

## 3. AVAILABLE RENEWABLE ENERGY SOURCES

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Uruguay has natural resources that allow for the development of renewable energies. A high water flow, constant and predictable winds, uniform solar irradiation throughout the territory (although with seasonal variation) and a thriving agro-industrial sector provide opportunities from biomass.

### What are renewable energies?

Renewable energy is energy from virtually inexhaustible sources, either because of the huge amount of energy they contain or because they can be naturally replenished. The main sources of renewable energy include solar energy, wind energy, hydropower, tidal energy (obtained by harnessing the energy of tides), geothermal energy (obtained by harnessing the heat generated within the Earth) and biomass. Renewable energies are defined as opposed to non-renewable energies, which are those found in nature in limited quantities.

#### 3.1.1. HYDROPOWER

Hydropower generation in Uruguay is the main source of electricity. The hydropower generation system is made up of three cascade power plants on the Río Negro: Gabriel Terra (Rincón del Bonete), with an installed capacity of 152 MW; Baygorria with 108 MW and Constitución (Palmar) with 333 MW; and a binational power plant on the Uruguay River (Salto Grande) with a capacity of 1,890 MW, of which 945 MW correspond to Uruguay and the rest to Argentina.

Salto Grande generated 63% of the hydroelectric power in 2020, while Palmar supplied 20%, Gabriel Terra 10% and Baygorria 8%. Currently, large-scale hydropower use in Uruguay is close to its maximum limit. However, there is additional capacity for the installation of small hydropower plants (SHPs) that could eventually become an additional source of supply.

#### 3.1.2. WIND ENERGY

In recent years, wind energy has become more reliable and has found its way into the electricity systems of many countries. Uruguay is no stranger to the international context and has entered into a wind energy development program with strong investments, allowing it to take advantage of the great availability of the resource in the country.

Uruguay's topographic characteristics, with large plains and almost no obstacles, guarantee constant and predictable wind availability<sup>1</sup>. So far, all development and expansion of wind generation capacity has been onshore. The feasibility of installing offshore wind power plants, which have had an important development in some northern European countries, has not been explored.

TABLE No. 2 - PRIVATE WIND ENERGY GENERATORS

Generator	Generator Agent	Primary Source	Installed Capacity
PERALTA I GCEE	AGUA LEGUAS S.A.	Wind	58.75 MW
PERALTA II GCEE	AGUA LEGUAS S.A.	Wind	58.75 MW
TALAS DEL MACIEL I	ASTIDEY S.A.	Wind	50 MW
TALAS DEL MACIEL II	CADONAL S.A.	Wind	50 MW
CORFRISA	CORPORACIÓN FRIGORÍFICA DEL URUGUAY	Wind	1.8 MW
ENGRW	ENGRW EXPORT & IMPORT CO. S.A.	Wind	3.6 MW
MELOWIND	ESTRELLADA S.A.	Wind	50 MW
PARQUE EÓLICO CARAPÉ I	FINGANO S.A.	Wind	51 MW
MINAS I	GENERACIÓN EÓLICA MINAS S.A. - GEMSA	Wind	42 MW
PARQUE EÓLICO FLORIDA II	GLYMONT S.A.	Wind	49.5 MW
PARQUE EÓLICO 18 DE JULIO	IKEROL COMPANY S.A.	Wind	10 MW
PARQUE EÓLICO JULIETA	IWERYL S.A.	Wind	3.6 MW
PARQUE EÓLICO MAGDALENA	KENTILUX S.A.	Wind	17.2 MW
PARQUE CERRO GRANDE	LADANER S.A.	Wind	50 MW
LUZ DE LOMA	LUZ DE LOMA S.A.	Wind	20 MW
LUZ DE MAR	LUZ DE MAR S.A.	Wind	18 MW
LUZ DE RÍO	LUZ DE RÍO S.A.	Wind	50 MW
MARYSTAY	MARYSTAY S.A.	Wind	2 MW
PALOMAS	NICEFIELD S.A.	Wind	70 MW
PARQUE EÓLICO LOMA ALTA - CENTRAL 1	NUEVO MANANTIAL S.A.	Wind	14 MW
NUEVO MANANTIAL CENTRAL 2	NUEVO MANANTIAL S.A.	Wind	4 MW
CUCHILLA DEL PERALTA I	PALMATIR S.A.	Wind	50 MW
PARQUE EÓLICO KIYÚ	PARQUE EÓLICO KIYÚ S.A.	Wind	49.2 MW
PARQUE EÓLICO FLORIDA I	POLESINE S.A.	Wind	50 MW
PARQUE EÓLICO SOLÍS DE MATAOJO	POSADAS & VECINO S.A.	Wind	10 MW
PARQUE EÓLICO MALDONADO II	R DEL ESTE S.A.	Wind	50 MW

<sup>1</sup> A survey conducted by the MIEM and the School of Engineering of the University of the Republic in 2009 has allowed for the creation of a national wind energy map - [Wind Energy Program in Uruguay](#) (PEEU).

PARQUE EÓLICO MALDONADO	R DEL SUR S.A.	Wind	50 MW
PARQUE EÓLICO VENTUS I	República Administradora de Fondos de Inversión S.A.	Wind	9 MW
PARQUE EÓLICO VILLA RODRÍGUEZ	TOGELY COMPANY S.A.	Wind	10 MW
PARQUE EÓLICO LIBERTAD	TOGELY COMPANY S.A.	Wind	7.7 MW
PARQUE EÓLICO ROSARIO	TOGELY COMPANY S.A.	Wind	9 MW
PARQUE EÓLICO MARÍA LUZ	TOGELY COMPANY S.A.	Wind	9.75 MW
PARQUE EÓLICO CARAPÉ II	VENGANNO S.A.	Wind	40 MW
PARQUE EÓLICO NUEVO PASTORALE I	VIENTOS DE PASTORALE S.A.	Wind	52.8 MW

Source: Prepared by Uruguay XXI based on UTE data.

### 3.1.3. SOLAR ENERGY

Uruguay is located in a geographical latitude range from 30° 04' to 34° 53'. The annual average daily global irradiation on a horizontal plane over the Uruguayan territory is 4.6 kWh/m<sup>2</sup>. The Solar Energy Laboratory (LES)<sup>2</sup> of the University of the Republic (UdelaR) has very detailed geographical and temporal information about solar resource characteristics.

In recent years, the installed capacity of large-scale photovoltaic energy parks, as well as small and medium-scale facilities, has increased sharply. As for solar thermal energy facilities, these have also undergone significant development in Uruguay in recent years, increasing from an area of 50,000 m<sup>2</sup> in 2014 to almost 100,000 m<sup>2</sup> (according to the National Energy Balance 2020).

TABLE No. 3 - PRIVATE SOLAR ENERGY GENERATORS

Generator	Generator Agent	Primary Source	Installed Capacity
ALTO CIELO	ALTO CIELO S.A.	Solar Photovoltaic	20 MW
CASALCO	CASALCO S.A.	Solar Photovoltaic	1.76 MW
TS	CERNERAL S.A.	Solar Photovoltaic	1 MW
EL NARANJAL	COLIDIM S.A.	Solar Photovoltaic	50 MW
DICANO	DICANO S.A.	Solar Photovoltaic	11.25 MW
FENIMA	FENIMA S.A.	Solar Photovoltaic	9.5 MW
ARAPEY SOLAR	GIACOTE S.A.	Solar Photovoltaic	10 MW
MENAFRA SOLAR	GIACOTE S.A.	Solar Photovoltaic	20 MW

<sup>2</sup> [Solar Energy Laboratory](#)

ABRIL	GILPYN S.A.	Solar Photovoltaic	1 MW
LA JACINTA	JACINTA SOLAR FARM S.R.L.	Solar Photovoltaic	50 MW
DEL LITORAL	JOLIPARK S.A.	Solar Photovoltaic	16 MW
NATELU	NATELU S.A.	Solar Photovoltaic	9.5 MW
PETILCORAN	PETILCORAN S.A.	Solar Photovoltaic	9.5 MW
RADITON	RADITON S.A.	Solar Photovoltaic	8 MW
VINGANO	VINGANO S.A.	Solar Photovoltaic	1 MW
YARNEL	YARNEL S.A.	Solar Photovoltaic	9.5 MW

Source: Prepared by Uruguay XXI based on UTE data.

### 3.1.4. BIOMASS

Biomass is described as “any organic matter that can be used as energy”. This concept covers products and by-products of woody and herbaceous origin, including also certain industrial and municipal wastes. In recent years, Uruguay has undergone a major change in its agricultural sector, with a strong expansion in the production of crops such as soybean, rice, and wheat.

At the same time, forestry in Uruguay has seen a significant expansion, reaching almost one million hectares of forested land, which has allowed for the development of mechanical wood processing industries. The development of energy production from non-traditional biomass has taken place in this context of a growing forestry sector and pulp industry, and within the framework of a State energy policy aimed at promoting renewable energies. The advantages of biomass as a source are mainly associated with its potential management capacity and its ability to act as a backup for the electricity system.

TABLE No. 4 - PRIVATE BIOMASS GENERATORS

Generator	Generator Agent	Primary Source	Installed Capacity
ALUR	ALCOHOLES DEL URUGUAY S.A.	Biomass	10 MW
BIOENER	BIOENER S.A.	Biomass	12 MW
MONTES DEL PLATA	CELULOSA Y ENERGIA PUNTA PEREIRA S.A.	Biomass	180 MW
FENIROL	FENIROL S.A.	Biomass	10 MW
GALOFER	GALOFER S.A.	Biomass	14 MW
ARBORETO	LANAS TRINIDAD S.A.	Biomass	0.6 MW
LIDERDAT	LIDERDAT S.A.	Biomass	5 MW
PONLAR	PONLAR S.A.	Biomass	7.5 MW
URUPLY	URUPLY S.A.	Biomass	12 MW
UPM	UPM	Biomass / Fuel Oil	161 MW

UPM 2	UPM	Biomass	310MW
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On the other hand, an important effort has been made by the public sector to analyze the country's potential for the generation of this type of energy. Examples of this are the already completed [PROBIO](#) and [BIOVALOR](#) projects.

### 3.1.5. FOREST RESOURCES

In recent years, electricity generation projects using forestry and agricultural residues have been established in the country, as a result of bidding processes that promoted investment. Uruguay has a high percentage of wood to be processed by the industry and, therefore, there is great potential for the revaluation of by-products from the mechanical wood processing chain.

Forest industry operations produce large amounts of waste in different processes, which can be used to promote the production of different biochemical products, biomaterials, and advanced biofuels. Uruguay currently enjoys the status of country with bioeconomy-oriented policies and is committed to diversified and higher value-added forestry production transformation.

### 3.1.6. AGRICULTURAL AND LIVESTOCK WASTE

There are currently several energy generation experiences from other agricultural residues, although it is estimated that these resources are currently underexploited. One of the first sources of energy of this kind used in the country has been rice husks, with two enterprises currently processing this waste and another one experimenting with the use of sugar cane bagasse.

Regarding waste generated by livestock activities, there are also experiences of biogas production from anaerobic digestion in the dairy and wool industries.

### 3.1.7. LIQUID BIOFUELS

Uruguay—as an important agricultural producer—has the necessary conditions for the production of liquid fuels from biomass. Bioethanol and biodiesel production has increased in the last decade. In 2020, the biomass supply for the production of biofuels was 2% of the total energy supply. These biofuels were generated exclusively from domestic raw materials, as established in the Agrofuels Law (No. 18,195).

The company ALUR S.A. (90.79% owned by Ancap) is the main producer of agrofuels in the country. It has a bioethanol production capacity of 92,200 m<sup>3</sup>/year, mainly used to supply Ancap, where it is blended with gasoline at a rate of approximately 10%. In addition, it has an annual production capacity of 50,000 tons/year of biodiesel, which is mainly supplied to Ancap, for an approximate 5% blend with diesel oil. The company has also succeeded in placing its products in international markets.

Ancap has an initiative to take advantage of existing biomass resources in accordance with its obligations under Article 67 of the Forestry Law (No. 15,939). Together with the Latitud Foundation of the Technological Laboratory of Uruguay (LATU), Ancap created a research center for second-generation biofuels (CIDEB) from lignocellulosic residues. This center carries out research projects aimed at obtaining second-generation biofuels from lignocellulosic materials originating from forest crops, forest residues or energy crops.

### **3.1.8. URBAN WASTE**

The use of municipal solid waste (MSW) for energy production is a mechanism increasingly used worldwide as a way to mitigate the pollution generated by large urban centers. Uruguay has no medium or large-scale plants for the transformation of urban waste into energy, apart from pilot plans carried out by some municipalities.

The treatment and final disposal of urban waste is the responsibility of each of the country's 19 municipalities. According to the different studies available, it is estimated that MSW disposed of in the main Final Disposal Sites totals 1,100,000 tons/year, of which 780,000 tons/year are from Montevideo.

The national and departmental authorities consider waste recovery through energy production as a necessary action, are interested in developing this type of projects to cover various urban centers and understand that there are opportunities for the participation of private actors.

In September 2019, the Waste Management Law was approved<sup>3</sup>. The law is intended to be a regulatory instrument that frames and regulates waste management, with clear guidelines aligned with the environmental policy. The law is based on a sustainable development model, promoting the revaluation of waste, and supporting new forms of business and employment.

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<sup>3</sup> [Waste Management Law](#)