# RENEWABLE ENERGIES IN URUGUAY


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Uruguay XXI
INVESTMENT, EXPORT AND COUNTRY BRAND PROMOTION AGENCY

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# WHY INVEST IN RENEWABLE ENERGIES?

## 1.1.1. URUGUAY AND ITS SUCCESS TOWARDS DECARBONIZATION

- Without resources such as gas, oil or coal, in 2008 and 2009 Uruguay faced supply problems and high energy production costs due to the global increase in fuel prices.

- In 2010 Uruguay reached a multi-party agreement and adopted as a public policy the energy transition towards local and renewable sources, ensuring its implementation and continuity.

- The **first stage of the energy transition involved more than US$ 8 billion of public-private investment**. The transformation was carried out with the public sector playing the role of system coordinator and administrator of the auction scheme, which provided certainty to national and international private investors.

- **The International Renewable Energy Agency (IRENA[1] ) highlighted the Uruguayan model** and highlighted the call system carried out by the state-owned electricity company, UTE, as examples to follow in its guide for the design of auctions. Private participation through innovative promotion schemes without relying on direct subsidies was highlighted.

## 1.1.2. ELECTRICAL MATRIX

- In a year with regular rainfall, 97% of the national electricity demand is covered by renewable energies. In 2024, this figure will reach 99% including wind (32%), biomass (13%), and solar (3%), in addition to traditional hydroelectric power (51%).

- The first stage of the energy transition positioned Uruguay at the forefront of renewable energies, **placing it as the seventh country in the world with the highest share of variable renewable energies** (such as solar and wind) in its electricity generation, according to information from **REN21 (2024)**. In addition, the country is the leader along with Denmark and Lithuania in wind energy production. [2]

[1] IRENA - Renewable Energy Auctions
[2] Source: VRE generation: REN21 - Renewable 2024 Global Status Report (link)

- Private companies played a key role in the energy transformation. A good example is Ventus, a Uruguayan company specialized in wind and solar energy. Its experience and success in the local market allowed it to export its services to other countries in the region.

### 1.1.3. THE SECOND ENERGY TRANSFORMATION

- Uruguay has opportunities for improvement in the area of energy demand. Fossil fuels account for 40% of the country's total consumption, with a high incidence in the transport and industrial sectors. More than half of carbon dioxide emissions originate from the burning of fossil fuels.

- **Uruguay aims to achieve a model of economic growth consistent with a reduction in greenhouse gas emissions.** The Uruguayan government has developed a series of measures aimed at achieving these objectives:
  - In 2020 the Ministry of Environment was created and Helsinki's premises were incorporated in the Budget Law.
  - In 2021 it developed the roadmap for the production of green hydrogen in the country. The Central Bank of Uruguay (BCU) presented a strategy for the diversification of international reserves based on green bond investment funds. The BCU and the Ministry of Economy and Finance (MEF) agreed to implement the Sustainable Finance Roundtable and a tax on $CO_2$ emissions from the use of fossil fuels was approved.
  - In December 2021, it presented its long-term Climate Change Strategy, which aims for $CO_2$-neutral emissions by 2050.

- The main goals of the second stage of the energy transition are:
  - Direct electrification of end uses.
  - Development of a green hydrogen economy.
  - To consolidate a Smart Grid to efficiently coordinate energy supply and demand.
  - To continue to incorporate energy storage technologies.
  - To expand the possibilities of generating energy from agricultural waste, transforming an environmental liability into an energy asset.
  - To advance in the energy recovery of solid urban waste.
  - To incorporate clean energies into the transportation sector by applying the latest available technologies.

- The **production of green hydrogen** is a natural step for Uruguay in its process of decarbonization of the energy matrix. Uruguay offers advantages:
  - High potential for renewable energy generation.

- High availability of water and biogenic $CO_2$.
- Competitive production costs of green hydrogen and derivatives.
- Strategic location in the region and access to the Atlantic Ocean.
- Logistics and supply chain continuity.
- Tax incentives and government support.

» The government of **Uruguay announced the first major investment in the production of green hydrogen** in the country. It will be carried out by the Chilean company HIF Global with an investment of **US$ 6 billion** including the investment in generation. The project will be located in the department of Paysandú. The construction of the green hydrogen plant will begin in 2026 and is expected to last about 30 months.

# 2. FIRST STAGE OF THE ENERGY TRANSITION

In 2008 Uruguay presented its 2005-2030 energy policy strategy, which established guidelines with a long-term vision that focuses on the diversification of generation and supply sources, the incorporation of renewable energies and the improvement of energy efficiency. In 2010, all parties represented in parliament reached an agreement that laid the foundations for the construction of a public policy.

As a result of the implementation of this national strategy, Uruguay achieved in a short period of time the decarbonization of electricity generation. On average, renewables represented 99% of the electricity matrix in 2024[3] (48% wind, solar and biomass and 51% hydroelectric), significantly reducing greenhouse gas emissions from the energy sector.

## 2.1.ENERGY SUPPLY

In 2023, energy supply reached 6,564 ktoe, which represented a historical record for the country with a 16% increase compared to 2022 levels.

The increase in energy generation was accompanied by a change in the composition of the total energy matrix. Energy from fossil sources significantly reduced its share in the total supply, from

[3] Values between January and November 2024

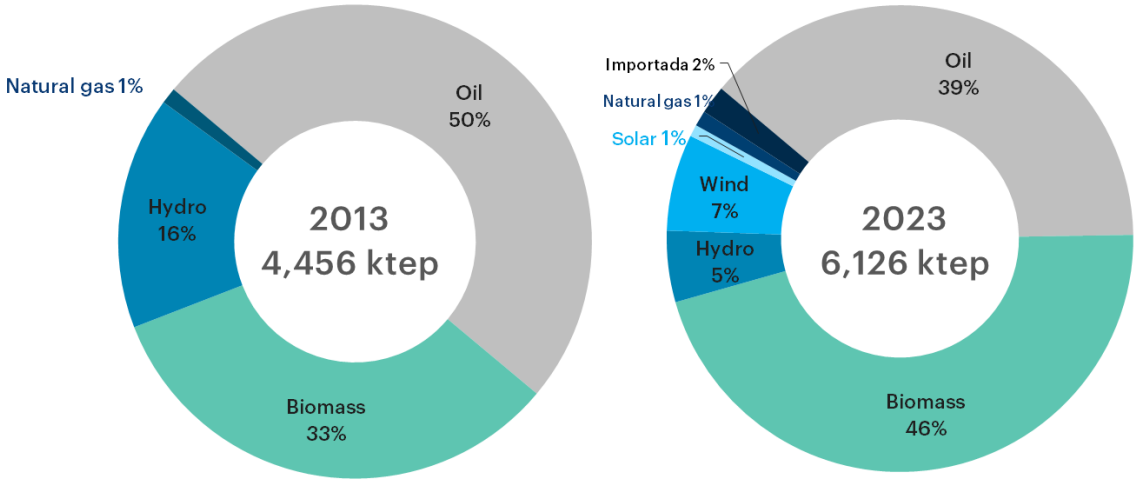
50% in 2013 to 38% in 2023[4]. In contrast, biomass, wind and solar energy increased their relative importance. In 2023, their shares were 46%, 7% and 1%, respectively, while in 2013 neither wind nor solar energy contributed significantly to the supply.

Hydropower decreased its weight in the supply; it went from 13% between 2009 and 2013 to 8% between 2019 and 2023 (5% in 2023). The drop in participation was due to the increase in electricity demand with a generation capacity that remained constant. It should be noted that the country's most relevant water resources are almost fully utilized and the future increase in supply will only be possible through small hydroelectric plants.

Chart N° 2.1

**ENERGY SUPPLY MATRIX-URUGUAY**

(2013 vs. 2023)




Source: Energy Balance, National Energy Directorate of the Ministry of Industry, Energy and Mining (DNE- MIEM).

The drought, lasting from 2020 but intensified strongly in the first half of 2023, strongly affected the participation of renewable energy sources in the electricity generation matrix. In 2023, hydro generation in Uruguay reached its lowest point in two decades[5], registering only 3,429 GWh.

**Renewable energies accounted for 59% of the total energy matrix in 2023** (whereas in 2013 they were 49%), an excellent number by international standards.

Finally, electricity imports have decreased systematically in recent years and currently represent 2% of the country's supply matrix.

[4] The 2018-2023 average is considered to take into account periods of low rainfall recorded in the last year.
[5] ADME Annual Report ( link )

## 2.2. ENERGY DEMAND AND CONSUMPTION

Demand can be characterized by analyzing the distribution of energy consumption by the various sectors of activity.

During the last two decades, the Uruguayan economy experienced the highest period of economic growth since records have been kept, which led to an uninterrupted increase in energy demand. Higher production levels and the introduction of new energy-intensive activities, particularly in the wood and cellulose sector, led to increased demand for energy in industry. The second most important sector in energy demand was transportation, due to higher levels of production and mobility by households.

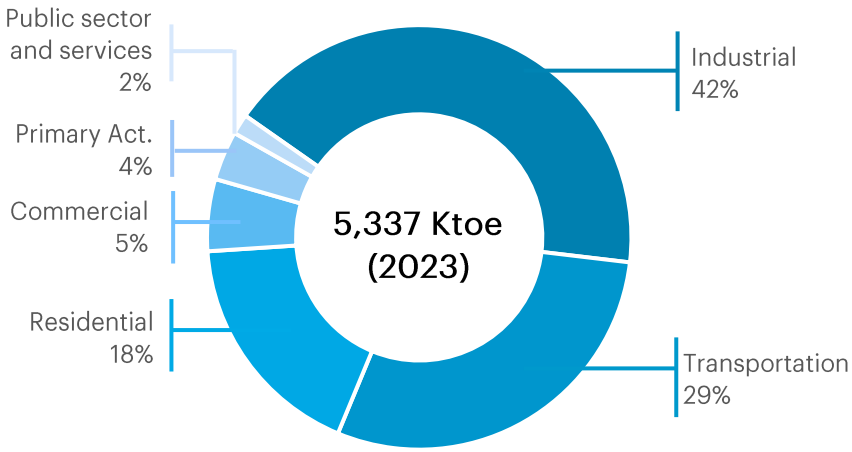
In 2023, total energy consumption was 5,337 ktoe, which implied an increase of 38% compared to 2013 values. Industry was the main energy demanding sector with 48% of the total consumed, followed by transportation with 26% and the residential sector with 16%.

Since 2008, the industrial sector has been the main energy consumer in the country, generating three quarters of the total consumption. With 67%, the most demanded energy is biomass and the pulp and paper industry is the main consumer – which uses waste from its own activity to generate energy and consumes 68% of the industrial sector's total – followed by the wood industry (7%), cement (5%), chemicals, rubber and plastics (4%) and in fifth place slaughterhouses (3%) together with dairy products (3%).

The transportation sector is responsible for 69% of oil derivatives consumption. In 2023, fossil fuel consumption increased 3% compared to 2022. Demand had accelerated in recent years due to the recovery of economic activity and increased post-pandemic mobility with growth of 9% and 5% in 2021 and 2022 respectively.

Chart No. 2.2

**ENERGY CONSUMPTION MATRIX - URUGUAY 2023 (Ktoe)**




Source: Energy Balance, DNE- MIEM.

The National Energy Directorate of the Ministry of Industry, Energy and Mining (DNE) conducted a prospective study of energy demand for 2015-2035[6]. Table No. 2.1 shows the projections of final energy demand by sector for two possible scenarios (both assume the construction of the third pulp mill). The baseline scenario, with the current efficiency measures and presumable technological improvements, assumes that there will be no significant changes within the structure of the sectors. The second scenario assumes the implementation of a series of policies aimed at increasing the efficiency of each sector, deepening the actions of the baseline scenario.

Table No. 2.1

**ENERGY DEMAND BY**
(Average annual growth 2015-2035)

| Scenarios | Residential | Commercial Services | Industrial | Primary Activities | Transportation | Total |
|---|---|---|---|---|---|---|
| **Trend** | 2.0% | 2.9% | 3.2% | 2.8% | 2.8% | 2.8% |
| **Policy and Efficiency** | 0.5% | 1.8% | 2.7% | 2.5% | 2.3% | 2.2% |

Source: DNE

## 2.3. ELECTRIC POWER

Electric power accounted for 42% of total production, with a generation of 1,107 Ktoe in 2023. Electricity exports accounted for 2% of the country's production. Imports represented 11% of the gross supply of electricity, the latter totaling 1,206 Ktoe in 2023.

With an investment of more than US$ 8 billion, the electricity matrix underwent a decarbonization process in the previous decade that positioned Uruguay as a leader in the incorporation of renewable energies.

During 2023, investments in energy infrastructure reached US$ 377 million. In the electricity system, works totaled US$ 337 million and accumulated US$ 1,043 million in the period 2020-2023, 71% of what was foreseen in this government period (US$ 1,467 million). Some US$ 40 million was allocated to the energy program of ANCAP, the state-owned fuel, alcohol, and cement management company. In the electricity system, UTE made progress in expanding capacity and renewing the transmission network, including the construction of a 500 kV line in the north of the country and another in Cardal, with a combined investment of US$ 53 million. Energy efficiency projects were also promoted, including the installation of smart meters. UTE also inaugurated the first stage of the Electric Route, with 311 charging points distributed throughout the country to promote electric mobility. In the commercial area, ANCAP focused its investments on the maintenance and improvement of the La Teja refinery, which included changes in distillation towers and technological adjustments to move towards energy transition.

[6] Prospective Energy Demand Study - DNE.

In 2024, **Uruguay will invest US$ 505 million in the energy sector[7],** with US$ 425 million earmarked for the electricity system and US$ 81 million for ANCAP's energy program. The state-owned company UTE will be the main investor with an expected amount of US$ 265 million, which is included in the agency's five-year plan (2023-2027), which aims to make investments of US$ 1.1 billion. Seventy percent of this amount will be invested in expansion and improvement works for the distribution and transmission of the electric grid[8]. In the transmission system, additional investments of US$ 160 million are expected to complete works in Tacuarembó, Salto, and Cardal. UTE also plans to complete the installation of smart meters in all supplies and complete the rural electrification plan to achieve a 100% electrified Uruguay. For the energy transition, ANCAP will maintain its focus on improving efficiency and reducing the environmental impact of the La Teja refinery, preparing the facilities for the progressive abandonment of fossil fuels.

### 2.3.1. POWER GENERATION

With an extensive network of 83,277 kilometers, electrification covers 99.8% of the country's households. The national electricity system is composed of two extensive high-voltage transmission grids. One network of 1,078 kilometers of 500 kV connects the Salto Grande dam on the Uruguay River and the Terra, Baygorria and Constitución dams on the Río Negro with the metropolitan area of Montevideo, the main consumption center. The other network, with a capacity of 150 kV and a length of 3,923 kilometers, connects the generation plants with practically all the departmental capitals and the main consumption centers, covering a total of 72 150 kV stations.

Uruguay has an installed capacity of approximately 4,900 megawatts (MW) for electricity generation. Wind farms play a significant role, totaling more than 1,500 MW, which is equivalent to 31% of the total capacity. Within this figure are distributed 1,000 MW of private generators and 500 MW of wind farms owned or managed by UTE. Hydroelectric generation capacity contributes with another 1,500 MW; biomass contributes about 400 MW (8%); solar energy represents about 270 MW (5%) and thermal generation plants based on fossil fuels total approximately 1,200 MW, which is equivalent to about 25% of the total generation capacity.

The state-owned energy company UTE plays a fundamental role in the sector, since it produces and acquires electric power from private producers and distributes it to consumers. Contracts entered into with private entities are implicitly guaranteed by the State and, in practice, UTE was the executor of public policies that allowed the diversification of the energy matrix.

Uruguay's electricity system stands out for its high reliability. According to the World Economic Forum's Global Competitiveness Index, Uruguay ranks first in Latin America in terms of the quality of electricity supply in the country. In November 2022, UTE received for the third time the "Gold Award 2022" granted by the Regional Energy Integration Commission (CIER), which qualified it as the best company evaluated by its customers among 35 companies in the region, both public

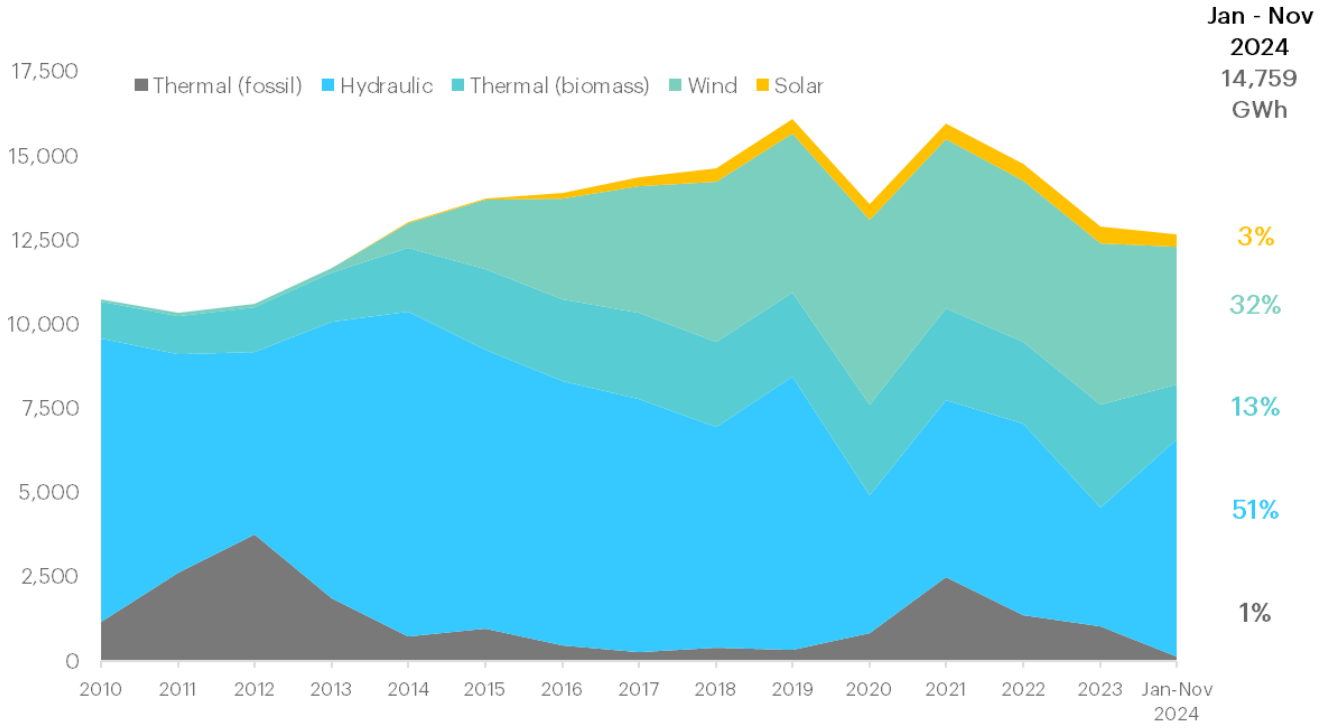
[7] Statement of Reasons for the Accountability 2023 (Link)
[8] Source: El Observador article to the president of UTE (link) and Portal UTE (link).

and private. Uruguay's electricity production in 2022 reached 14,759 GWh, one of the highest historical records, only surpassed in 2019 and 2021.

Chart No. 2.3

**ELECTRICITY GENERATION BY SOURCE (GWH)**

(2010 - Nov 2024)




Source: Created by Uruguay XXI based on data from BEN 2023.[9]

From January to November 2024, electricity generation from renewable sources was 99%, while in 2023 it stood at 92% due to a drop in hydroelectric source caused by the drought. In a year of normal rainfall, the share of renewable energies exceeds 97% of the national electricity demand.

However, despite isolated events in recent years, the trend indicates that non-conventional renewable energy sources, such as wind, biomass and photovoltaic, are gaining prominence in the Uruguayan electricity matrix. In 2023, these sources accounted for 65% of total electricity generation, in contrast to thermal energy production from fossil sources, which experienced a significant decrease in the last decade and accounted for only 4% in the average from 2023 to November 2024.

Three connections with Argentina and two with Brazil allow Uruguay to exchange electricity with other countries in the region. Since 2013, Uruguay has become a net exporter of electricity.

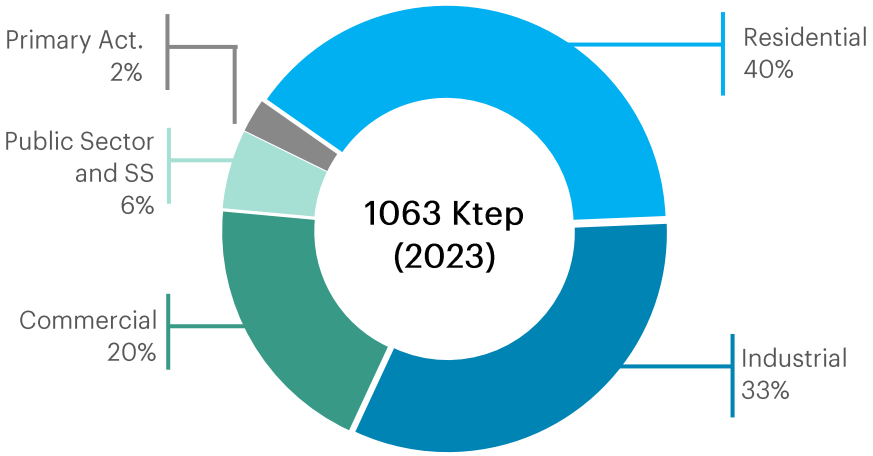
[9] The BEN considers all energy generated in the country, both for self-consumption and generation injected into the National Interconnected System (SIN).

## 2.3.2. ELECTRICITY DEMAND

Electricity consumption totaled 1063 Ktoe in 2023, an increase of 2% year-on-year.

Chart No.2.4

**ELECTRICITY DEMAND BY SECTOR (GWH)**




Source: Created by Uruguay XXI based on data from BEN 2021.[10]

The residential sector is the main electricity demander, with a 40% share of the total, followed by the industrial sector with 33% and the commercial sector with 20% of the total.

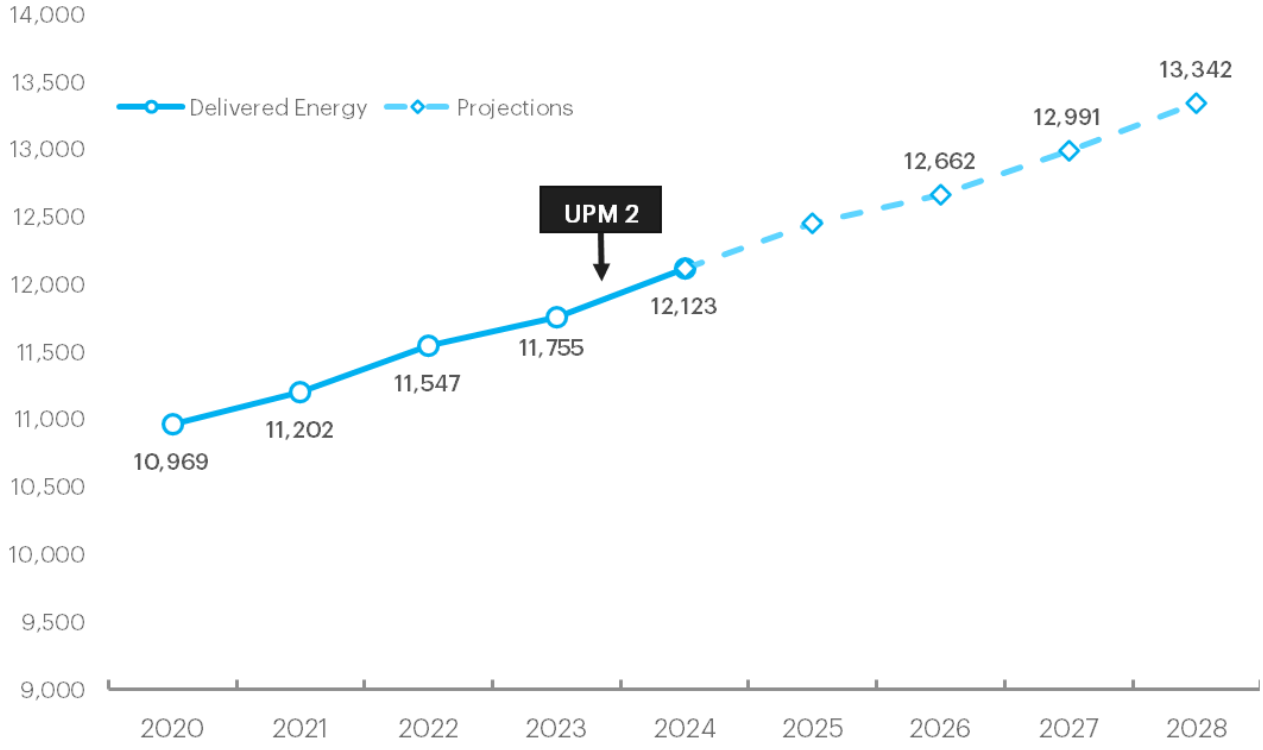
The most recent Seasonal Programming report, created by the Electricity Market Administration (ADME), projects an increase in energy demand at an average annual rate of 3.1% for the period 2025 - 2028.

[10] The BEN considers all energy generated in the country, both for self-consumption and generation injected into the National Interconnected System (SIN).

Chart No. 2.5

**PROJECTED GROWTH IN FINAL ENERGY CONSUMPTION**

2020 - 2028 (Ktoe)




Source: Created by Uruguay XXI based on DNE and ADME.[11]

Looking at electric power production, the sector's medium-term momentum is expected to be linked to an increase in electric mobility, associated with the incorporation of battery-electric vehicles.

## 2.3.3. INTERNATIONAL ELECTRICITY TRADE

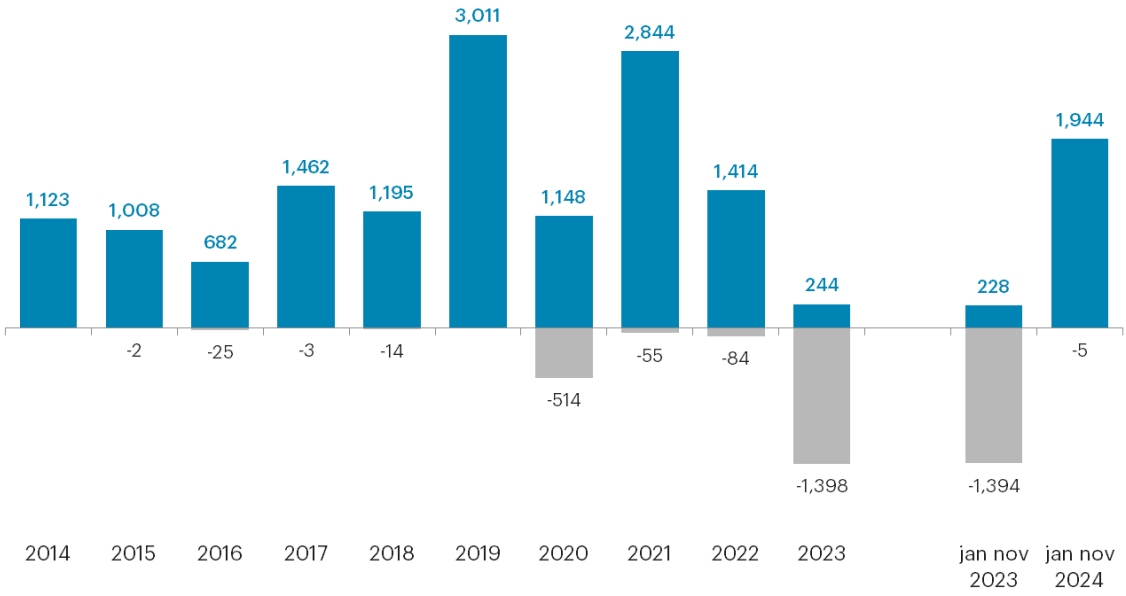
For most of its history, Uruguay depended on energy imports to meet its domestic demand. In the last decade, it improved its electrical interconnection with neighboring countries and diversified its generation sources, which allowed it to produce electricity in a more sustainable manner and at competitive costs. Foreign sales are currently a significant source of income for the country, and have allowed Uruguay to position itself as a net exporter of electricity to the region.

According to UTE data, between January and November 2024, electricity exports totaled 1,944 GWh, which represented 16% of the country's total electricity generation. The end of 2022 and a good part of 2023 were marked by a water shortage that hit UTE's hydroelectric generation hard. As a result, Uruguay's surplus of electricity available for export decreased, a situation that resulted in a 50% drop in the volume of electricity exported and a strong increase in imported energy, which for the first time in twelve years resulted in a negative net balance.

[11] ADME Report for the month of May-2024 (link)

Chart No. 2.6

**ELECTRICITY EXPORTS AND IMPORTS (GWH**




Source: Created by Uruguay XXI based on data from UTE.[12]

During the most critical months of the drought, from February to June 2023, the country imported energy from Brazil to ensure the supply of demand.

From January to November 2024, Uruguay exported 1,944 GWh of electric power, generating revenues of US$ 149 million, 1.5% of total exports of goods for the year. Ninety-one percent of sales were to Argentina and the remaining 9% went to Brazil.

# 3. SECOND STAGE OF THE ENERGY TRANSITION

The first stage consisted of the reconversion of the electricity matrix to renewable energy sources: biomass, hydro, wind and solar. Renewable sources account for 97% of the country's electricity matrix under normal weather conditions.

According to the World Economic Forum's 2023 report, Uruguay ranks 23rd in the Energy Transition Index and is the leader in Latin America, followed by Costa Rica (25) and Brazil (14)[13]. Uruguay stands out in the index for its high percentage of renewable energy in the energy mix, its

[12] The BEN considers all energy generated in the country, both for self-consumption and generation injected into the National Interconnected System (SIN).
[13] The index measures countries' progress in the transition to a more sustainable, efficient and equitable energy system. World Economic Forum, 2023

low energy intensity and greenhouse gas emissions. In addition, the country has a solid regulatory framework for the energy transition and a high participation of civil society in the process.

However, Uruguay still has room for improvement in the energy demand pillar. The country has a high motorization rate and a relatively energy-intensive industrial sector. This translates into a relatively high energy demand, which could be reduced through energy efficiency and electrification of demand.

The second stage of the energy transition, which Uruguay is already beginning to move towards, seeks to establish an efficient institutional framework to make the country $CO_2$ neutral. The aim is to decarbonize the rest of the energy sector (transport and industry) and industrial raw materials, in addition to developing a hydrogen economy, sustaining the high share of renewable energies in the electricity matrix and achieving a more efficient use of the electricity system.

Uruguay's energy transformation strategy is attracting international attention. The International Renewable Energy Agency (IRENA) highlighted Uruguay's promotion and incentive model and included the calls made by UTE as examples to follow in its guide for the design of auctions. It highlighted the achievement of incorporating strong private participation in investment through innovative promotion schemes without relying on direct subsidies.

Decades of experience in the development of renewable energy projects, solid regulatory frameworks, political, institutional and legal stability, as well as macroeconomic health make Uruguay an attractive country for investments in projects that allow the decarbonization of sectors that present greater difficulty in reducing their climate footprint.

## 3.1. GREEN HYDROGEN: URUGUAY'S NATURAL STEP TOWARDS DECARBONIZATION[14]

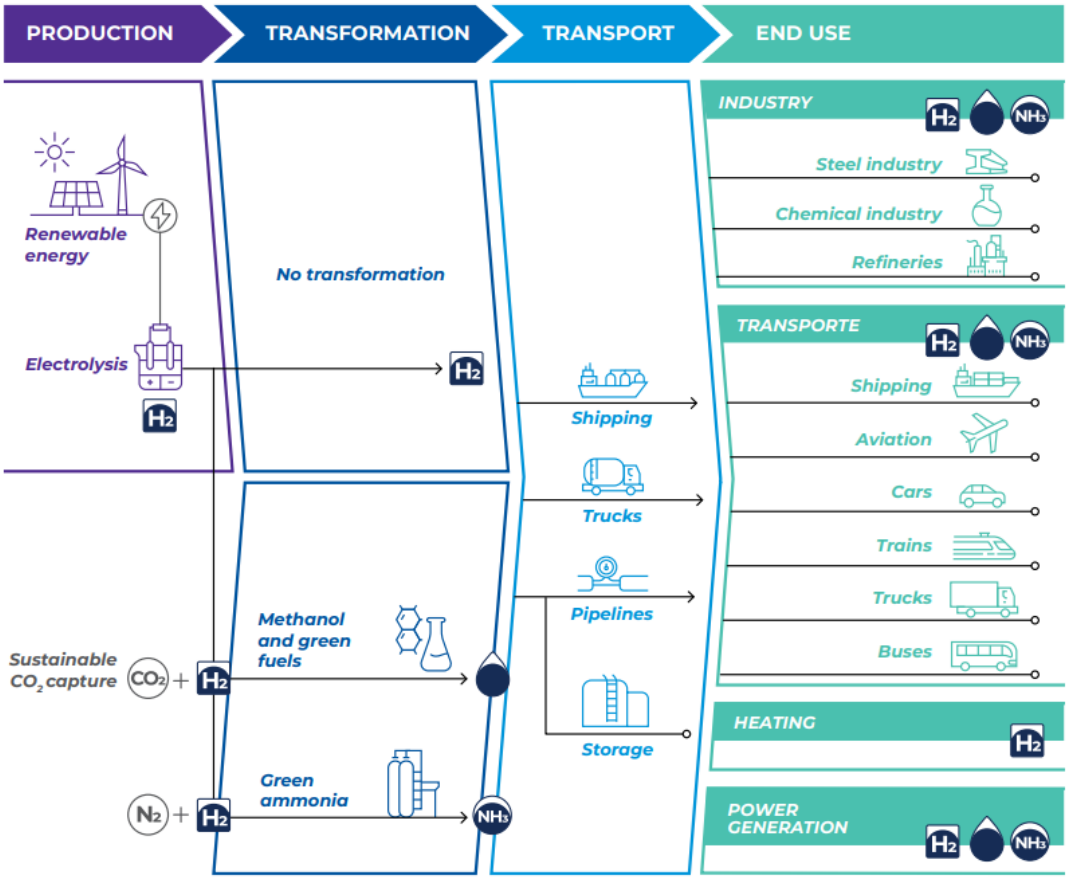
### 3.1.1. WHAT IS GREEN HYDROGEN?

Hydrogen is one of the most abundant resources on the planet. It can store and transport energy that can be used directly or in the production of other energy sources. Hydrogen can be produced from renewable electrical energy for a wide variety of uses.

[14] Green hydrogen roadmap in Uruguay - 2023 (Link)

Figure No. 3.1

**USES OF HYDROGEN AS AN ENERGY SOURCE OR FEEDSTOCK**




Source: Created by the Ministry of Industry, Energy and Mining (MIEM) based on the International Energy Agency document, *"Green Hydrogen: A guide to policy making"* (International Renewable Energy Agency, 2020).

Green hydrogen can decarbonize various uses (transport, thermal energy, industrial energy, raw materials and stabilization of highly renewable electricity grids), becoming an energy vector with great potential, especially in scenarios where decarbonization cannot be completed directly or through electrification.

The cumulative property of hydrogen could allow improving the participation of renewable energies in the energy system, balancing the peaks and valleys of electricity demand and storing renewable energy at times of high availability to be dispatched at other times of high demand.

Green hydrogen favors the integration of renewable energies on a large scale. Its condition as an energy vector allows it to be used to store and transport energy generated through renewable sources from regions of the world with high productive capacity to areas with a deficit of resources. This process of global transition in energy generation will allow countries that historically have not had relevant energy resources to position themselves as new players with diverse roles and possibilities.

### 3.1.2. WHY GREEN HYDROGEN IN URUGUAY?

After the decrease in the use of fossil fuels in the electricity matrix, green hydrogen is a natural step in the process of decarbonization of energy demand. In addition, the country has important competitive advantages to be a relevant producer of green hydrogen and derivatives, both for the local market and for export.

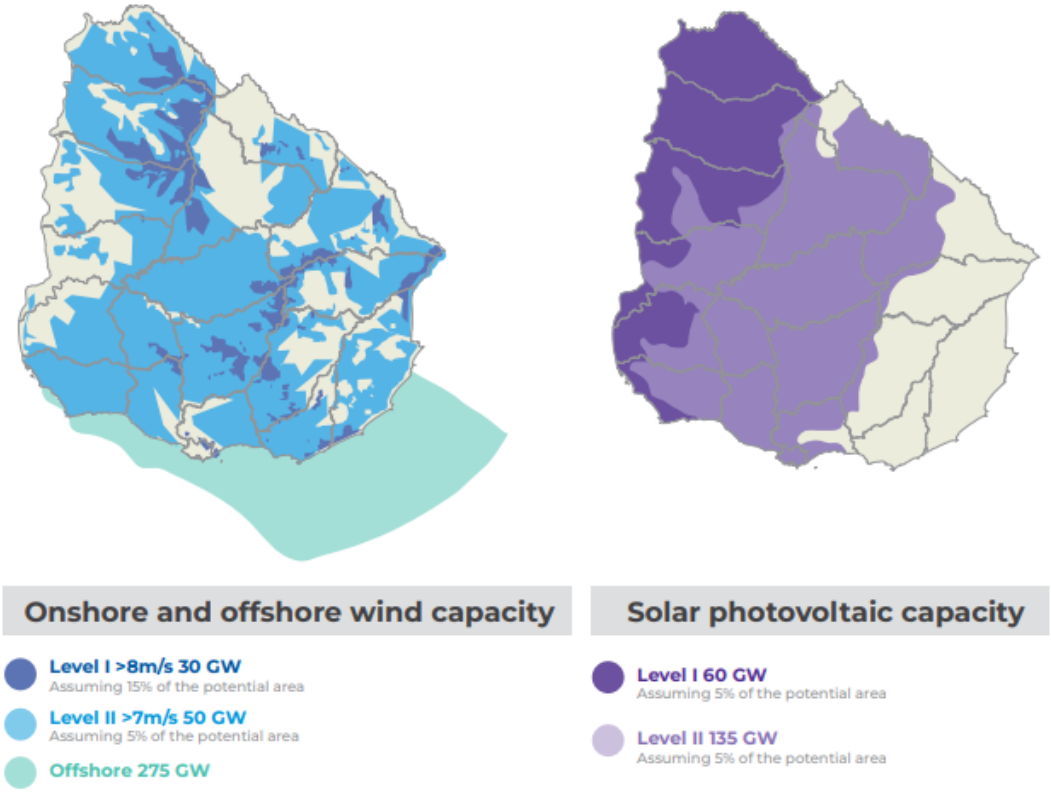
***High renewable energy generation potential and resource complementarity***

Uruguay has great potential to generate renewable energy, mainly wind and solar. The country has a good combination of wind and sun, which allows obtaining high-capacity factors in the electrolyzer and low hydrogen production costs.

Solar and wind renewable energies in Uruguay could reach levelized cost of energy (LCOE) of between US$ 16 and US$ 19 per MWh by 2030. Offshore wind energy would have costs in the range of US$ 26 to US$ 28 per MWh. In 2040, these costs could be reduced to US$ 11 per MWh for solar energy, US$ 15 per MWh for wind energy and US$ 21 per MWh for offshore wind energy. The western regions of the country have the best characteristics for solar power generation, while the northern and central regions have medium quality resources.

Figure No. 3.2

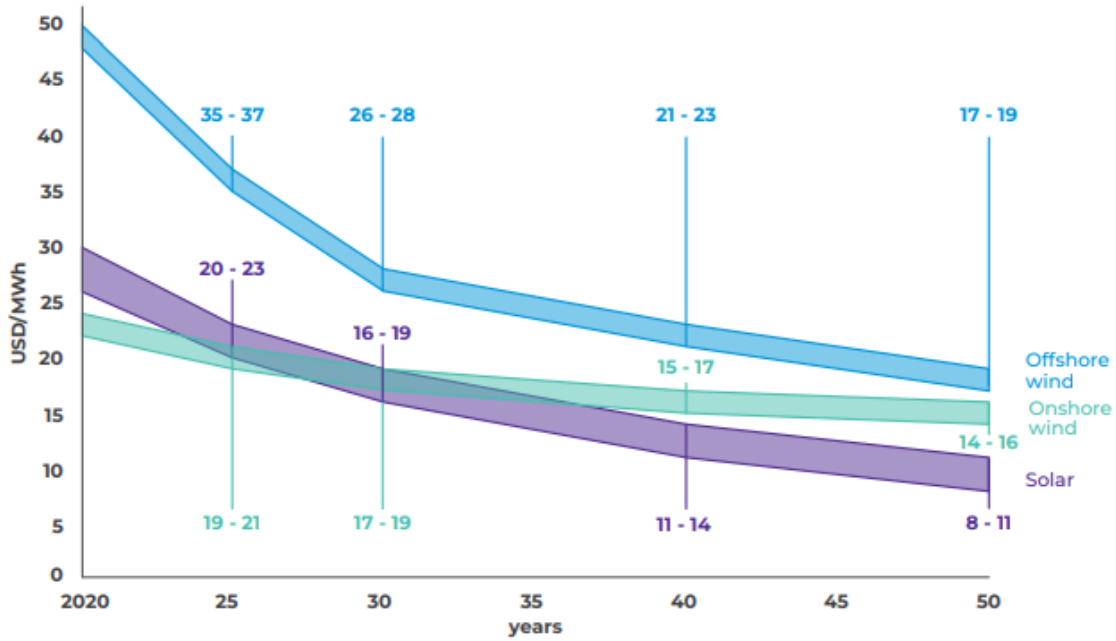
**POTENTIAL CAPACITIES (GW) BY RENEWABLE SOURCE**




Source: Green hydrogen roadmap in Uruguay - Atlas Solar, MIEM, McKinsey & Company, 2021, according to contract # :C-RG-T3777-P001 concluded with the Inter-American Development Bank (IDB)

For wind energy, high quality areas are located on the border between the departments of Rivera, Tacuarembó and Salto, and between Lavalleja, Florida and Treinta y Tres. The area available for offshore wind energy development would allow the installation of an additional 275 GW of capacity.

Chart No. 3.1
**LEVELIZED COST OF ENERGY**
(BASED ON 5% WACC, NOT INCLUDING TRANSPORTATION COSTS) AT SCALE (+500 MW), US$/MWH.




Source: Green hydrogen roadmap in Uruguay - Atlas Solar, MIEM, McKinsey & Company, 2021.

### *High water availability*

Uruguay has great potential to produce green hydrogen, but it is necessary to analyze a critical input for this industry: water.

Potential water consumption for green hydrogen production is relatively low, representing around 0.5% of the total water available in 2022. However, it should be considered that green hydrogen production will be concentrated in some regions of the country where impacts could be generated.

To ensure sustainability in hydrogen production, it is necessary to carry out specific studies and have accurate information on water use aspects. These studies should consider consumption on a spatial and temporal scale, taking into account other existing uses and the projections defined for the particular territory.

### *Availability of biogenic $CO_2$*

Uruguay has potential in the production of hydrogen derivatives as raw materials, fuels and green fertilizers. Biogenic $CO_2$, which is carbon dioxide produced by the decomposition of biomass, is

available in the country. This $CO_2$ is used in the production of hydrogen derivatives through processes such as artificial photosynthesis or hydrogenation.

It is estimated that in 2024 Uruguay would emit approximately 11 million tons of biogenic $CO_2$ that could be used to produce hydrogen derivatives. These emissions occur mainly in industrial facilities that use biomass for energy generation, such as pulp and pulp mills and smaller scale plants of energy production. Domestic forest biomass production is sustainable, and Uruguay is very well positioned in terms of sustainable development certifications in forestry production. More than 90% of the forests are certified by the two main certifiers worldwide: FSC (Forest Stewardship Council) and PEFC (Program for the Endorsement of Forest Certification)[15]. All of the timber marketed by the industry is certified. Annual availability is around three million cubic meters, far exceeding the country's industrial capacity.[16]

### *Logistics*

Uruguay has access to the Atlantic Ocean and a developed logistics infrastructure. The country has access routes throughout the territory, including rail, river and road transport. In addition, it has a track record of success in building energy infrastructure, which gives it the ability to overcome the logistical challenges associated with renewable generation and hydrogen exports.

The country has no major geographical features and has access routes throughout the territory and infrastructure for local transportation of hydrogen and its derivatives. It is important to point out that the Central Railway will connect the area with the greatest renewable energy potential with the port of Montevideo, providing very good opportunities for the transportation of hydrogen derivatives and facilitating their export possibilities.

### *Competitive green hydrogen production costs*

Renewable energy production costs would allow Uruguay to reach green hydrogen (LCOH) production values of between US$ 1.2 and US$ 1.4 /kg$H_2$ in the Western region and between US$ 1.3 and US$ 1.5 /kg$H_2$ in the Eastern region, for a scale above 500 MW, by 2030.

[15] FSC and PEFC are certifications from international non-governmental organizations that promote environmentally appropriate, socially beneficial and economically viable management of the world's forests.
[16] See analysis of co2 availability for the production of green h2 derivatives in Uruguay.

Chart No. 3.2

**HYDROGEN PRODUCTION COST CURVE BY REGION IN URUGUAY, PRODUCTION COST COMPARISON 2030**

(WACC: CHILE 6%, AUSTRIA 5.4%, SAUDI ARABIA 5.3%, SPAIN 5%) (US$ /KG $H_2$)


Source: Roadmap for green hydrogen in Uruguay - McKinsey & Company, 2021.

These production costs would allow Uruguay to position itself competitively among net exporters such as Chile, Saudi Arabia, Oman, Namibia or Australia.

For projects larger than 500 MW in scale, local transport and storage of hydrogen by pipeline emerges as the most economical option. This is achieved by installing electrolysis plants next to the renewable energy generation plants. The cost associated with local transport and storage is between US$ 0.3 and US$ 0.5 /kg$H_{(2)}$.[17]

[17] For more information see Uruguay's Roadmap for Green Hydrogen and Derivatives

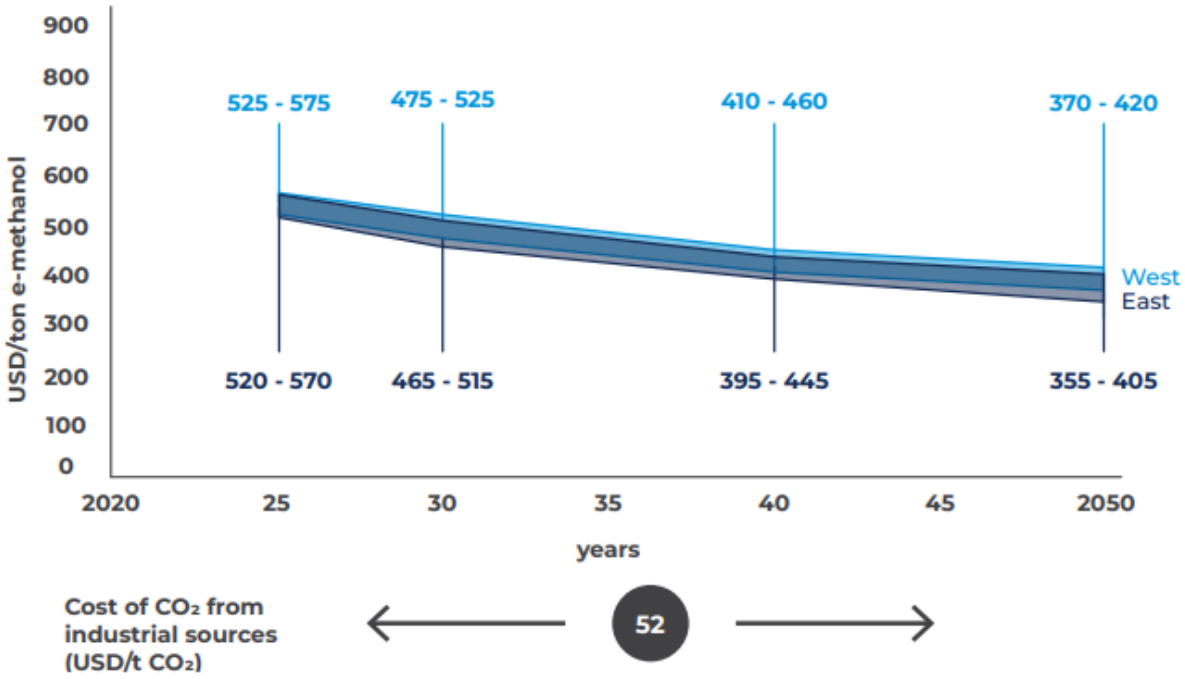
### *Competitive production costs of derivatives*

Regarding the production of derivatives, by 2030 the production costs of green e-methanol and e-Jet Fuel could reach 465 US$/t and 1,205 US$/t respectively, considering industrial sources for biogenic CO2.

Chart No. 3.3

**PRODUCTION COST CURVE FOR E-METHANOL**

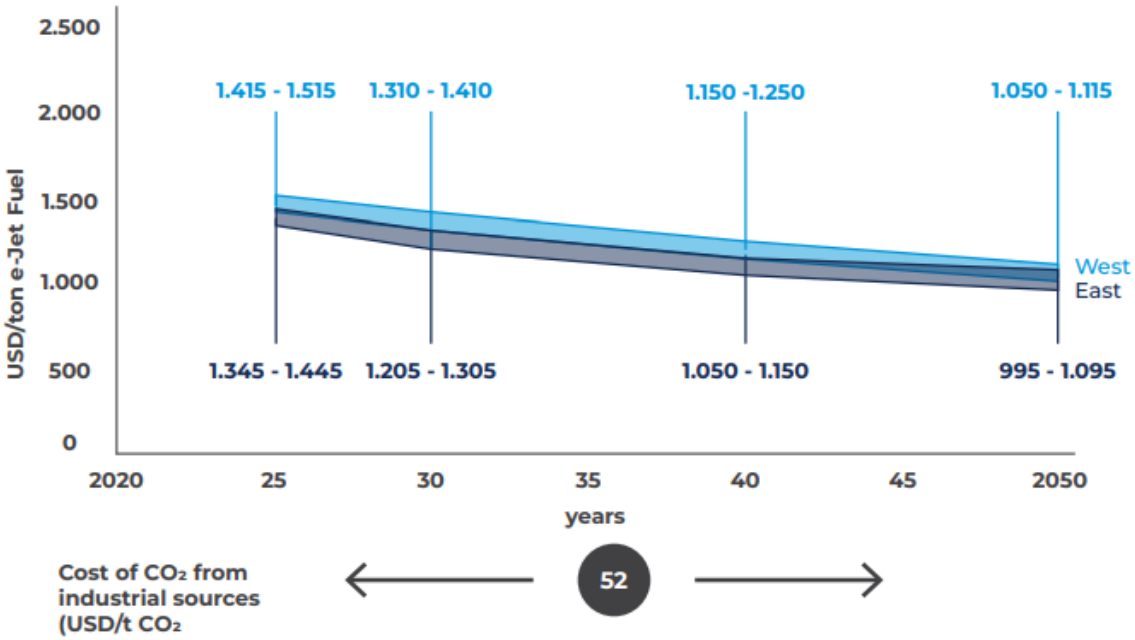
(US$/TON E-METHANOL)




Source: Roadmap for green hydrogen in Uruguay - McKinsey & Company, 2021.

The competitiveness of these products compared to those of fossil origin is linked to the application of $CO_2$ taxes in importing countries, as well as to the definition of quotas for green products in particular sectors such as maritime and aviation.

Chart No. 3.4
**JET FUEL PRODUCTION COST CURVE**




(US$/TON JET FUEL)

Source: Roadmap for green hydrogen in Uruguay - McKinsey & Company, 2021.

***Government commitment***

- The government of Uruguay is moving forward in promoting its green hydrogen ecosystem through the development of its national strategy. Its final version was presented in November 2023.[18]

- In 2022 the government launched the Hydrogen Sector Fund, instrument that promoted the presentation of innovation and production pilot projects with up to US$ 10 million non-refundable. The winner of the fund was a project that will encompass 17 cargo trucks, adapted to run on green hydrogen. The consortium leading the proposal operates with forestry companies that will deliver the cargo to UPM.[19]
  - In turn, there are tax incentives for the development of large-scale projects for the production of green hydrogen and derivatives.

Based on these actions, the government is making progress in regulatory aspects, formalizing the country's interest, attracting the participation of private actors, increasing the knowledge about the technology, its production and logistics, and the development of local capabilities, among others.

[18] Final version of Green Hydrogen Roadmap 2023 (link)
[19] Green hydrogen project in freight transportation (link)

## 3.1.3. INVESTMENT PROJECTS

### HIF Global

Chilean company HIF Global will invest US$ 6 billion in the production of green hydrogen in Uruguay[20]. The proposal aims to produce 180,000 tons of synthetic fuels per year, using part of the required 710,000 tons of carbon dioxide from ALUR's ethanol plant in Paysandú[21]. An additional 2 GW of renewable electricity generation will be installed in the country from solar photovoltaic and wind sources for an electrolysis of 1 GW of power. Green hydrogen will be used to produce e-fuels, such as e-gasoline and e-Diesel, which can be used in traditional vehicles.[22]

The HIF Paysandú e-Fuels project has been divided into two phases. The first phase will start in 2026 and will consist of the construction of the electrolyzer plant and the green hydrogen storage and distribution infrastructure. The second phase will consist of the construction of the e-fuels production plant.

### Tambor Green Hydrogen Hub

Tambor Green Hydrogen Hub is a green hydrogen production project located in the department of Tacuarembó. It is an initiative of the German company Enertrag in collaboration with the Uruguayan company SEG Ingeniería. The project consists of the construction of a wind farm and a solar farm with a total capacity of 470 megawatts (MW). This renewable energy will be used to power an electrolyzer that will produce green hydrogen.

The annual production of green hydrogen from the project will be 15,000 tons. This hydrogen will be used to produce renewable e-methanol, a sustainable fuel that can be used in the chemical industry and in transportation.

### Pilot H24U

The H24U pilot is a green hydrogen development project for heavy cargo transportation in Uruguay. It is an initiative of the companies Saceem, CIR and Fraylog with electrolysis technology to be provided by Air Liquide. The project was winner of the Green Hydrogen Sectorial Fund of the Ministry of Industry, Energy and Mining (MIEM). The project consists of the incorporation of 17 trucks from the forestry sector to run on green hydrogen. The trucks will be adapted with hydrogen storage tanks and engines adapted to run on this fuel.

The production of green hydrogen for the project will be carried out by a 5 MW electrolyzer plant located in Pueblo Centenario, Durazno. The plant will be powered by energy from a 10 MW solar farm.

[20] Uruguay HIF Memorandum of Understanding
[21] ALUR is the acronym for Alcoholes del Uruguay. It is a sustainable agribusiness company that produces biodiesel, bioethanol, chemicals, animal feed, energy and sugar. ALUR is part of the ANCAP Group (link).
[22] Chilean company to make millionaire investment in Uruguay to produce eFuels from green hydrogen (link). HIF Uruguay official website (link)

The H24U pilot is scheduled to begin operating in 2026. The project will last three years and will assess the technical and economic feasibility of using green hydrogen in heavy-duty transport.

The H24U project was divided into two phases. The first phase will run until 2026 and will consist of the construction of the electrolyzer plant and the solar farm. The second phase, which will run until 2024, will consist of converting the trucks and conducting test runs.

The project will have a total cost of US$ 43.5 million. The MIEM will contribute US$ 10 million through the Green Hydrogen Sector Fund. The rest of the financing will be provided by the companies participating in the project.

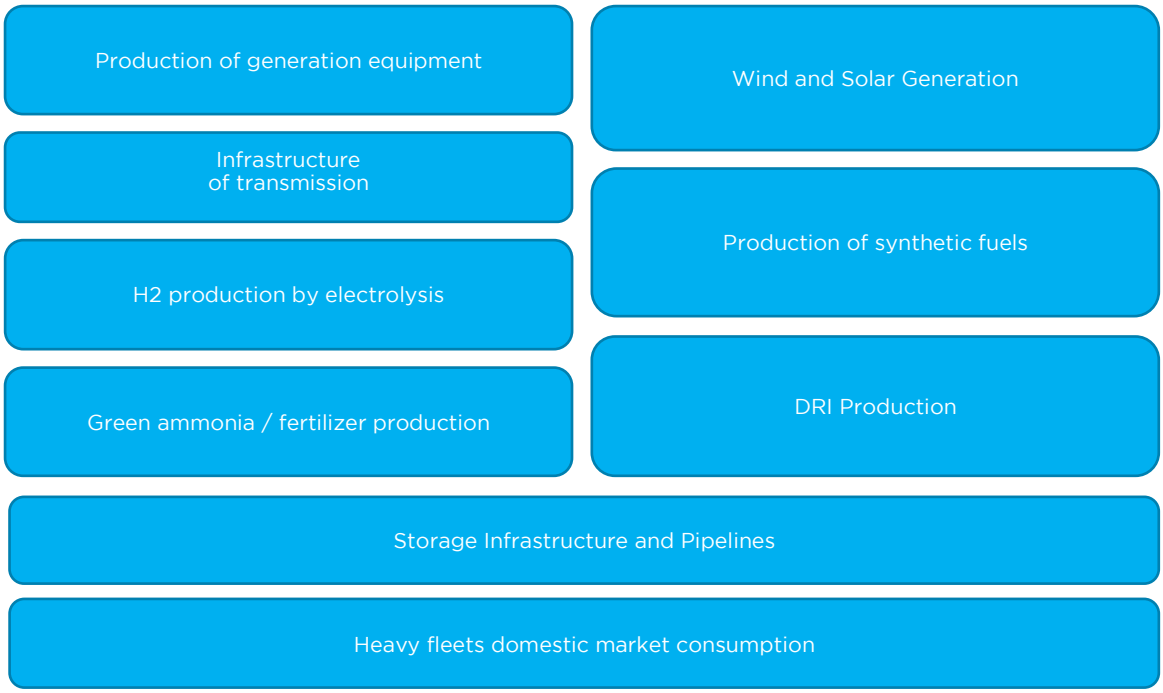
The H24U project is an example of Uruguay's commitment to renewable energy development and demonstrates Uruguay's potential to become a regional leader in green hydrogen development.

**Kahiros**

The Kahiros project will be the first green hydrogen plant in Uruguay. With a total investment of US$ 39 million, it will be located in Fray Bentos and is expected to start operations in 2026. The project will have a 3.9 MW photovoltaic solar farm and a two-megawatt (MW) electrolyzer, capable of producing 76,700 kilograms of green hydrogen per year.

The main objective of the project is the decarbonization of heavy transport, using the green hydrogen produced to supply Montes del Plata trucks with a range of 700 kilometers and refueling times of only 12 minutes. It also seeks to strengthen forestry logistics and the pulp production chain, positioning itself as a key player in the sustainability of these sectors.

## 3.2. INVESTMENT OPPORTUNITIES




### Wind Farms

The policy of incorporating wind energy as a renewable and competitive source for the country was very successful. Prior to 2008, there were no large-scale wind farms in the country. In 2023 there were 41 wind farms in operation with an installed capacity of 1.52 MW[23]. This large investment was possible thanks to a varied menu of business models.

Regarding the development of medium-scale wind farms, since 2014 Uruguay enables its subscribers to generate their own electricity from any energy source, without losing their subscriber status. This framework has no limitations on the voltage of connection to the electric grid and does not enable the injection of electric power to the national electric grid.

In the case of wind farms financed through the domestic capital market, participation in the financial trusts structured for the Pampa and Arias wind farms demonstrated the eagerness of retail and institutional investors to include these instruments in their investment portfolio.

[23] These totals do not include microgeneration facilities or subscribers with generation (link).

## Solar Parks

The use of solar energy transformation technology has undergone significant development in the country. To date, there are 19 large-scale photovoltaic plants that feed their energy into the power grid, with a total capacity of around 301 MW. The plants range from a few MW installed up to 50 MW (in plants such as "La Jacinta" or "El Naranjal", installed in the area of Salto, in the northwest of the country). In addition, the number of connected small-scale PV generation facilities reached 1,708 projects and the grid went from 0.04 MW in 2011 to 44.5MW in 2023.

## Bioenergy Plants

The development of energy production from non-traditional biomass occurred in parallel with the growth of forestry activities and the pulp industry, as well as agricultural production in areas such as soybeans, rice and wheat, under the protection of an institutional framework for the development of instruments and incentives for the energy use of biomass by-products from forestry and other chains.

The main raw materials used to generate energy from biomass (heat and electricity) are black liquor, forestry residues, firewood, bagasse, rice husks, and biogas from dairy waste, wool production, and urban solid waste. The country's existing bioenergy plants represent 9% of the installed capacity (425 MW). In 2023, it was increased when the new cellulose plant came into operation, generating a firm, predictable and renewable energy surplus of more than 150 MW, which is fed into UTE's electricity grid[24].

Currently, the low price of electricity generation from other renewable sources is the key challenge for the development of new bioenergy plants in the country. For this reason, it is likely that new bioenergy projects will operate in association with other industrial processes in integrated complexes (biorefineries).

Other alternatives for bioenergy development could be the generation of advanced fuels (renewable diesel, green hydrogen, methanol, renewable natural gas, aviation and marine biofuels), as well as solid biofuels (pellets).

## Waste thermo-valorization plant

The recovery of urban waste through its transformation into energy is one of the explicit objectives of the energy policy and one of the pillars of the National Waste Management Plan, which proposes the efficient management and recovery of waste.[25]

According to a study carried out by the National Directorate of Environmental Quality and Assessment (DINACEA), with more than one million tons of solid waste generated annually, the area metropolitan Montevideo would be the most attractive for the installation of a large-scale plant to generate energy from the thermal treatment of waste.

[24] More information (link)
[25] National Waste Management Plan (link)

There is also the possibility of a project covering urban waste from all over the country or regional partnerships that would allow the feasibility of generating energy from waste from several departments.

On the other hand, based on globally available technology, it is now possible to profitably handle smaller volumes (e.g. 100-150 tons/day), which makes the possibility of setting up several plants in the interior of the country more feasible.

### Energy storage

In order to continue expanding generation capacity based on wind and solar resources (which are non-dispatchable energy sources), it will be necessary to introduce more complex forms of variability management in the long term. One possible strategy is to achieve more dynamic exchanges with neighboring countries' systems (Argentina and Brazil), while another option is to implement energy storage mechanisms. The technologies available today are in the process of increasing efficiency and competitiveness (e.g., batteries) or are associated with high investment amounts and construction periods (dams and/or storage and pumping plants). However, it is estimated that in the future they would be a technically and economically viable option for the country.

Energy storage makes it possible to move the supply from one moment to another, reducing the need for backup thermal power plants in the system. In addition, it is very useful if the storage is installed in a distributed manner for a more efficient use of the grids. On the other hand, due to its almost 100% renewable matrix with an important hydroelectric participation, characterized by a high variability and increasing participation of wind and solar energy, storage is not a good mechanism to use Uruguay's structural surplus of electric power.

In September 2021, the first energy storage system began operating. It is a 30 kW power system and 12 lithium-ferro-phosphate batteries that accumulate a capacity of 97 kWh. In 2020, the installation of storage systems was enabled in Uruguay for UTE customers. Investments in this technology are also eligible for tax benefits by the Commission for the Application of the Investment Law (Comap).

## 3.3. ELECTRIC MOBILITY

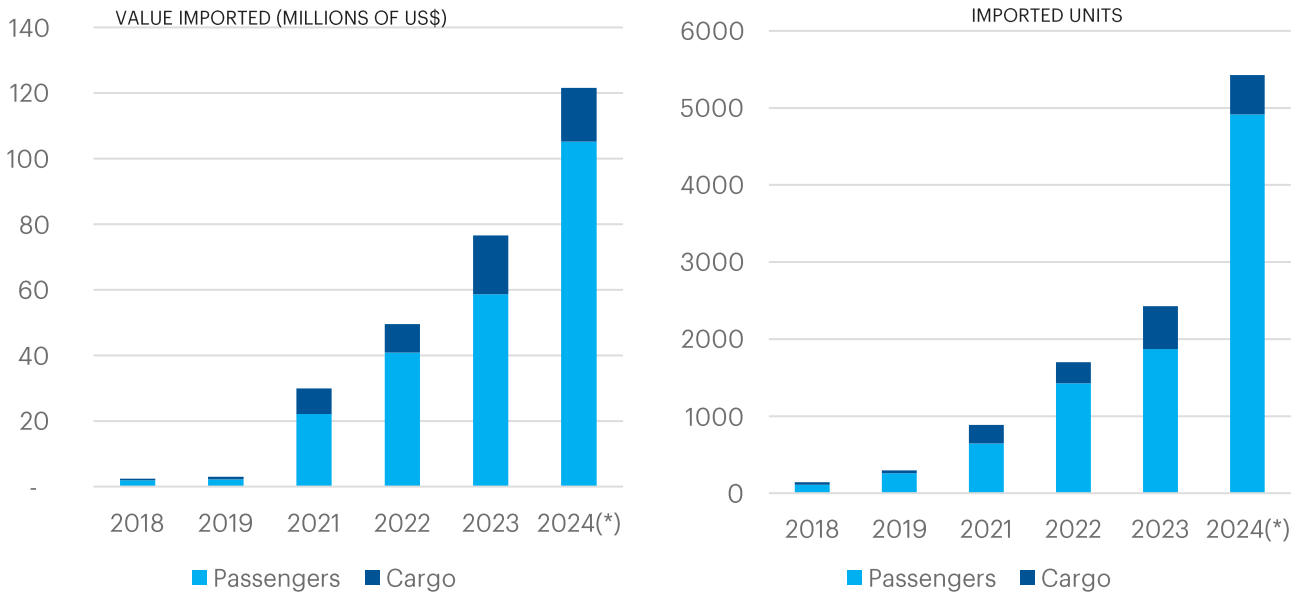
In Uruguay, the transportation sector is the main consumer of petroleum derivatives and the second largest consumer of energy after industry. Electric mobility means reducing polluting gas emissions, noise pollution and advancing in energy sovereignty over the transport sector. The objective is to electrify urban public transport, company fleets and applications, as well as to promote electrification among private vehicles.

In terms of infrastructure, Uruguay is a pioneer in the region and has the first electric road in Latin America. The country has installed more than 327 charging points, one charger available every

50km[26]. Of the total number of chargers installed, 119 are fast charging, which allows 80% of the accumulation to be completed in 20 minutes. Some 220,000 charges were completed in 2023, double the previous year's figure. In this direction of transport electrification, the MIEM developed the MOVÉS project, for battery electric vehicles.[27]

Imports of electric vehicles, which include those purchases made by various public agencies and companies, also indicate greater dynamism. While in 2018, 140 vehicles were imported for a value of US$ 3 million, just five years later a total of 2,428 electric vehicles were imported for about US$ 77 million. From January to November 2024, there was an increase in the imported value of 150% in the year-on-year comparison, totaling US$ 122 million. Over the last five years, some 11,000 electric vehicles have entered the country, 85% of which were for passenger transportation and the remaining 15% for freight transportation.

Chart No. 3.5
**IMPORTS OF ELECTRIC VEHICLES**[28]




Source: Created by Uruguay XXI based on Customs data.
(*) Data 2024 corresponding to the January-November period.

Uruguay is experiencing a remarkable growth in the adoption of electric vehicles, although they still represent a minority percentage of the total vehicle fleet in the country. According to data published by the Automotive Trade Association (ACAU), between January and October 2024, 4,152 new electric vehicles were sold, 8% of total sales and four times more than in the 2022 total.

[26] Charging points - Presidency and UTE
[27] Among the incentive measures for electric vehicles that have been promoted since 2010 are the reduction of the Internal Specific Tax (IMESI) applicable to hybrid and electric vehicles, the incorporation of electric utility vehicles to the cleaner production indicator of the Investment Promotion Law and the modification of the Global Tariff Rate for cars with an exclusively electric propulsion engine which was set at 0%.

[28] NCM 870380 and 870490.

Table 3.1

**ELECTRIC VEHICLE SALES (JAN - OCT 2024)[29]**

| Type of vehicle | Electric | Total | Part(%) |
|---|---|---|---|
| Cars | 2794 | 20,704 | 13% |
| SUV | 1059 | 12,660 | 5% |
| Utility | 299 | 16,661 | 1% |
| Total | 4.152 | 50,025 | 8% |

Source: Created by Uruguay XXI based on ACAU data.

Although electric vehicles do not yet dominate the automotive market in Uruguay, the growth in sales demonstrates a growing interest on the part of consumers in cleaner and more sustainable mobility alternatives. This trend reflects Uruguay's commitment to the adoption of more environmentally friendly technologies.

Thanks to its commitment to electric mobility and the great development in the generation of clean energy, Uruguay was chosen by Volkswagen to launch its electrification strategy in Latin America[30] . The country received the first ten units of the e-up model, 100% electric vehicles.[31]

The State continues to make progress in improving the infrastructure for electric mobility, and is currently installing fast charging points to improve user comfort. For its part, there is a set of incentives for electric mobility.[32]

As the charging infrastructure for electric vehicles continues to develop and stimulus policies are implemented, it is likely that the adoption of electric vehicles in Uruguay will continue to grow in the coming years. This will not only contribute to reducing greenhouse gas emissions, but will also promote sustainability and energy efficiency in transportation.

Uruguay offers access to more than 400 million people in the region. The country has free access to the Argentinean and Brazilian markets for automotive products[33], with zero tariff regimes of origin for exports to both countries. One of the agreements for new models only requires a minimum regional content of 25% for the first year, reaching 40% after the third year. Within this regime -which has quantitative limitations- there is still an important margin for companies that want to export to both Argentina and Brazil.

Uruguay has an important benefit for vehicle assembly companies, which can exonerate the Global Tariff Rate on SKD and CKD Kits for the assembly of vehicles[34]. In addition, the automotive and auto parts sector benefits from a 10% FOB refund of the value of its exports.[35]

[29] For more information see the Automotive Sector report
[30] Why did VW choose Uruguay to start its 100% electric disembarkation in the region after a seven-year process? - The Observer.
[31] For more information see the ICT Sector Report in Uruguay.
[32] UTE Electric Mobility Incentives (link)
[33] Motorcycles are excluded and road and agricultural machinery is included.
[34] Decree No. 251/019
[35] Decree No. 316/992

## 3.4. ENERGY EFFICIENCY

As a complement to the changes in the energy matrix, the authorities are implementing the National Energy Efficiency Plan[36]. This plan foresees the promotion of measures that include an economically convenient reduction in the amount of energy required to produce a product or service and that, at the same time, ensure equal or higher quality levels. Likewise, this concept includes the substitution in the final use of traditional energy sources for non-conventional renewable energy sources.

To meet this objective, among other actions, it is necessary to finance and/or guarantee investment projects and technical assistance in Energy Efficiency (EE) in the public and private sectors. For this purpose, there are different economic and financial instruments for promotion.

### 3.4.1. INTELLIGENT NETWORK

As different energy sources are incorporated, the management of the electricity system becomes increasingly complex, both at the generation and distribution stages. On the one hand, it is necessary to complement the different energy resources in order to take maximum advantage of the generation capacity at the lowest possible cost. On the other hand, as consumption peaks - throughout the year and throughout the day - do not usually coincide with the times of most abundant and cheapest generation, it is also necessary to optimize consumption.

[36] National Energy Efficiency Plan link)

# 4. ANNEXES

## 4.1. INFORMATION ON URUGUAY'S ENERGY SYSTEM

The BEN summarizes information related to energy production, transformation, and consumption, and its main objective is to be an input for consultation on the evolution of the country's energy situation, as well as on the different variables considered. At the same time, it provides information to all organizations, companies, and individuals involved in the energy planning process.

Link: BEN - MIEM

UTEi contains information on management, consumption, billing and status of services of the main company of the Energy Sector in Uruguay, which is dedicated to activities of generation, transmission, distribution and commercialization of electricity, as well as to provide advisory services and technical assistance in the areas of its specialty and related areas in the country.

Link: UTEi

The bet on green hydrogen is one of the axes of the second energy transition that Uruguay is starting to go through. The Green Hydrogen site of the Ministry of Industry has relevant information on this process

Link: H2U

# SUPPLEMENTARY ANNEXES

The annex consists of the following sections.

## MAIN PRIVATE COMPANIES IN RENEWABLE ENERGIES

The remarkable transformation of the sector was possible due to the close coordination between the public sector (calling for proposals, selecting and signing the long-term PPAs that allowed the financing and effective implementation of the projects) and the involvement of the private sector. Both domestic and foreign companies contributed to the development and implementation of new technologies. As a result, these companies, many of them SMEs, expanded their capabilities and now provide services to the countries of the region.

## INSTITUTIONALITY AND REGULATORY FRAMEWORK

The success of the sector is partly due to the existence of an energy policy that sets the course, a solid institutional framework and a regulatory framework that is attractive to investors.

## ACTIVE RENEWABLE ENERGY SOURCES

Uruguay has natural resources that allow 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.

# 5. URUGUAY IN BRIEF (2024)

## URUGUAY IN FIGURES

| Official Name | Oriental Republic of Uruguay |
|---|---|
| Geographical location | South America, bordering Argentina and Brazil |
| Capital | Montevideo |
| Surface | 176,215 km². 95% of the territory is productive land suitable for agricultural and livestock |
| Population (2023) | 3.44 million |
| GDP per capita (2023) | US$ 22,421 |
| Currency | Uruguayan peso ($) |
| Literacy rate | 0,98 |
| Life expectancy at | 77.9 years |
| Form of government | Democratic republic with a presidential system |
| Political division | 19 departments |
| Time zone | GMT - 03:00 |
| Official language | Spanish |
| Geographical location | South America, bordering Argentina and Brazil |

## MAIN ECONOMIC INDICATORS UPDATE

| Indicators | 2019 | 2020 | 2021 | 2022 | 2023 | 2024* |
|---|---|---|---|---|---|---|
| GDP (Var % Annual) | 0.93% | -7.38% | 5.56% | 4.71% | 0.37% | 3.35% |
| GDP (US$ Millions) | 62,166 | 53,615 | 60,728 | 70,236 | 77,131 | 79,715 |
| Population (Millions of people) | 3.44 | 3.44 | 3.44 | 3.44 | 3.44 | 3.44 |
| GDP per Capita (US$) | 18,095 | 15,593 | 17,648 | 20,395 | 22,422 | 23,173 |
| Unemployment Rate - Annual Average (% EAP) | 8.9% | 10.4% | 9.3% | 7.9% | 8.3% | 8.6% |
| Exchange Rate (Pesos per US$. Annual Average) | 35.3 | 42.1 | 43.6 | 41.1 | 38.9 | 40.0 |
| Exchange Rate (Average Annual Variation) | 14.7% | 19.2% | 3.6% | -5.6% | -5.5% | 2.9% |
| Consumer Prices (Cumulative annual % change) | 8.8% | 9.4% | 8.0% | 8.3% | 5.1% | 5.2% |
| Exports of goods and services (US$ millions)** (Millions)** (Millions) | 17,391 | 14,028 | 19,973 | 23,611 | 28,789 | 29,394 |
| Imports of goods and services (US$ millions)** (Millions)** (Millions) | 13,610 | 11,598 | 15,448 | 19,406 | 19,306 | 19,692 |
| Trade surplus / Deficit (Millions US$) | 3,781 | 2,430 | 4,526 | 4,205 | 9,483 | 9,702 |
| Trade surplus / Deficit (% of GDP) | 6.1% | 4.5% | 7.5% | 6.0% | 12.3% | 12.2% |
| Overall Fiscal Result (% of GDP) | -4.4% | -5.8% | -4.1% | -3.4% | -3.6% | - |
| Gross capital formation (% of GDP) | 14.1% | 16.4% | 18.3% | 18.9% | 17.3% | - |
| Public Sector Gross Debt (% of GDP) | 59.9% | 74.5% | 69.8% | 68.1% | 69.1% | - |
| Foreign Direct Investment (Millions of US$) *** | 1.994 | 831 | 2.977 | 3.285 | 2.262 | - |
| Foreign Direct Investment (% of GDP) | 3.2% | 1.5% | 4.9% | 4.7% | 2.9% | - |

Sources: Central Bank of Uruguay (BCU), National Statistics Institute (INE), MEF and estimated data (*). Fiscal outturn data include the effect of Law N°19590 (cincuentones). In 2017 the BCU adopted the methodology of the 6th balance of payments manual. Data based on this new methodology include purchase and sale of goods and re-exports and are available since 2012. Data are net flows so they may take negative values (**).