


Result of the characterization survey of agro-industrial waste in Uruguay (2015-2017)
BIOMETHANE POTENTIAL (L_CH4/KG_SV)
700
600
500
400
300
200
100
0
590
540
500
490
480
400
280
280
200
200
200
180
150
Hair
Tanneries
Solid from waste water treatment
Slaughterhouses
Blood
Industrial poultry
Manure and ruminal content
Slaughterhouses
Pig manure
Pig farms
Olive waste
Olive oil mil
Marc
Winery
Chicken manure (cage-pit)
Poultry production
Feathers
Industrial poultry
Manure
Feedlot
Manure
Dairy farm
Grapestem
Winery
Chicken bedding
Poultry production


Result of the characterization survey of agro-industrial waste in Uruguay (2015-2017)
KJELDAHL NITROGEN (%BS)
14
12
10
8
6
4
2
0
12,00
12,50
9,80
8,80
4,30
3,75
3,10
3,10
2,34
1,90
1,84
1,70
1,55
1,29
1,18
1,12
1,10
Feathers
Blood
Industrial poultry
Hair
Tanneries
Solid from waste water treatment
Slaughter-houses
Chicken manure (cage-pit)
Chicken manure (mec. cage)
Chicken bedding
Intensive poultry farming
Pig manure
Pig farms
Gallinaza (Piso)
Poultry farm
Manure and ruminal content
Slaughter-houses
Marc
Winery
Manure
Dairy farm
Deep bedding
Pig farm
Manure
Feedlot
Olive waste
Olive oil mil
Grapestem
Winery
Pressed manure
Dairy farm

IV. Research and development in nutrients circularity in dairy farms

At the request of the MGAP, Biovalor coordinated the actions necessary to implement an inter-institutional, multidisciplinary research and development project gathering national dairy experts, academic staff, coordinators of the agro-industrial chain, and government officials.[35]

The objective is to study the economic, environmental and social impact of implementing different management systems of dairy farm effluents based on the use of nutrients, organic matter and water. The project is being implemented on four research dairy farms, where training is provided to technicians and operators and where speeches are directed to the productive sector.

It is a 3-year initiative, ending in 2022. The multidisciplinary team assesses the opportunity for improvement of the productive system, ensuring that the results promote the necessary cultural change. It is expected that the results achieved will determine whether an environmental liability, such as an effluent, can be transformed into a productive asset for the sector.

A central aspect of this project is that effluent treatment technologies are implemented full-scale to be analyzed and visited by dairy farmers. The possibility of experiencing the use of various technologies live reduces the farmers' uncertainty and risk perception of incorporating new technology to traditional production schemes.

35. School of Agronomy and School of Veterinary of the University of the Republic, the National Agricultural Research Institute, the Technical and Vocational Education Council - Technical Vocational School of Uruguay (CETP-UTU), the Technological University (UTEC), the National Dairy Institute (INALE), the MGAP, MA DINAMA and MIEM.

V. Research on the impact of compost use on fruit trees

Composting and its application to soil as an organic amendment generate positive economic and environmental results. In this regard, Biovalor, in conjunction with INIA, the MGAP's Farm Board (DIGEGRA) and MIEM's National Directorate of Energy (DNE) agreed to the implementation of a three-year research project to improve knowledge on the use of compost in fruit plantations during the implantation stage at the INIA 'Las Brujas' Experimental Station and in 3 private fruit farms; the project is to be completed in 2023.

National horticulture and fruit farming currently demand this type of product, which competes with other waste types and is often less competitive due to its higher price and VAT. One of the expected results of the research project is to know the impact of compost on the physical-chemical and biological conditions in which the plants grow, and to define this impact in economic terms. Obtaining this information in a reliable way is crucial to promoting public and private decision-making. In this regard, the information generated will be a useful tool for the development and implementation of the *'National Plan for the Promotion of Agro-Ecological Production,'* created by Law No. 19,717 in 2018 and coordinated and monitored by the Honorary Commission of the Plan.[36.]

VI. Support to undergraduate and postgraduate theses in circular economy

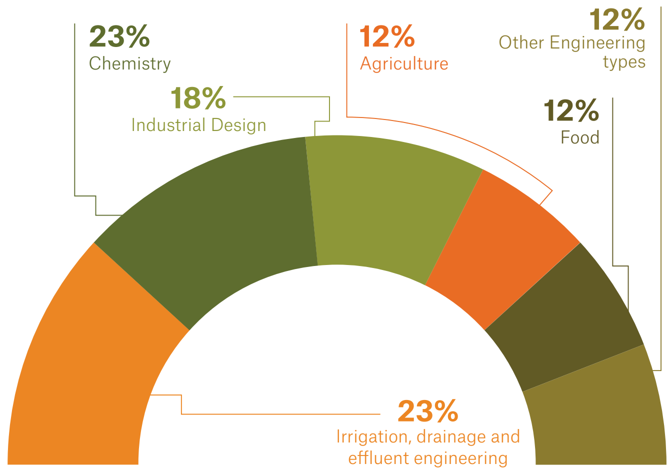
Finally, it is worth highlighting Biovalor's active work in the field of academic development through a call to support theses on circularity issues in conjunction with the UdelaR, UCUDAL, ORT, UTU and UTEC and in connection with the Pando Technology Hub (PTP).

Seventeen theses were selected; background information for academic analysis was provided as one of the strategies to improve their writing process.

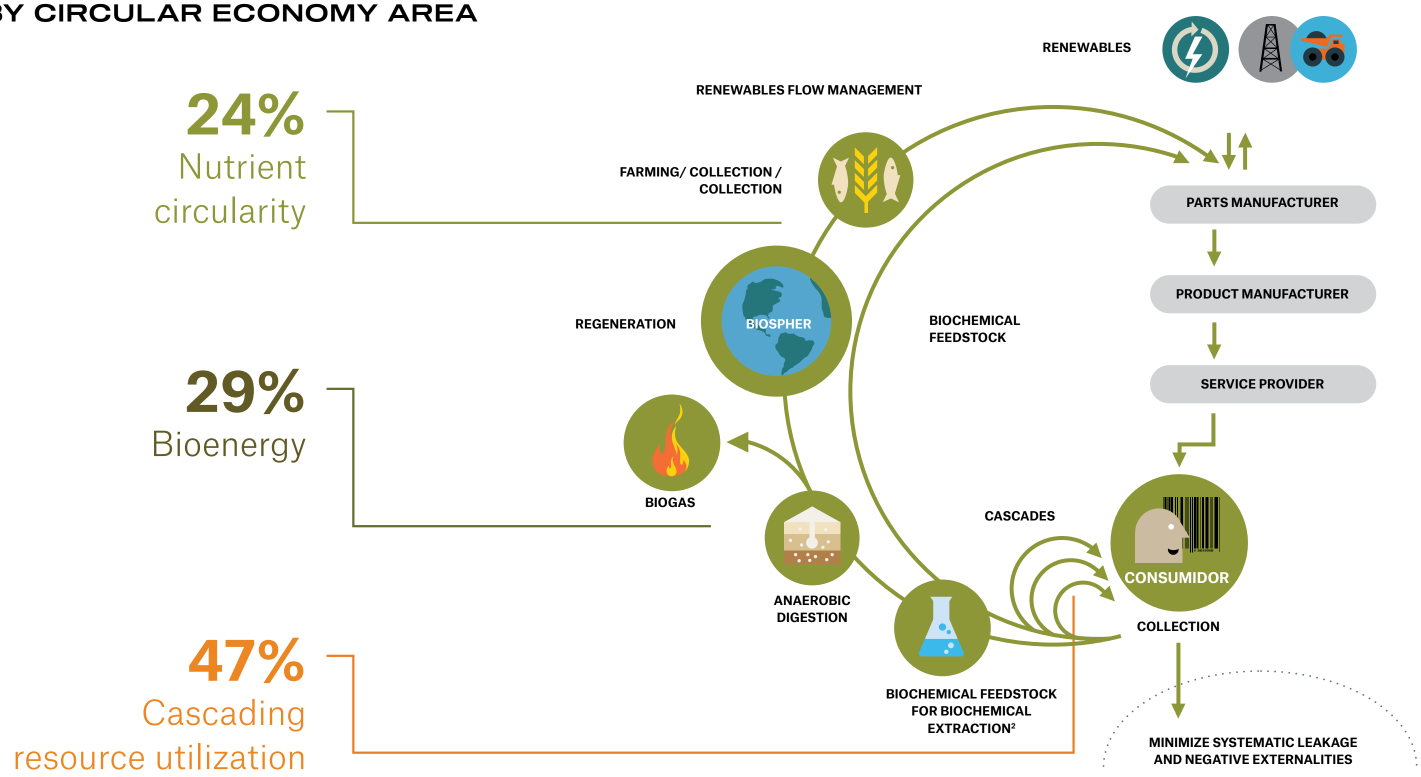
36. DIGEGRA Farm Board/ DGDR: Rural Development Board.

THESES PRESENTED IN THE CALL FOR 'YOUR THESIS WITH BIOVALOR,' 2020

BY SUBJECT AREA



BY CIRCULAR ECONOMY AREA



OPPORTUNITIES WITH THE PRIVATE SECTOR

From its inception, Biovalor identified the strengthening of networks of promotion and articulation with the private sector as an area of strategic action in order to accelerate transformations and enable private investment to be leveraged in the incorporation of new technologies and processes.

I. Circular Economy Forum

One of the most relevant initiatives in this regard was the implementation of the first Circular Economy Forum (fEC) in 2017. The forum had more than 25 speakers from 14 countries and three thematic areas; there were more than 350 attendees, and more than 700 stakeholders from civil society, government, companies, and academia relevant to the circular economy were mapped.

The forum also included two workshops on circular business models in cities and food production.

Visit the fEC site:

The fEC was a milestone in the process of presenting the concept of circular economy in Uruguay; it attracted the interest of very relevant stakeholders in the field of public policies, innovation, knowledge, entrepreneurship and production.

After the forum, new alliances were developed and several areas of opportunity for the development of the concept of circular economy in Uruguay were identified.

II. Circular Opportunities Program:

One of these alliances was the collaborative work between the National Development Agency (ANDE) and Biovalor to launch the so-called *'Circular Opportunities Program'* through which entrepreneurs are invited to develop circular economy ideas and business models with the technical and financial support of both organizations. The projects must also contribute in return, aiming to generate a long-term commitment.

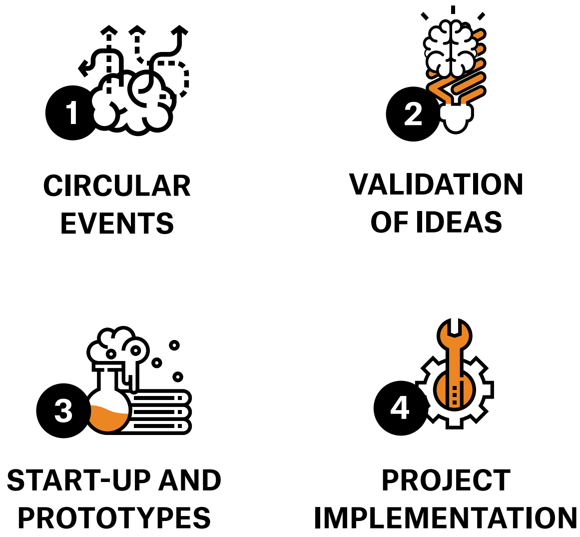
Visit the Circular Opportunity Program site:

The first call was launched in 2018, with a financial contribution by ANDE and Biovalor (50% each) of USD 675,000. A joint evaluation and monitoring committee for the projects presented was set up.

The program was designed to support all stages of business development, without restrictions in the sectors involved. The project supports three areas, from the design of a project to its startup and implementation, depending on the maturity of the proposal. In addition, special attention is given to the organization of inspirational and motivational events, where cases from different sectors or with different circular business models are presented.

Over the past two years, 48 projects and ideas have been implemented and new ones will do so in 2020. With the combined support of ANDE and Biovalor for USD 1,506,685, the private sector investment was leveraged in USD 2,052,680. The program continues to this day with the main funding of ANDE and contributions from several stakeholders. Some of the projects selected under the various support modalities are presented below.

The concepts and projects develop innovative ideas in circular economy for various types of waste and activity sectors, all clearly related to the domestic reality when it comes to productive inputs and outputs; this does not only provide structure to an idea, but it also promotes its development in a specific market, completing a real cycle of productive innovation.



→ EXAMPLE 1 VALIDATION OF IDEAS: VALORIZATION OF SHEEP LEATHER

Urucol aims to convert sheep leather waste into hydrolyzed collagen - a high value-added product - as well as into other byproducts. Funding was requested to characterize collagen based on raw material available in Uruguay. The skin is mainly composed of water and proteins, collagen being the protein present in the greatest amount (95%). Ovine collagen is the one most similar to human collagen, allowing better absorption. Because of this, it is better than the bovine collagen available in the market. This collagen can be used as a food supplement, in the cosmetic industry, and in the pharmaceutical industry (for biomedical capsules and patches).

→ EXAMPLE 2 VALIDATION OF IDEAS: RECYCLED CELLULOSE ECO-FRIENDLY INSULATION

The objective is to validate the economic and process feasibility of cellulose thermo-acoustic insulation from recycled paper for the construction sector. The idea is to recover paper and cardboard that is currently sent to a final disposal site or to stockpilers that sell them abroad or in the local market without any added value, and to convert it into an insulator, composed of approximately 85% recycled material, by means of a simple process of defibrating, chemicals addition, compacting and packaging. The use of this insulation aims to improve the comfort of light-panel constructions (expanding in Uruguay and the region), since its high thermo-acoustic efficiency and its versatility of application (water spray, insufflation or manual) makes it easy to incorporate into new or existing constructions.

→ EXAMPLE OF START-UP AND PROTOTYPES: VITANNA

The project aims to develop the production and marketing of tannat grape marc flour, a common waste of the country's wine industry. According to the project, there are 1,469 vineyards in Uruguay, mainly in the south of the country, totaling an average annual production of more than 100,000 tons; 97% of the grape harvest is destined for wine production and the rest is mainly marketed as table grapes. Approximately 20,000 tons of marc are generated annually as a byproduct of the wine industry. Wine marc is rich in dietary fiber and polyphenols, the concentration and quality of which are superior to those contained in other fruits. It contains, resveratrol, a concentrated natural super antioxidant. The focus of production is on the Tannat grape marc since, although all grape varieties are rich in fibers and polyphenols, this variety, apart from being the flagship strain in Uruguay, has a greater presence of resveratrol than any other grape. Also, in countries where grape flour is produced, none is produced exclusively from Tannat marc. This makes the product innovative Internationally and gives it a differential value as the flour produced from Tannat marc has better properties than any other grape flour.

→ IMPLEMENTATION EXAMPLE: RCD RECYCLING

The project’s expected result is the reduction of rubble volume sent to landfills, recycling construction waste and generating new products. Currently, 150,000 tons/year of rubble are accepted at the municipal landfill in Montevideo, which represents between 40-50 dumpsters a day. Rubble accounts for between 15% and 20% of waste volume entering the landfill. The circular productive process of the company begins with selective deconstruction in the building site, then rubble is processed obtaining a recycled arid of different granulometry that makes it possible to generate, from recycled concrete, a variety of products to be reinserted in the construction cycle.


3
4
2
5
1
6
Identificar 6 sectores de
alimentos para trabajar en Economía Circular


06

LESSONS LEARNED DURING THE BIOVALOR PROJECT IMPLEMENTATION

Regarding innovation processes through demonstration projects:

→ Regarding the identification and development of new ideas for waste valorization, the Biovalor Project organized knowledge development and transfer workshops for projects and companies to develop and strengthen existing ideas so that some could then be presented as demonstration projects. This process of capacity building and formulation of robust schemes of technological incorporation are enriched when there are real funding possibilities at the end of the process, as it happened with the demonstration projects co-funded by Biovalor.

In the implementation of demonstration projects, a transparent, competitive and co-funded mechanism was developed to find the best partners to develop them. This strategy identified highly committed people whose projects were of high priority in their business and productive strategies. In this sense, high co-financing ratios were also achieved, with a leverage of more than twice the funding provided by Biovalor.

→ The demonstration projects implemented were not carried out under laboratory conditions or from an exclusively academic perspective. The demonstration projects were implemented under market conditions and with business partners with lines of business that were real and innovative. This approach encouraged other companies to adopt new technologies and, on the other hand, allowed public institutions to consider these options among the 'best available technologies' in their promotion tools and for regulatory purposes.

→ Another fundamental aspect in the selection and support of demonstration projects was based on the active participation of the ministries leading the Biovalor Project. This allows the new technologies implemented not only to generate value and lessons learned for the company or organization, or even for the business sector, but also for the policy and regulatory framework.

→ Both, in the demonstration projects and in the design of instruments and regulations, the Biovalor Project implemented direct and collaborative work schemes with the active participation of the project management unit. For example, regarding the demonstration projects, apart from funding granted to selected proposals, close technical support was provided to assess and overcome possible barriers, to better understand the technology being used, and to measure, first hand, all the stages of implementation. In this sense, the counterparts in the development and implementation of new technologies, rather than beneficiaries were 'partners' in the project. This close technical relationship between peers made consistent progress in the incorporation of technology, especially in small and medium-sized companies, where technical teams are often scarce and/or unskilled.

→ Some of the selected demonstration projects could not be implemented despite technical support and co-funding. The reasons were diverse, but one of the most important ones was the difficulty of the suppliers to adapt the technology to their specific characteristics and requirements that led to longer implementation times and higher costs. These factors discouraged entrepreneurs making it impossible for them to continue. It was necessary to design new projects to use the equipment already purchased; this required adaptation to new systems and conditions, which was an extra challenge for the management unit. The problems that arose and the difficulty in solving them showed the importance of the suppliers' experience and ability to adjust their technology solutions to the objectives set.

Regarding waste management processes:

→ The role of the operator, in waste valorization strategies, often becomes decisive, in particular for those sectors where the generation characteristics make valorization in origin inviable, because of the scale of waste, the specialization of the generator, the investment required by the process, or other factors. In these cases, it is important that waste operators can offer recovery services in the vicinity of generators, in order to save transaction and logistics costs. Waste operators can often successfully implement sustainable recovery processes by charging a fee for the service they perform. Also, waste operators handle higher volumes of waste than a single generator, they are in a better position to incorporate technology, achieving greater efficiency in the management and recovery processes, but they must strengthen actions to deal with the environmental aspects derived from their work.

Regarding knowledge generation processes:

→ On several occasions, the Biovalor Project made agreements with national academic centers, rather than with national or international consulting firms; the aim was to develop national research and development capacities while designing the processes for the requested products. These processes, although slower at the beginning, result in more robust products, with the academic community playing a key role in the construction of new solutions in circular economy.

The large number of new theses presented in this matter shows an emerging interest in teachers and young students in the creation of new knowledge in circular economy.

Lessons learned in strategic communication:

→ A comprehensive communication strategy was developed, which positioned circular economy on the country's agenda and also promoted the gradual construction of an ecosystem of companies, projects, academic and public institutions, and civil society organizations with specific features. The communication strategy created an identity beyond the project and shared by several institutional stakeholders that enabled them to propose circular economy alternatives.

Lessons learned in the implementation of international cooperation actions:

→ Although the project took twice the time planned, it met its objectives and carried out its specific activities. It also provided support to the institutional, regulatory and strategic transformation processes in Uruguay, in particular, the emerging concept of circular economy. The implementation of the project always aimed at catalyzing the various institutional opportunities in the field of circular economy, contributing to a strategic transformation. In this sense, the project went beyond its various specific and tangible results, such as demonstration projects or knowledge products; it became a leading player in the construction of a new national ecosystem of circular economy.

Perhaps the most relevant lesson learned is the realization that the concept of circular economy and the knowledge acquired during the implementation of the Biovalor Project increase climate ambition and promote progress toward the Sustainable Development Goals, implementing innovative mitigation actions that also generate value and positively impact not only on the economy and society, but on other environmental areas, such as the reduction of organic waste and the reduction of soil and water pollution. These actions can also contribute to a carbon neutral world by 2050. The circular economy still presents challenges to be faced and aspects to work on, but its perspective is promising both locally and globally.

EPILOGUE

URUGUAY'S SECOND ENERGY TRANSITION

The strong uptake of non-traditional renewable sources in Uruguay, reaching 98% of renewable-based electricity generation in 2019, 32% of which was wind power,[1] presented the challenge of managing energy supply and demand. While traditional power generation systems such as burning fossil fuels, biomass, or hydroelectric power generate electricity according to the level of demand, non-traditional wind and solar-based systems generate energy depending on the wind and sun supply that do not necessarily match demand, thus generating electrical surplus.

Uruguay is among the first countries to face this situation throughout its territory, the same will probably happen in the near future among those countries that are the most advanced in low-emission power generation from non-traditional renewable sources. This reality creates an unprecedented situation in which advanced schemes of energy circularity need to be defined.

Uruguay is exploring opportunities for circularity in order to align electrical energy supply and demand through several complementary strategies: these include energy storage (batteries, thermal accumulation, and pumping and turbinate plants), green hydrogen and accumulation in thermal systems (hot water and ice banks).

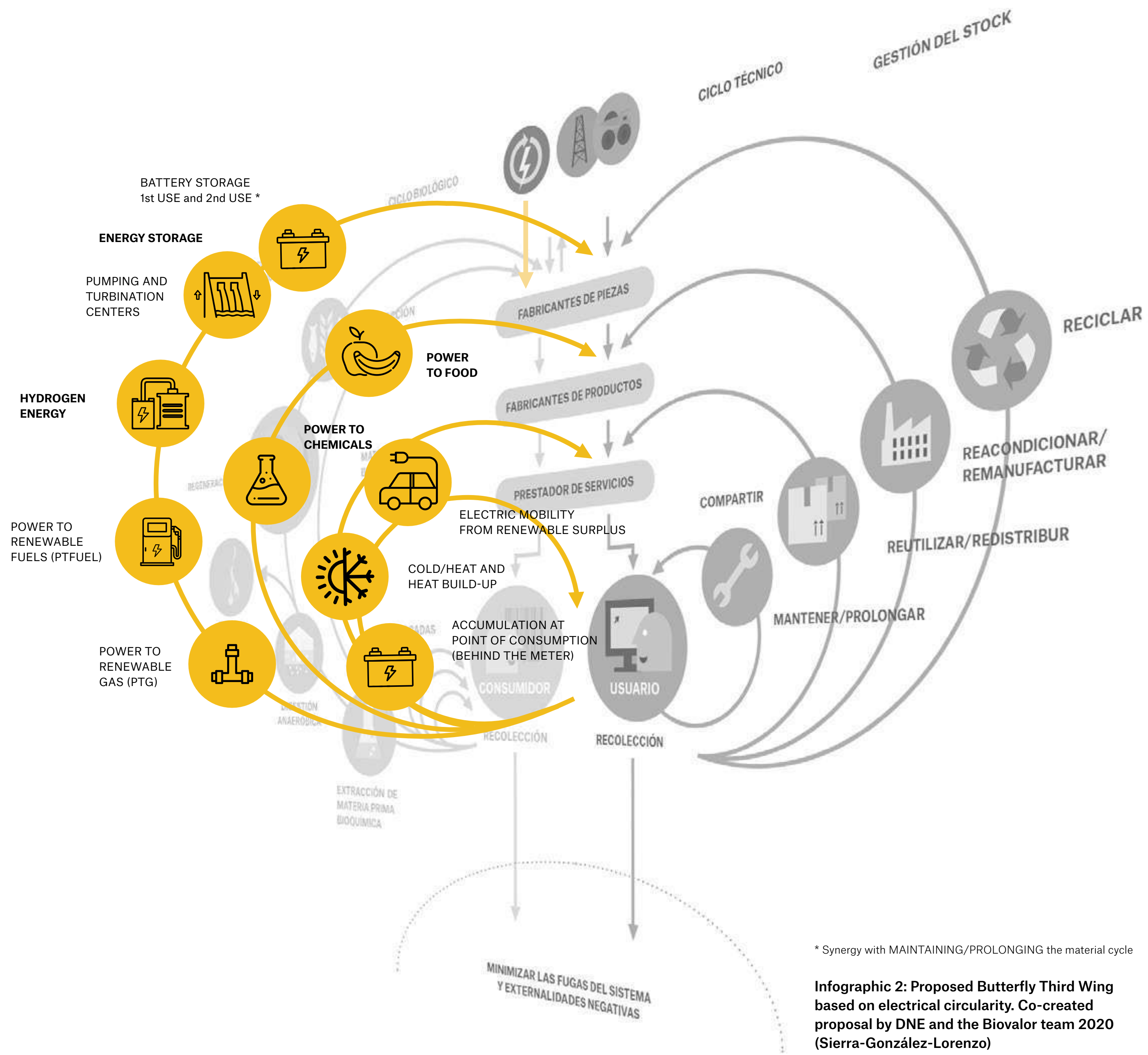
Schemes are also being developed to promote residential and industrial electrical consumption in demand valleys and charging of electric vehicles at night. These criteria of circularity in the electricity sector allow for the possibility of using, thanks to complex circular systems, the renewable electricity generated in the demand valley with a lower economic value, at peak times with a higher economic value.

This new phase of the Uruguayan electricity system, called the second energy transition, will provide new learning opportunities at the frontier of knowledge, and practice at a national scale with an integrated network. These opportunities could even lead to 100% renewable, zero emission power generation in the very short term and strongly contribute to the gradual decarbonization of urban transport through the use of electric mobility and of freight transport through green hydrogen. This scenario shows the strategic contributions and lessons learned that the Uruguayan electricity sector can share to achieve emissions neutrality by 2050, being power generation, to date, the main source of global emissions.

Finally, it should be noted that these contributions will continue with the new project *'Promoting the transition to circular economy in Uruguay through innovations in clean technologies'* by the Ministry of Industry, Energy and Mining as from 2021. The project, supported by UNIDO and funded by GEF, will be jointly implemented with the Ministry of Environment and the Ministry of Livestock, Agriculture and Fisheries. The new project aims to *'promote the transition to sustainable production forms and low-emission technologies in selected sectors with a circular economy perspective.'* Priority sectors are: food systems, industry 4.0, and energy; the latter under the *'Power-to-X'* approach, which allows the alignment of supply and demand schemes.

1. https://ben.miem.gub.uy/oferta5.html

THE THIRD CIRCULAR WING: RENEWABLE ELECTRICAL ENERGY SURPLUS



* Synergy with MAINTAINING/PROLONGING the material cycle

Infographic 2: Proposed Butterfly Third Wing based on electrical circularity. Co-created proposal by DNE and the Biovalor team 2020 (Sierra-González-Lorenzo)

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