

# 13

CLIMATE  
ACTION



## TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

### CASE STUDY: ITAIPU AND SDG 13

Activities by Itaipu Binacional supporting implementation of the Sustainable Development Goal 13 (SDG 13) of the United Nations 2030 Agenda for Sustainable Development





Aerial photo of a nature reserve /Source: Itaipu Archive



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# CATALOGING IN PUBLICATION (CIP)

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## Itaipu Binacional

Take Urgent Action to Combat Climate Change and its Impacts / Itaipu Binacional. Dirección de Coordinación Ejecutiva. Directoria de Coordenação. Central Hidroeléctrica de Itaipu: Itaipu Binacional, 2019.  
60 p.: il.; 29,7x21 cm

Includes photographs of Itaipu Binacional.

1. Climate change 2. Environment protection 3. Itaipu Binacional  
I. Title.

CDU 551.583

Cataloging in Publication made in Biblioteca CHI-MD, Superintendencia de Ingeniería, Dirección Técnica.

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The report *Take Urgent Action to Combat Climate Change and its Impacts* is an accomplishment of Itaipu Binacional.

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**Design and layout:** División de Imagen Institucional - Asesoría de Comunicación Social

**Print:** 50 copies

Printed in 2019

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# WHERE ARE WE?



Integration that  
generates Renewable  
Energy and promotes  
Sustainable Development





## **ITAIPU BINACIONAL AND THE UNITED NATIONS 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT**

Itaipu is a binational entity created in 1974 by Brazil and Paraguay in order to utilize the Paraná River, along the border of the two countries, to generate hydropower. Today, the Itaipu Hydropower Plant is the largest generator of renewable power in the world (ITAIPU, 2018 a). As of 2018, Itaipu had generated a total of over 2.6 billion Megawatts-hour (MWh) since the beginning of its operation, in 1984 (ITAIPU, 2019 a).

Since its conception, Itaipu Binacional has followed sustainable development principles as reflected by its 15 strategic objectives and integrated actions and programs, supporting social well-being, economic growth and environmental protection, contributing to regional prosperity in Paraguay and Brazil. Itaipu's activities in the region have been recognized as excellent examples of "Best Practices" in the effective implementation of the United Nations 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs) (ITAIPU, 2019 b).



## SDG 13: TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

**Target 13.1** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

**Target 13.2** Integrate climate change measures into national policies, strategies and planning.

**Target 13.3** Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

**Target 13.a** Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible.

**Target 13.b** Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.

Source: United Nations.





Itaipu Reservoir / Itaipu Binacional

About 101,000 hectares of forests surround the Reservoir, enhancing resilience to climate change. This area represents the protected buffer zone for the Reservoir along both the Brazilian and Paraguayan margins. It includes a total of 10 biological sanctuaries and reserves (ITAIPU, 2018 b) that protect native biodiversity of the region and advance research and conservation initiatives. These areas and the Reservoir provide valuable connections among important remnants of the Upper Paraná Atlantic Forest, located in Paraguay, Brazil and Argentina.

The effective integrated management, protection and conservation of all water and terrestrial ecosystems located in the area are key activities supporting ecosystem services, sustainability and prosperity for the region, which encompasses the Itaipu Reservoir and its surroundings.

Itaipu plays a very important role in the mitigation and adaptation of climate change effects resulting from greenhouse gas (GHG) emissions. As the largest generator of renewable power in the world, Itaipu contributes to the global efforts on combating climate change and its impacts, which is the definition of the Sustainable Development Goal on Climate Change (SDG13) of the United Nations 2030 Agenda for Sustainable Development. Its reliable and efficient generation of clean electricity for over three decades has resulted in the avoidance of the use of massive quantities of fossil fuels and, consequently, has averted the emissions of millions of tons of GHG to the atmosphere annually.

The electricity generation from the Itaipu Hydropower Plant replaces the equivalent of 550,000 barrels of oil or 50 million cubic meters of natural gas each day. In relation to the impacts of climate change, Itaipu is avoiding the emissions of about 87 million tons of CO<sub>2</sub> each day equivalent, if it is replacing coal, and 39 million tons if it is replacing natural gas (ITAIPU, 2018 a).

**The fixation of CO<sub>2</sub> in the biomass of Itaipu's Protected buffer zone and reserves is approximately 23 times higher than its emissions, related to the three scopes of the GHG Protocol (ITAIPU, 2018 a), which are disclosed annually in the company's sustainability reports.**

Despite all these favorable numbers, Itaipu has been strongly committed to reducing CO<sub>2</sub> emissions, with clear targets in its strategic plan, considering reductions on internal consumption of electric energy and fossil fuels in the entity's vehicles, and distances traveled by employees and visitors on flights contracted in airplanes.

Itaipu is also committed to climate change adaptation efforts by implementing ecosystem based adaptation measures, such as the increase natural forest cover, rewilding protected areas with key native species such as pollinators, seed dispersers and predators, and by recovering and protecting water resources at watershed basin scale.



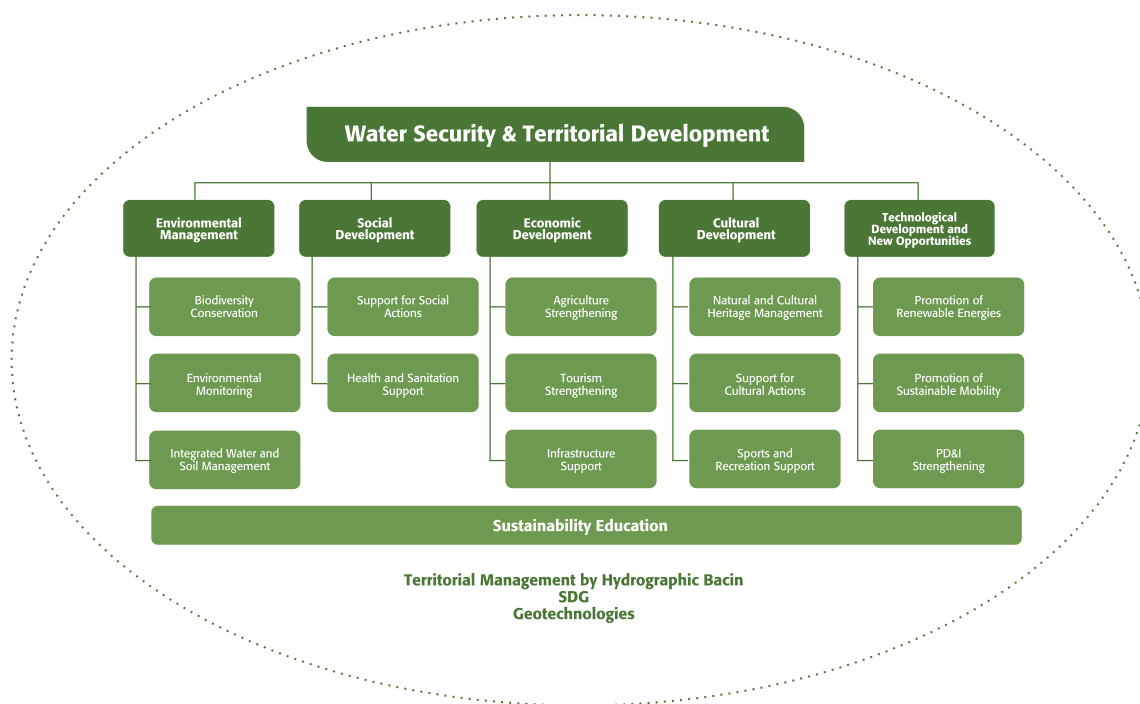
The spillway - Alexandre Marchetti/Itaipu Binacional



# SUSTAINABLE DEVELOPMENT STRATEGY OF ITAIPU

Alongside with efficient and reliable power generation, Itaipu's sustainable development strategy recognizes that water security<sup>1</sup> and sustainable development at the influence area<sup>2</sup> require optimum environmental management besides social, economic, cultural and technological development. These important objectives are the basis for the comprehensive approach and integrated plan of actions carried out by Itaipu (ITAIPU, 2019 a). Therefore, Itaipu has partnered with municipalities, communities, private owners and other stakeholders for the effective implementation of this strategy, monitoring and analyzing climate variability and trends, establishing a climate monitoring platform and promoting renewable energy and ecosystem services on a regional scale.

These initiatives are part of the overall sustainable development strategy of Itaipu, specifically environmental management, which includes biodiversity conservation, environmental monitoring, and integrated management of water and soil. The overall strategy also includes social development, supporting initiatives related to social actions, health and sanitation, according to the chart below. This approach is intrinsically linked to the SDGs of the United Nations 2030 Agenda for Sustainable Development, in particular to the objectives and specific targets of the SDGs on water (SDG6) and energy (SDG7).



Itaipu's vision for 2020 is to be "the generator of clean, renewable energy with the best operating performance and the world's best sustainability practices, promoting sustainable development and regional integration" (ITAIPU, 2018 c). A model of territorial management is being implemented by Itaipu in the basin of the Reservoir of the hydropower plant.

The basin includes 54 municipalities in the state of Paraná, Brazil, 1 municipality in the state of Mato Grosso do Sul, Brazil, and 15 municipalities in Paraguay, with an overall population of almost 1.7 million people. Besides covering this territory, some actions are being developed in other areas in Paraguay (PNUD, 2018; DGECC, 2018).

<sup>1</sup> Water security refers to the recovering and preservation of watersheds and reservoirs through permanent and integrated actions that promote the sustainable use of natural resources, better socio-environmental conditions and the best availability of water in quantity and quality for different applications.

<sup>2</sup> Territorial unit that includes the watersheds from which waters drain towards Itaipu's Reservoir.



Protected areas of Itaipu /Itaipu Binacional



## Itaipu and the SDG 13

There are more than 100,000 hectares of protected areas on both Paraguayan and Brazilian sides, which represent more than 8.6 hectares per kW installed. This protected area prevents the excessive sedimentation of Itaipu's Reservoir, considering that "sedimentation affects the safety of dams and reduces energy production, storage, discharge capacity and flood attenuation capabilities" (Hydrovision International, 2017).

Recently, Itaipu became the first hydroelectric power plant in the world to have its own protected areas and supporting landscapes in Paraguay and Brazil recognized by UNESCO as core areas of the Biosphere Reserve of the Man and Biosphere Program (ITAIPU, 2018 d; ITAIPU, 2018 e).

In Paraguay, Itaipu was also responsible for coordinating the Paraguay Biodiversity program with support from the Paraguayan government and from the Global Environment Facility of the World Bank. The program aimed at preserving biological diversity by linking forest fragments and promoting ecosystem services and sustainable land use. In Brazil, protected areas connect to the south with the Iguacu National Park through the Santa Maria Biodiversity Corridor, and to the north with the Ilha Grande National Park in Mato Grosso do Sul. In both countries, Itaipu is also developing projects to conserve native endangered species (UNFCCC, 2017).

The most important activities in Itaipu's Sustainable Development Strategy with respect to climate change are centered on the following: continuing to provide reliable, efficient and clean renewable power (avoiding GHG emissions from fossil fuels) for Brazil and Paraguay; implementing an integrated management program of natural resources, protecting and restoring water and terrestrial ecosystems with the participation of local communities and all relevant stakeholders; ecosystem based adaptation by implementing a comprehensive and extensive program of reforestation

and remediation in the areas of influence of Itaipu; quantifying emissions and sequestration of greenhouse gases; monitoring and analyzing climate variability and trends; establishing a Climate Monitoring Platform; promoting the use of other forms of renewable energy to satisfy energy needs in the transport, agriculture, industrial and residential sectors of the economy, thus minimizing waste generation and helping to further mitigate climate change effects; installing an Early Flood Warning System (SATI); and supporting centers for emergency supplies in case of extreme climatological events.

Itaipu has also defined targets for 2019 related to the three scopes of the GHG Protocol of Brazil. This effort started in 2016 and it reinforces Itaipu's commitment to actions that mitigate global climate change. The three scopes refer to reductions in fossil fuel use, electricity consumption and distances travelled on flights. These targets have been resulting in the reduction of greenhouse gas emissions. They include a reduction in the consumption of fossil fuel in Itaipu's own fleet of vehicles and of electricity consumption of 1.5% with respect to the average values observed in the 2011-2015 period, and a reduction of 0.6% in the annual total distances covered by flights contracted on passenger planes for transporting employees and visitors (ITAIPU, 2018 a).

These efforts already provided positive results by 2017, including a significant reduction on diesel consumption and, in parallel, an increase in the consumption of ethanol and gasoline in the vehicles and equipment of the Itaipu fleet. The Company has prioritized the use of ethanol in cars and reduced the need for diesel oil in generators. Another good result is the increase of more than 100% in both photovoltaic microgeneration and the use of biomethane to supply the fleet (ITAIPU, 2018 a).



1.

**REFORESTATION:  
RESTORATION OF  
FOREST ECOSYSTEMS**



The exact venue where Itaipu dam was later built. On the left bank, Brazil. On the right bank, Paraguay.  
Source: Itaipu Archive

**Itaipu** has a comprehensive and extensive program for reforestation and restoration of forest ecosystems. In 1976, Itaipu conducted an inventory to identify and qualify forest cover in both the Brazilian and Paraguayan areas of the Plant's project. Unlike the Paraguayan margin, where the original forest was still preserved, the Brazilian margin was deforested and used for agricultural activities, as a result of the expansion of the agricultural frontier in the 1960s and 1970s (Eletrobras, 2011). In this sense, the reforestation of forest ecosystem had a different timing in Brazil and Paraguay.

## Objective and description

In Brazil, the Basic Plan for the Environment Conservation was developed in 1975, as the Entity's first socio-environmental management tool. At that time, environmental concern was still emerging worldwide, but it led Itaipu to be the only Eletrobras company to voluntarily recover its Permanent Preservation Area (APP) up to 2001, when the issue started being mandatory by law (Eletrobras, 2011).

For the implementation of the hydroelectric plant complex, Itaipu acquired an area in Brazil and Paraguay of more than 235,500 ha, which includes 135,000 ha for the Reservoir and more than 100,000 hectares of "dry area", used for forest conservation purposes. The relationship between flooded versus forested area was different from what was usually practiced at the time of construction, if compared to other hydroelectric projects in which smaller portions of land were preserved.

The "dry area", which refers to the Itaipu Protected Areas, is divided into Biological Reserves, Biological Refuges and Permanent Protection Areas (APP), distributed along the Reservoir in both banks. They are called the Protection

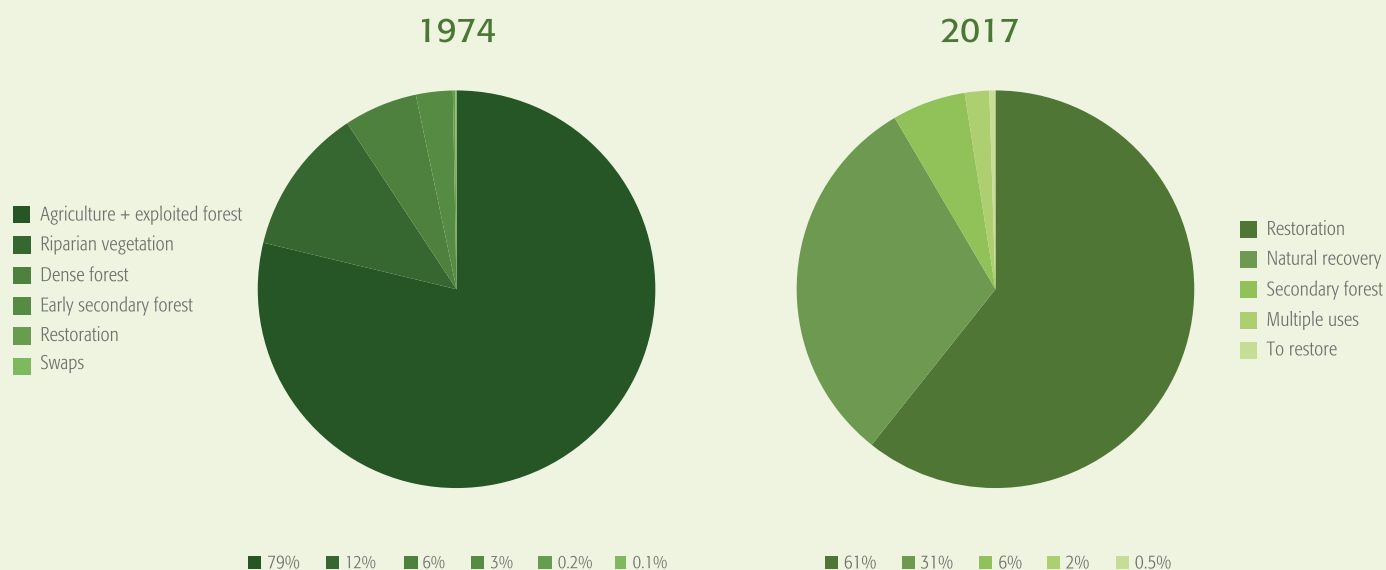
Strip or Protected Belt. Its purpose is not only to absorb fluctuations in the water level of the Reservoir, but also to contribute to the conservation of water resources, landscape, geological stability, biodiversity, genetic flow of fauna and flora, soil protection and ensure the well-being of the surrounding populations. Conceptually, today, these conservation actions are considered ecosystem-based adaptation measures for climate change.

In 1979, Itaipu started implementing its largest reforestation program, with the predominant use of native forest. Between 1979 and 1981, approximately 1.3 million tree seedlings were planted (Eletrobras, 2011)

One of the relevant results of such reforestation program is that Paraná, the state in Brazil in which the Plant is located, contributed more to the restoration of the Atlantic Forest in Brazil than any other state. More than 75,000 hectares have been regenerated in the last 30 years, and 28% of this area (or almost 21,000 ha) corresponds to the actions of Itaipu Binacional in the Brazilian margin of the Reservoir (ITAIPU, 2017a).



## Land use in the area occupied by the Protection Strips (Brazil):



Data taken from the Forest inventory of the Itaipu dam region of influence (UNIVERSIDADE FEDERAL DO PARANÁ, 1978) and from the Itaipu databank (ITAIPU BINACIONAL, 2017 b)



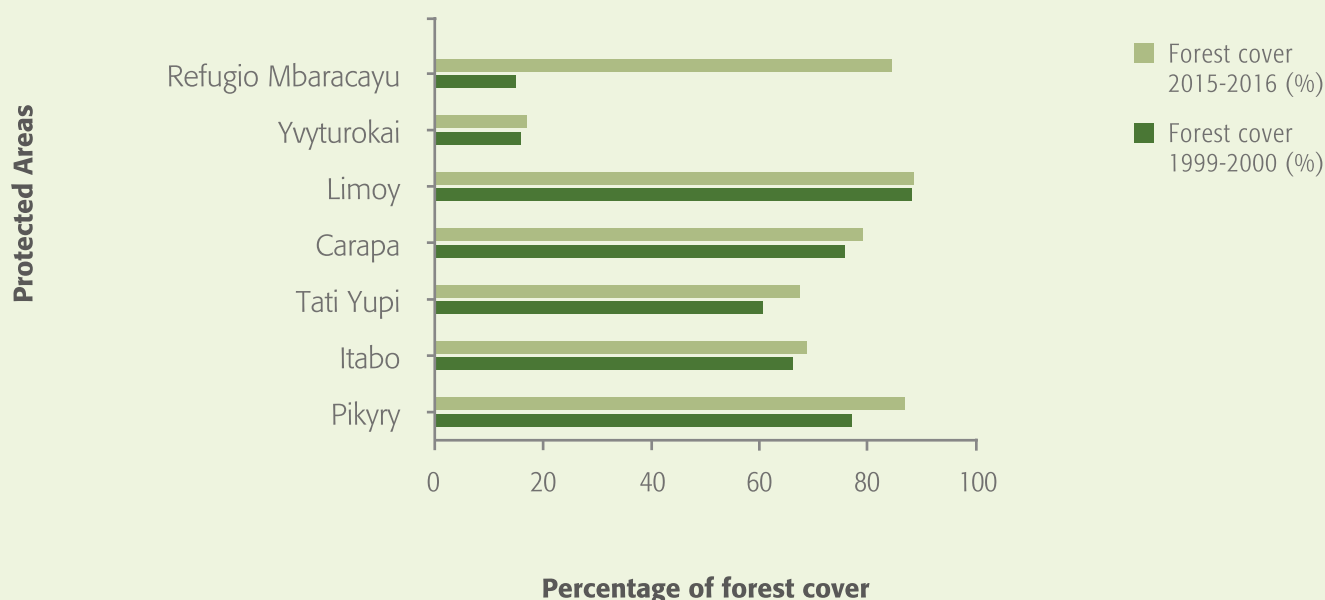
In Paraguay, the reforestation and restoration program began in 1991. It represents one of the main programs being supported and implemented by Itaipu, bringing all kinds of benefits, including global benefits related to climate change. The program covers a very extensive territory throughout all the areas of influence of the Reservoir, stretching from Hernandarias to Saltos del Guaira, for a total of 1,524 km (ITAIPU, 2012).

In relation to the overall objective of conservation of protected areas, Itaipu has developed, and continues to support, the following resilience and adaptive activities:

forest inventory; forest regeneration and restoration; collection and germination of seeds and the production of seedlings of native forest species for use in the areas of Itaipu and the Paraná Basin and maintenance of an ex situ genetic bank of native forest species. These activities help ensure the integrity of the biodiversity of more than 100,000 hectares of protected terrestrial ecosystems.

This is one of the most important tasks related to the restoration of the forest ecosystems of the Upper Paraná Atlantic Forest in Paraguay. In addition to providing

## Itaipu's Protected Areas dynamics throughout the years



Source: Da Ponte, 2017

ecosystem benefits related to climate change, reforestation protects the Reservoir against sedimentation, thereby increasing the lifespan of the hydroelectric power plant and supporting the establishment of biological corridors.

Itaipu and its partners have also implemented comprehensive "Good Practices" for water and soil conservation related to the recovery and protection of riparian forests.

In the Paraguayan bank, restoration corresponds to a total area of more than 2,000 hectares. Around 1,900 hectares are under restoration and 409 additional hectares are under natural regeneration through a program of cultured care and management.

The Protected Areas under Itaipu's management showed increments on their forest cover, with natural restoration rates (natural reforestation) varying between 1% (in the Yvytyrokai) and 69% (Binational Biological Refuge Mbaracayú from 1999/2000 to 2015/2016), as shown in the figure above.

Restoration of forest ecosystems is also supported by Itaipu's Nurseries, which are in charge of producing seedlings and donating them to public and private institutions to help mitigate climate change. The Nurseries also support the planting of trees in public places, including streets, parks, avenues and squares. They began operations in 1976.

Itaipu's Nursery in the Paraguayan border currently produces 100,000 plants monthly, of which approximately 70% are used in programs in protected areas for reforestation, tree planting and environmental education. The other 30% of the plants are donated to people in the area of influence of Itaipu. The Nursery works with more than 90 species of forest, fruit and ornamental plants, both native and exotic.

In the Brazilian border, the forest nursery located in the Biological Refugee (RBV) is responsible for the production of seedlings of about 100 species of the Atlantic Forest biome and meets all the demands of the company's environmental programs for the ecological restoration of riparian forests in the Paraná river, region 3, accomplished in partnership with governmental

institutions and others. Between 2003 and 2018, more than 3 million tree seedlings were produced and distributed.

Such reforestation programs supported by Itaipu both in the Brazilian and Paraguayan borders led to formation of a Biodiversity Corridor, which connects the Iguaçu and the Ilha Grande National Parks. The Santa Maria Ecological Corridor, as it is called, is an important link for the Trinational Biodiversity Corridor, formed by extensive natural areas of the Province of Misiones (Argentina) and the reserves maintained by Itaipu Binacional in Brazil and Paraguay, as well as public and private conservation units in Brazil along the Paraná and Iguaçu rivers. The biodiversity corridor is intended to allow the genetic flow of regional flora and fauna. Past deforestation has led to a fragmentation of natural areas, now limited to government and private conservation units, as well as some isolated remnants of rural properties, creating an island effect. Without the interconnection of green areas, low genetic variability can lead to the extinction of several species of flora and

fauna (ITAIPU, 2018 f) and compromise all categories of ecosystem services, such as provisioning, regulation, support and cultural.

## Related Targets

These activities are related to Target 13.1 on strengthening resilience and adaptive capacity to risks related to climate and natural disasters in all countries. They also relate to Target 13.2 on the integration of climate change measures into policies, strategies and planning at institutional and regional levels.

The activities are based on the restoration of ecosystems as a means of mitigating and adapting to climate change. They are an integral part of the plans of the company from the beginning of its activities, regardless of obtaining carbon credits (ITAIPU, 2015).



Biodiversity Corridor - Alexandre Marchetti /Itaipu Binacional



The activities are also closely related to Target 13.3 given the important role that Itaipu plays in capacity building including education and awareness-raising on climate change related issues.

## Challenges

Considering the large size and the location of Itaipu, on the border between two countries, there are many challenges related to monitoring and maintaining the Forest Protection Strip. It has been critical to keep a qualified technical team within Itaipu that receives constant technical updates and uses quality equipment and systems that enable real-time optimum decision making and monitoring (Eletrobras, 2011).

Other challenges include the invasion of exotic plants and animals, illegal entry of people, deforestation, cattle entry, and soil compaction. The presence of invasive alien species, pest attacks, intentional forest fires, clandestine dumps, cattle ranching and extreme weather affects restoration activities and creates negative impacts on the growth of trees. There is a need for constant conflict management and for ensuring the active participation of local communities. As of Itaipu's Nurseries, the main challenge is related to the processes of purchase and/or acquisition of technologies to facilitate the production of seedlings.

## Lessons learned

Through these experiences, Itaipu has learned about the adoption of new restoration techniques using fast-growing plants with good canopy cover (pioneer) during the first phase, and then enrichment with species of diversity. Protection of the soil against erosion and avoidance of the elimination of weeds that do not compete with the planted individuals are other good practices. Adequate selection of species allows rapid formation of the forest canopy and a more efficient control of invasive species. The monitoring of the reforestation efforts should continue even after the work

has been completed in order to verify the success of the interventions.

The experience of Itaipu's Nurseries has helped master the optimization of the activities of seed collection and cultivation and maintenance of seedlings in order to achieve more resistant plants in their final implementation in the field.

## Results

Itaipu has had excellent results in these activities, providing global benefits in relation to climate change mitigation. Restoration and conservation of the protected area of over 101,000 hectares translates into the capturing of 5.9 million tons of CO<sub>2</sub> equivalent per year. As of today, Itaipu has planted more than 26 million trees in almost 22,000 hectares of protected areas in Brazil and in Paraguay.

In Paraguay, work continues to consolidate areas in restoration for a total of 2,195 hectares.



# 2.

## **QUANTIFICATION OF EMISSIONS AND SEQUESTRATION OF GREENHOUSE GASES**



The Reservoir and the forest biomass - / Itaipu Binacional

## Objective and description

Itaipu has been building an inventory of different types of emissions and has been involved in a carbon sequestration process as activities supporting the Sustainable Development Goal on Climate Change (SDG13). The main objective of these activities is to enable a synergistic and integrated analysis of different variables related to emissions and relevant to sequestration processes that will help mitigate the effects of climate change. These activities should result in proposals for structural improvements to reduce the consumption of non-renewable resources and to promote further use of renewable energy.

At the same time that the productive processes of Itaipu emit GHGs, the maintenance of the vegetation of its Protection Strip and Wildlife Refuges promotes the fixation of the atmospheric CO<sub>2</sub> in the biomass of the trees, both above and below the ground. The donation of seedlings to the municipalities bordering the Reservoir for riparian areas restoration also contributes to the increase in the fixation of atmospheric carbon.

Itaipu started these activities in 2010, in areas of direct influence of the Entity, including bordering cities and in

places upstream of the Reservoir, due to the transfer of seedlings. The inventory related to GHG emissions is carried out based on internationally accepted parameters for quantification of GHG emissions, which are audited annually by third parties. Regarding emissions, Itaipu uses the GHG Protocol, which is accepted worldwide.

The sequestration of CO<sub>2</sub> is being implemented by using biomass processes. This activity is based on a detailed study carried out in 2010 with input data on species that were used in the process of forest recovery of the entire area involved. Every year, both carbon fixation and emission due to burning events throughout the protected areas of Itaipu are calculated in order to produce a net balance of carbon sequestration.

Each year, Itaipu checks the variables related to major scopes of the GHG Protocol that have negatively and positively impacted GHG emissions. Such procedure complies with the Terms of Commitment signed between Itaipu and Eletrobras, in which the absolute and relative GHG reduction targets were established for the three major scopes of the GHG Protocol.



## Related Targets

These activities are related to Targets 13.2 and 13.3 of the climate change objective SDG 13. Quantification of emissions and sequestration of greenhouse gases relate to integrating climate change into the policies, strategies and planning of Itaipu (Target 13.2). These activities also improve education, awareness-raising and human and institutional capacity on climate change (Target 13.3).

## Challenges

Challenges to implementation relate mainly to the lack of all the data necessary to compute some of the variables needed to complete the inventory. The situation has improved over the last years, and now an effort is being made to collect all the data that are necessary to be able to achieve a comprehensive inventory of relevant variables. The same challenge was experienced in relation to the process of sequestration of CO<sub>2</sub> by biomass, but the situation has improved after a relevant study on vegetal species was performed in the region.

## Lessons learned

Through these experiences, Itaipu observed that quantifying GHG emissions is a multidisciplinary task that depends on a wide variety of supporting professionals, with different academic backgrounds and hierarchical positions. For this reason, Itaipu has established focal points to collect the raw data in the most consistent and accurate way possible to keep continuous improvement of the results.

## Results

These activities have resulted in an improved and fairly complete data collection program, that supports all issues related to climate change. The environmental and human benefits stemming from the knowledge and

practice of good measures to reduce GHG emissions go beyond corporate boundaries as they impact the entire planet.

With regards to GHG emissions, it is important to mention that Itaipu elaborates its sustainability report annually in accordance with the Standards methodology of the Global Reporting Initiative (GRI), which is the world's main tool for reporting sustainability practices. The publication of these reports, besides being a tool for transparency and dissemination of good sustainability practices, contributes to the identification of points for improvement in its management, with the aim of achieving better results on Sustainable Development Goals. Since 2017, Itaipu has published the report "Greenhouse Gas Emissions Inventory" which has been assured by KPMG Risk Advisory Services.

These reports show that Itaipu, in pursuit of meeting its corporate objectives, monitors, among others, environmental management indicators related to greenhouse gas emissions and climate change, which assists in the evaluation of the results of its environmental policies and actions. The results show that the actual performance in 2018 was significant better than the goals in all categories (ITAIPU, 2018 a.). In some cases, the performance in 2018 was extraordinarily better than the 2018 goals, especially in annual reduction in the consumption of fossil fuels and electricity. For example, the 2018 fossil fuel consumption reduction goal was 1.50%, but the improvement in performance was of 47%.

Based on the emissions quantification activities, the annual managerial emissions of GHGs are around 22,000 t CO<sub>2</sub>, whereas the Reservoir emissions reach approximately 235,000 t CO<sub>2</sub> equivalent per year. However, the GHGs fixation by the vegetation of the Protection Strip and Wildlife Refuges reaches 5.9 million t CO<sub>2</sub> (Brazil and Paraguay together). It means that the sequestrations of CO<sub>2</sub> outweigh the emissions by around 23 times.

Material Topic	Related GRI topic	Business indicators	Goals for 2018	Performance at 2018	Goals for 2019	DSG and the Global Compact Principles
<b>Environmental Management</b>	Greenhouse gas emissions and climate change <sup>4</sup>	Annual absolute reduction in the consumption of fossil fuels of the own fleet <sup>5</sup>	1,50%	47% 	2,00%	
		Annual absolute reduction in electricity consumption <sup>5</sup>	1,50%	40% 	2,00%	
		Annual absolute reduction of total distance traveled on flights contracted on line planes for the transport of employees and visitors <sup>5</sup>	0,60%	9% 	0,80%	
		Annual relative reduction in the consumption of fossil fuels of the own fleet <sup>5-7</sup>	1,50%	50% 	2,00%	
		Annual relative reduction in electricity consumption <sup>5-7</sup>	1,50%	43% 	2,00%	
		Annual relative reduction of total distances traveled on flights contracted on lines lanes for the transportation of employees and visitors <sup>5-7</sup>	0,60%	13% 	0,80%	

Sustainability Report 2018, p. 17



# 3.

## **MONITORING AND ANALYZING CLIMATE VARIABILITY AND TRENDS**





Storm at the Itaipu dam - Alexandre Marchetti / Source: Itaipu Archive

## Objective and description

The main objectives of this activity are to:

- 1) Identify and analyze climatic extremes in the region during the 20<sup>th</sup> and 21<sup>st</sup> centuries, using direct variables and/or climatic indices;
- 2) Evaluate, characterize and identify the relationship between temperatures and precipitations with some climatic indices;
- 3) Identify the periods and conditions most favorable to the occurrence of extreme climatic events; and
- 4) Propose new climatic indices, adapted to the region being studied.

This activity was initiated in 2018 and covers all the areas of influence of Itaipu. It is implemented by Itaipu and the Itaipu Technology Park (PTI) through the Territorial Intelligence Center (NIT). The objective of this partnership is to develop research in four strategic areas: water, climate, biodiversity and territory.

The Territorial Intelligence Center is a technical-scientific center for Itaipu, PTI and external collaborating institutions to cooperate in an organized manner that ensures sharing the same goals, indicators and results related to the four strategic areas. As a natural consequence of this process, there is a common knowledge base applicable to the technical, scientific

and social development of the region.

In summary, the Territorial Research Center provides support as a service that generates and analyzes data in important fields, including climate, water, biodiversity and territorial development, which are all interlinked. In addition, it produces information to serve as a basis for decision making and strategic planning in diverse instances (local, municipal or regional). It helps ascribe practical aspects to research and observation activities related to water security and sustainable regional development.

The research related to the Climate is developed in partnership with the Londrina State University (UEL), and with the State University of Western Paraná (UNIOESTE), coordinated by two professionals who hold Doctorates in climatology and with the support of two specialists from PTI, with master degrees in meteorology and in agricultural engineering.

As the research progresses, new climate indices will be generated for monitoring purposes. The effectiveness of this activity will be measured by the impact it will produce in the planning of public policies, interventionist actions and decision-making based on the new indices.

## Related Targets

These activities are related to Targets 13.1 and 13.3 of SDG 13. As a research activity involving water security and sustainable regional development, the constant monitoring and analysis of meteorological and climate variables is of fundamental importance. These activities will make it possible to identify the occurrence of extreme weather events. These are rare events that are also of high intensity, and in a climate changing scenario, can be more frequent.

Such extreme events constitute an additional challenge in the analysis of meteorological data and variability of such phenomena. Natural hazards due to weather (events occurring on a scale of few days) and climate phenomena (long-term averages of daily weather) have many impacts on societies and ecosystems, including health, energy production, water and food security, among others.

Therefore, this action aims at producing an analysis of the space/time variability of climate and its trends, both in the western region of Paraná and in the flooded area upstream of the Itaipu Reservoir in order to identify zones and periods that are sensitive to the impacts of extreme climatic and meteorological events.

Such information will increase the resilience of the region's communities to climate change, in perspectives ranging from agriculture support to emergency alerts.

## Lessons learned

Itaipu has learned that establishing partnerships with institutes of education and research specialists is crucial to the success of the project. Having a varied range of skills associated with land management allows unique approaches in the analysis and understanding of impacts from natural phenomena.

## Challenges

The greatest challenge for the implementation of this activity is having available historical and reliable climate data. Therefore, in order to achieve the previously stipulated results, it was necessary to invest funds in the creation of a climate monitoring platform with dense network infrastructure and variable collection points.

## Results

As the action has recently started, it is still not possible to measure the results. The expected benefits include characterization and understanding (with detail and precision) of the impacts of atmospheric features in the region of study, allowing, in the long and medium term, the planning, preparation and adaptation of strategies for extreme events. Another expected result is the consolidation of the Territorial Intelligence Center in the development of research in the area of Water Security and Sustainable Regional Development.



4.

## **CLIMATE MONITORING PLATFORM**





SMEC platform - Alexandre Marchetti / Itaipu Binacional

## Objective and Description

The main objective of this activity is to establish a standardized database of meteorological and climate data that allows different actors to analyze variability and climate trends in the region under different perspectives. The Climate Monitoring Platform, with an extensive network and multiple collection points covering many variables, provides valuable support to all the stakeholders for the analysis and understanding of impacts from natural phenomena. Therefore, research projects, public policy planning, interventionist actions and decision-making can be based on a scientific basis, making results more efficient and accurate.

Itaipu has supported this activity in all of its areas of influence since 2011, in partnership with the Itaipu Technology Park (PTI), the Agronomic Institute of Paraná (IAPAR) and the State University of Western Paraná (UNIOESTE). The climate monitoring platform includes stations distributed all around its area of influence.

The Climate Monitoring Platform includes four

modules: acquisition, transmission, storage and analysis. This structure allows the improved use of particular technology concepts in each of these modules supporting their objectives. The acquisition and transmission modules are based on the Internet of Things (IoT). The storage module is implemented through Big Data processing; the analysis module uses notions of Artificial Intelligence and Business Intelligence.

The characteristics of the Platform also allow the expansion of its use to store and integrate environmental data from other projects developed by Itaipu or partner agencies. Examples of such projects may include the monitoring of quality and quantity of surface and groundwater or the identification of fauna species in the areas of protection.

## Related Targets

These activities are related to Targets 13.1, 13.2 and 13.3. They strengthen resilience and adaptive capacity to climate change. The Platform allows Itaipu to integrate climate change measures in its policies, strategies and planning, and supports education and human and institutional capacity on climate change mitigation and adaptation

fields of concern is also a critical issue. Therefore, Itaipu has carefully established partnerships with institutes of education and research in technology and innovation and in fields of interest such as agronomy.

## Challenges

The main challenge for Itaipu has been to build a high-quality platform for environmental variable monitoring projects with a robust infrastructure for data collection, transmission and analysis. This is a difficult task for this region and for Latin America in general. In order to achieve good results, Itaipu had to invest additional resources in research and development to absorb more efficient technologies, particularly in field data acquisition and transmission.

## Results

The structuring and establishment of a concise database is the premise for the development of climate-related scientific initiatives in the region. From this point of view, the development of the Climate and Meteorology Monitoring Platforms is a very valuable accomplishment and only the beginning of a series of products, projects and research that will allow deepening the technical knowledge and understanding of the climate phenomena.

In addition, this activity has also allowed the learning and implementation of new technologies, especially for data collection and transmission, which brings significant improvement to the network's monitoring process. As a consequence, new skills are being absorbed by technical staff and partner researchers.

## Lessons learned

Itaipu has learned valuable lessons from this activity. It is important to implement solutions that are integrated among all the steps of the monitoring process (collection, transmission, storage, and analysis), but that are, at the same time, still technically independent. For instance, the use of a new atmospheric station technology for data collection should preferably not impact the transmission, storage and analysis steps, but connect with them in an integrated manner to achieve more effective solutions. This modular independence allows flexibility and agility in the adoption of new technologies and facilitates the improvement of results.

Having specialists for each of the modules and in the

Finally, the Atmospheric Monitoring Platform has a total of 105 integrated monitoring stations so far. They are distributed throughout the state of Paraná, and one of their functions is to provide extra help to rural producers to improve productivity and data collection of relevant environmental variables. When analyzing the influence of variables, such as the amount of rain and sunshine in the soil during the agricultural process from planting to harvesting, it has been possible to optimize irrigation systems and the use of pesticides.



**5.**

**PROMOTION  
OF RENEWABLE  
ENERGY**





Biomethane Demonstration Unit inside Itaipu  
Itaipu Binacional

**Itaipu** conducts various activities designed to promote the use of renewable energy. These efforts contribute to the global goals on climate change mitigation by reducing anthropogenic emissions of GHG. Some of these activities include: development of a production chain for silicon-based photovoltaic panels; implementation of solar thermal projects; installation of solar-wind hybrid systems; creation of the International Center for Renewable Energy with emphasis on the development of biogas processes and biogas demonstration units; training courses on solar photovoltaic energy; Western Paraná energy planning; the Atlas of Wind and Solar Potential Energy of Paraguay, and the State of Paraná Solar Energy Atlas, in Brazil.

Itaipu also has a representative as the Coordinator of the Observatory of Renewable Energies of Paraguay (OER-PY). The OER is a program of inter-institutional and multidisciplinary technical cooperation that coordinates and promotes sustainable development with the purpose of increasing the use of renewable energy, energy efficiency and the diversification of the energy matrix.

## Objective and Description

The overall objective of these activities is to create awareness, disseminate knowledge and promote the use of renewable energy technologies and their positive impacts on climate change mitigation.

Itaipu is supporting Brazil and Paraguay in developing a production chain for silicon-based photovoltaic panels in

the border region between the two countries. The project will have positive economic impacts while enhancing social and environmental responsibilities, particularly in relation to climate change. The project is still in its developing phase, which includes defining responsibilities among the different players involved and establishing a road map for necessary actions to be taken in the future.



In Paraguay, during the construction of the “San Francisco Neighborhood” social housing project, Itaipu provided a solar thermal water heating system for the neighborhood that included 112 solar water heaters. The system was able to reduce by 76% the electric load of the served homes.

Also in Paraguay, Itaipu supported the installation of a Hybrid Electric Generation System for secure energy supply in the isolated area of Chaco. The system is based on solar photovoltaic and wind technologies, which have been providing reliable electricity in this rural area where there is no access to the grid.



Photovoltaic panels in the Paraguayan Chaco  
- /Itaipu Binacional

The goal of the International Center of Renewable Energy is to support the development of public policies that regulate and encourage the use of biogas.

Knowledge dissemination about biogas production has been supported by Itaipu since 2011. It includes training courses, data sharing and availability of reliable, organized and centralized information. Capacity building activities take place at national and international levels. At national level, the work is mainly in western Paraná, Brazil. At international level, Itaipu has conducted training activities in 27 countries in different parts of the world, including Central and South America and the Caribbean.



Colombari Farm - Nilton Rolin/Itaipu Binacional

Itaipu also maintains biogas demonstration units as part of its activities of supporting the development and use of biogas. It also conducts a program for monitoring and continuous improvement of the biogas demonstration units. The units are designed to treat effluents and organic waste through anaerobic digestion, focusing on biogas production. The demonstration units are located in the cities of Foz do Iguaçu, São Miguel do Iguaçu, Santa Helena, Marechal Cândido Rondon, Entre Rios do Oeste and Céu Azul, all in Paraná state, in Brazil.

The program consists of three steps: elaboration of cooperation terms between demonstration units and the International Center of Renewable Energies – Biogas (CIBiogás); elaboration of the Monitoring and Continuous Improvement Plan; and Implementation of the Monitoring and Continuous Improvement Plan. The involvement and motivation of the owners of the demonstration units are essential for monitoring and improving program effectiveness. CIBiogás monitors the demonstration units on a fortnightly basis.

Itaipu conducts courses on solar photovoltaic energy technologies and its applications. The courses are offered to people who live in the cities that are members of the Association of Municipalities of Western Paraná. The courses promote this renewable energy technology by educating the participants on the local and global benefits of using solar energy,

including its impacts on climate change mitigation.

The Western Paraná energy planning program has been supported by Itaipu since 2017. It represents a long-term planning of the region's energy sector, including guiding trends and targeting alternatives to expansion of the electric system in the next decade, with an integrated perspective of available resources, including new renewable sources of energy. The planning covers 54 municipalities linked to the West Development Program. The program uses 2016 as the base year of information, and it develops demand projections for the period of 2017-2026. Considering the energy scenario and its impact in the western Paraná, the project aims at contributing to energy security, taking into consideration the region's development. It is based on a clean and renewable energy matrix, that allows the use of local energy resources and aims at reducing overall energy costs and environmental impacts.

Itaipu participated in the development of the Atlas of the Wind and Solar Potential Energy of Paraguay and the Atlas of the State of Paraná Solar Energy. The objective of the Atlas is to share data about the potential of solar and wind energy in the territory in an interactive way, with easy access and free of cost. Obtaining and providing more accurate information about solar irradiation and estimated productivity of photovoltaic systems will allow greater interest regarding solar energy investments throughout the region, from small to large investors. This also allows more research to be carried out in different areas that need this energy source.

In the state of Paraná, in Brazil, Itaipu is conducting a study to determine the technical and economic viability of using solar photovoltaic technology in rural areas for agribusinesses. The program is being implemented in cooperation with the Itaipu Technology Park (PTI), the Cooperative Organizations of Paraná and the Brazilian Support Service to Micro and Small Enterprises. One of the main objectives is to determine the real cost for the installation of photovoltaic panels, their efficiency and useful lifetime.

## Related Targets

These activities are related to targets 13.2 and 13.3. They represent policies, strategies and planning measures by Itaipu of an integrated approach to renewable energy and climate change (Target 13.2). They also seek to improve education, awareness-raising and human and institutional capacity on climate change mitigation (Target 13.3).

## Challenges

Promotion of renewable energy by Itaipu has encountered interesting challenges. Nevertheless, most of these challenges have been overcome in the last years.

The production chain for silicon-based photovoltaic panels has faced difficulties due to the fast technological advances in the solar panel production chain, competitiveness in the global market, changes in business strategies and related government policies.

The lack of knowledge on the potential use of solar photovoltaic technology makes producers uneasy about investing in it. To solve this problem, Itaipu has invested in training courses related to solar technology.

With respect to biogas projects, the main challenges relate to the difficulty in raising awareness and interest in the benefits of producing biogas and demonstrating the significance and relevance of this natural resource regarding power supply as well as environmental issues. For the demonstration unit, a barrier is the lack of skilled personnel and suppliers and the lack of relevant laws and incentive policies.

The Western Paraná energy planning program faces low interest from the population due to their unfamiliarity with energy planning programs and their benefits.

For the State of Paraná Solar Energy Atlas, the large



number of partners implied the need to be able to meet different expectations within a limited budget. This was a huge challenge for this project. Distant institutions, difficulty of face-to-face meetings and several agendas at the same time have been limiting factors.

## Lessons Learned

An important lesson from the silicon PV panel production chain project is that the fast technological advances and recent political changes in the region result in the need to implement updates in marketing and strategic plans and in the integrated feasibility study for activities to be performed by each country.

From the Biogas projects, it is clear that there is very limited good quality data on the subject, and that digital data presented in a user-friendly way could be very valuable and promote interest.

The coordination required to collect reliable information is just as important as the accounting methods for energy balance from international agencies, when it comes to developing an energy planning program as the one developed for the Western Paraná.

From the Paraná Solar Energy Atlas, developed by several institutions, the lesson is that a control mechanism is necessary to achieve the results expected by all the partners.

people were reached through social networks and media. Also, an online biogas library was created, to store and centralize information and publications related to the subject. The biogas demonstration units allowed improved efficiency and outputs in effluent treatment systems, electric power generation and reduction of GHG emissions.

The PV courses have already instructed 26 technicians/engineers from the Paraná Company of Rural Technical Assistance (EMATER) on dealing with rural producer's questions regarding the generation of photovoltaic energy.

The results of the Western Paraná energy planning program are being monitored through meetings of the Energy Technical Chamber of the West Development Program, where the main regional players discuss the results and the next steps to take. A detailed energy area diagnosis was carried out, bringing forward guidelines on the continuity and quality of electric power supply in agribusiness. The potential of electric energy production with biogas and photovoltaic units was identified, as well as the projection of the consumption and charging of the electric system for the next 10 years, considering a decennial plan of energy consumption in different sectors.

The web portal that provides the Paraná Solar Energy Atlas is being spread through news agencies. More than 7,000 sessions with more than 14,000 views have taken place.

## Results

The silicon PV panels' project is expected to have very positive results with respect to job creation, economic development, technology knowledge enhancement and, ultimately, prosperity for the region.

The Biogas capacity building activities have resulted in more than 1,600 students being trained; over 275,000



6.

**EARLY FLOOD  
WARNING SYSTEM  
(SATI)**



Rainwater tanks - Rubens de Souza André/ Itaipu Binacional

## Objective and Description

Since 2018, Itaipu has been working on the installation of an early flood warning system (SATI), which will provide support by means of preventive actions in real time in cases when rivers could experience rapid overflowing due to unexpected atmospheric and hydrological changes.

The Early Warning System for Floods supports decision making processes regarding adverse hydrological phenomena in the Paraguay River and provides essential information to planning processes relevant to the management of associated risks. The system covers vulnerable populations of 24 riverside municipalities in 6 Departments of Paraguay. The implementation of this action is intended to be carried out by the Board of Meteorology and Hydrology.

The development of SATI is being carried out by the International Hydrology Center (CIH), interacting with the Directorate of Meteorology and Hydrology and in cooperation with a number of academic institutions. It uses technology fully developed by CIH based on

hydrological data used in real time to model river basin behavior. The system allows the elaboration of automated maps depicting possible flooding risk scenarios and is freely available in a web platform. The work carried out has been published in an indexed scientific journal (Vera & Vasquez, 2018).

In cooperation with the Center for Appropriate Technology of the Catholic University (UCA), consistent mathematical models have been developed to forecast the behavior of the Paraguay River for 12 days, from Porto Murtinho (Brazil) to Pilar (Paraguay). The implementation plan of this valuable system is currently being proposed for other relevant key national institutions.

## Related Targets

The early flood warning system is directly related to Target 13.1 because it relates to strengthening resilient and adaptive capacity to climate-related hazards. Also, it



is directly related to Target 13.3 since it enhances the human and institutional capacity on climate change adaptation, impact reduction and early warning. Furthermore, it intends to allow the transfer of technology on this important early warning system to appropriate public entities at regional and national levels.

## Challenges

Itaipu has experienced a number of challenges, particularly related to obtaining hydrometeorological, cartographic and remote sensing data from various institutions. These data need further processing given the different formats and structures in which they are available. Another main challenge is related to the operationalization of the large computational volume of the processes and the difficulties of developing the physical simulations of the Paraguay River's behavior.

## Lessons Learned

Itaipu understands the importance of involving all relevant stakeholders in the development of such an important system. Such involvement, particularly from public and academic sectors, has resulted in a very successful, innovative and fruitful experience with very valuable results so far.

## Results

Although further development is necessary to complete the overall Early Warning System for Floods, a WEB platform is already available to the public at (<https://hidroinformatica.itaipu.gov.py/yrato/>). The system can be used to forecast water levels and flows in different sections of the Paraguay River, delimiting areas affected by floods for a time period of up to 12 days in advance, in over 24 municipalities in 6 Departments of Paraguay.



7.

**CENTERS FOR EMERGENCY  
SUPPLIES IN CASE OF  
CATASTROPHIC EVENTS IN  
MINGA GUAZU AND SALTO  
DEL GUAIRA, PARAGUAY**



Delivery of badges to victims - Ever Portillo / Itaipu Binacional

## Objective and Description

Itaipu provides strong support to a center for emergency supplies in case of extreme climatological events located in Minga Guazu and Salto del Guaira. The centers were established in partnership with the Paraguayan National Emergency Secretary and other governmental and non-governmental organizations (ITAIPU, 2017 b).

The main objective of the centers is to provide emergency assistance to families and organizations affected by unexpected catastrophic events, such as floods, windstorms, landslides, hail events, etc. The centers strengthen timely responses with basic supplies such as blankets, mattresses, tents, zinc roof materials, containers and other important supplies critical to families who may have their dwellings partially or totally destroyed due to these unexpected events. The effort includes the use of vehicles specifically acquired for these purposes and temporary living facilities. In addition, the centers are backed by a control informatics system, qualified personnel, emergency offices and drone technologies.

## Related Targets

This activity is directly related to Target 13.3, which specifies the need to improve human and institutional capacity on climate change adaptation, impact reduction and early warning. It is also related to Target 13.1 on strengthening resilience and adaptive capacity to climate-related hazards and natural disasters, and to Target 13.2 on integrating climate change measures into national policies, strategies and planning.

## Challenges

The reduction of disaster risks and the minimization of their impacts on the population is becoming more challenging. Although statistical analysis of climatological events in recent years provides some relevant information, strengthening human and institutional capacity for rapid responses represents a difficult task. In general, unexpected climatological events are becoming more frequent and more intensive, and, at the same time, less predictable.



## Lessons Learned

The centers are the result of statistical studies conducted in Paraguay, which reflect an increasing number of unexpected climatological events in the area. The analysis indicated the need for timely emergency assistance in the form of materials, equipment and basic supplies to areas that are affected by these unexpected events that could become catastrophic for many communities and particularly affect poor segments of the population.

## Results

This effort has already assisted thousands of families affected by climatological events in the last several years. The partnership is a good example of cooperation among different stakeholders with tangible positive results that are benefiting many affected communities in Paraguay. The centers reflect Itaipu's commitment to activities supporting the social dimension of sustainable development.



# Our actions in the SDGs

Our approach - Integrated actions in the territory

The interlinkages between climate change related activities (SDG13) and other SDGs are vast. The strongest interlinkage is related to energy (SDG7), given the fact that Itaipu is the largest world generator of renewable energy in the form of hydroelectric power, with extraordinary positive consequences in relation to climate change mitigation. The interlinkage is also very strong in relation to water (SDG6), terrestrial

ecosystems/forests (SDG15), and economic growth (SDG8). Another strong interlinkage is with respect to partnerships (SDG17), given Itaipu's great commitment to supporting global climate change goals and its long-term partnerships with international, national, local and regional organizations committed to the protection of water and terrestrial ecosystems and to the pursuit of sustainable development.





Inside of a Generating Unit - Víctor Azcona / Itaipu Binacional







Servomotors - Alexandre Marchetti/ Itaipu Binacional

The sustainable development strategy of Itaipu and its comprehensive program of activities related to climate change, coupled with the optimum integrated management of water resources and protection of water and terrestrial ecosystems, represent an excellent example of the implementation in the field of SDG13 on climate change and the UN 2030 Agenda for Sustainable Development.

The strong interconnection between climate change and energy, water and ecosystems is evident for Itaipu, and the current activities and policies related to climate change are key to support global efforts on climate change mitigation, resilience and adaptation, inducing sustainable development and prosperity. Itaipu has been able to generate clean and reliable energy for over 35 years, avoiding the use of fossil fuels and the emission of millions of tons of GHGs to the atmosphere annually.

Itaipu is conducting valuable activities in support of mitigation and adaptation to climate change, and increased resilience, with successful results. In addition to generating reliable and clean electricity, Itaipu has

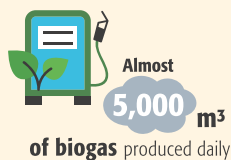
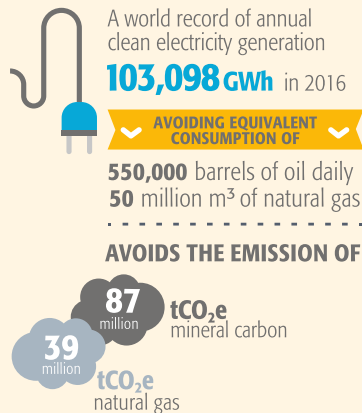
been implementing a comprehensive and extensive program of reforestation and remediation in its areas of influence for decades, and is providing support for the native fauna recovery through in situ and ex situ conservation processes. Also, Itaipu is strongly supporting the promotion of other forms of renewable energy to satisfy the needs of the transportation, agriculture, industrial and residential sectors of the economy, minimizing waste generation and helping to further mitigate climate change effects. Finally, Itaipu is implementing a comprehensive program on data collection, statistical analysis and parameter simulations that is allowing the assessment of current and future impacts resulting from climate change.

A summary of specific accomplishments resulting from Itaipu's climate change mitigation and adaptation activities is illustrated in the diagram below. It demonstrates the integrated and interconnected approach of Itaipu with respect to the social, economic and environmental dimensions of sustainable development.



# INFOGRAPHIC

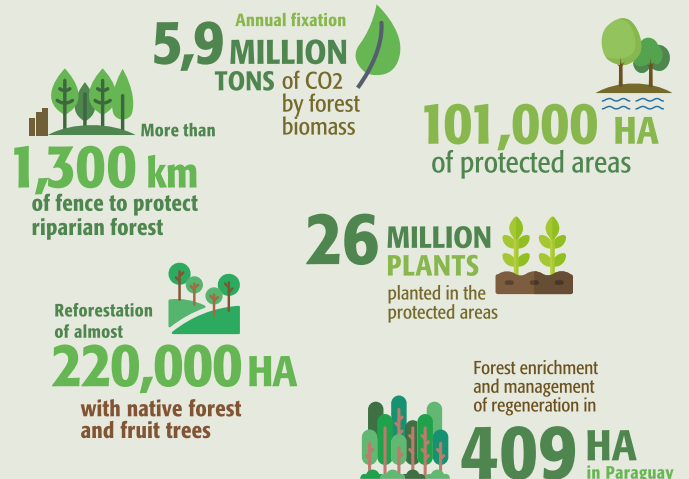
## SDG13 CLIMATE CHANGE



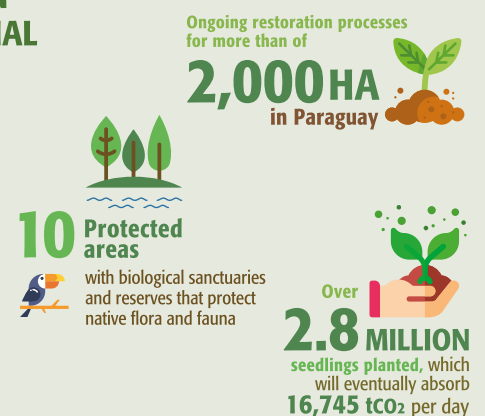
Creation of  
**International Center  
 on Renewable Energy**

Construction of  
**SOLAR THERMAL PARK**

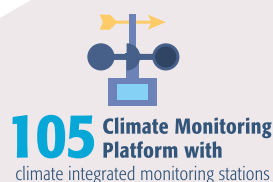
### RENEWABLE ENERGY SOURCES



### RESTORATION OF TERRESTRIAL ECOSYSTEMS



### AWARENESS, MONITORING AND CAPACITY DEVELOPMENT



Courses offered in **solar photovoltaic technologies**

Creation of **online biogas library**

Building a comprehensive inventory on **GHG emissions** based on internationally procedures and standards



More than **1,600** students being trained and over **275,000** people reached through social networks and media on biogas technologies and processes



Web portal of the **Paraná Solar Energy Atlas** reaching news agencies. More than **7,000** information sessions conducted with more than **14,000** views.



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Aerial view of the dam  
Daniel Snee/Itaipu Binacional









# 13

CLIMATE  
ACTION

