



PROJECT: “DESIGN, FINANCING, CONSTRUCTION, OPERATION AND MAINTENANCE OF THE

# HYDROELECTRIC POWERPLANT PAUTE – CARDENILLO

## General Description

This project represents the last phase of the Paute Hydroelectric Powerplant Complex, located in the foothills of the Andean Mountain range, 130 km northeast of Cuenca. The Paute-Cardenillo project consists on the design, financing, construction, operation, maintenance and transfer of a hydroelectric generation powerplant with a capacity of 595,65 MW and an annual average production of 3.400 GWh. It is initially estimated that the site required for the implementation of the project covers an approximate area of 551,82 hectare.

The general objective of the Project, according to the Master Plan of Electricity (PME), consist in the implementation of and hydroelectric infrastructure that allows the expansion and improvement of the generating system, in order to ensure an stable and sufficient supply of electric energy in the medium and long term, with the constitutional principles of obligatory, generality, uniformity, responsibility, universality, accessibility, regularity, continuity, quality and environmental sustainability.

Currently, the required investment by the electric sector to secure the future supply of the electric demand of the country is superior to USD 13 billion. 50% of this value, around 6,6 billion, is focused on this project.

## Project Type

Greenfield.

## Fundamental Criteria

This project contributes significantly to the national objectives established in Ecuador's 2024-2025 National Development Plan. It is also aligned with the PME, the Institutional Strategic Plan of the Ministry of Energy and Mines and the Generation Expansion Plan for the electricity sector.

Delegating Entity: Ministry of Energy and Mining

## Delegation and Compensation Model

\*Public Private Partnership

\*The generator (private manager) will not charge the fee directly to the final user but will invoice for the provision of energy to the distribution companies, through the respective regulated contracts. The distributing companies will in turn charge the users of the electricity service, whose rate is regulated in accordance with the provisions of Articles 54 and 56 of the Ley Orgánica del Servicio Público de Energía Eléctrica and which will include the costs associated with the generation of Cardenillo.

## Beneficiaries

Located in the influx zone:

The presence of this hydroelectric project in the area is an opportunity for the population and the Decentralized Autonomous Government (GAD's) of the provinces of Azuay and Morona Santiago. Preliminary the beneficiaries are the population of the Azuay province with 801.609 inhabitants and the Morona Santiago province with 192.508 inhabitants.

## Environmental Beneficiaries

\*Estimated reduction of more than 2,32 million tons of CO2 by replacing thermal generation for hydroelectricity.

\*Contribution to mitigate the greenhouse effect.

## Components

Scope A.- Development of the Paute – Cardenillo project through a direct interconnection to the discharge structure of the Hydroelectric Powerplant Sopladora, via a chamber of interconnection that will be built between the inferior balance chimney and the discharge of the Sopladora Powerplant.

Design flow rate: 150 m³/s.

It includes the following jobs:

Interconnection chamber: 9,900m long conduit tunnel, balancing chimney, pressure pipe in a vertical shaft, machine room to house 5 Pelton units with a total installed capacity of 443 MW.

The water used for power generation is returned to the Paute River through a 3,000m long tunnel.

The main disadvantage of this scope is that it looses the operational flexibility required by the National Interconnected System because in case of damage to the upstream plant, the downstream interconnected plant is forced to cease operations.

Scope B.- Development of the Cardenillo Project through a regulation dam located on the Paute River downstream from the restitution of the turbine flows at the Sopladora hydroelectric powerplant.

The design flow rate is 180 m³/s, as it would utilize the 150 m³/s turbine flow from Sopladora plus the flows from the intermediate basin that flow from the Daniel Palacios Dam to the Cardenillo Dam site, which for the analysis has been taken as equal to 30 m³/s based on the hydrology study results.

From the regulation dam, the underground hydraulic system can be developed either on the right or left side of the Paute River. However, for the analysis, both sides of the river have been considered:

B1. On the left side, the conduction structure has a length of 6,800 m; the equilibrium chimney and pressure shaft extend to the powerhouse located underground, where 6 Pelton units with a total power of 574 MW will be installed, and the discharge works in a tunnel with a length of 3,132m.

B2. On the right side of the Paute River, the conduction work, with a length of 6,589m, reaches the underground machine room with a capacity to house 6 Pelton units with a total installed power of 566 MW. The discharge of the turbinated flows is carried out through a 3,000-meter-long tunnel.

## Current Project Status

Phase: Structuring

Registration in the National PPP Registry (SOURCE):

## Infrastructure Type

Hydroelectric Powerplant

## Socioeconomic Information

### Positive Impact of the Project

- Reduction of the risk of electric shortages and economic losses
- Reduction of electricity imports.
- Cost reduction through the substitution of thermal generation.
- Reduction of pollution and greenhouse gases through the substitution of thermoelectric generation.
- Creation of direct and indirect jobs during the construction and operation of the hydroelectric powerplant, benefiting the local economy.
- Contribution to the country's energy security by providing a stable and renewable source of electricity, reducing dependence on fossil fuels and helping to mitigate climate change.
- Promotion of technological development in the energy sector, facilitating the adoption of cleaner and more efficient technologies in future projects.

## Project Overview

Project profile: 24/12/24

## Potential Jobs Generated

67.989 aprox.

## Potential Demand

This projection considers the trend growth of electricity demand and aligns with the policy of productive development and energy efficiency. The following tables present the projection for the annual electricity demand from 2023 to 2032:

Energy Demand Projection					
At generation terminals of the S.N.I.					
	Energy Demand (GWh)			Growth Rate (%)	
Year	Growth		Historical	Growth	
	Tendency	Base Case	4.65%	Tendency	Base Case
2023	28.824	30.190		3.0%	7.9%
2024	29.872	32.157		3.6%	6.5%
2025	31.090	35.569		4.1%	10.6%
2026	32.378	38.392		4.1%	7.9%
2027	33.447	40.502		3.3%	5.5%
2028	34.826	42.195		4.1%	4.2%
2029	36.383	43.989		4.5%	4.3%
2030	38.042	46.084		4.6%	4.8%
2031	39.651	48.290		4.2%	4.8%
2032	41.334	50.544		4.2%	4.7%
Growth 2023-2032	4.09%	5.89%			

On the other hand, the projection of the annual demand for power determined an average growth of 6.66% as shown below:

At generation terminals of the S.N.I.						
	Energy Demand (GWh)			Growth Rate (%)		
Year	Growth		Historical	Growth		
	Tendency	Base Case	3.81%	Tendency	Base Case	
2023	4.72	4.89			7.7%	11,5%
2024	4.85	5.17			2.6%	5.8%
2025	5.02	5.86			3.5%	13.2%
2026	5.20	6.31			3.7%	7,8%
2027	5.35	6.63			2,8%	5,0%
2028	5.55	6.86			3,7%	3,5%
2029	5.78	7.12			4,2%	3,9%
2030	6.03	7.46			4,3%	4,7%
2031	6.27	7.80			4,0%	4,6%
2032	6.52	8.12			4,0%	4,1%
Growth 2023-2032	3.64%	5.80%				

## Comparative Analysis of Alternatives (Project Profile)

It is important to point out that the PME, has already established a technical solution to the identified problem, the formulation of various conceptual alternatives is not contemplated. Therefore, only the two possible scopes for the development of the Paute – Cardenillo Project are:

Criterio	Scope A	Scope B
Type of development	Direct interconnection to the Sopladora Powerplant.	Regulation dam on the Paute River.
Location	Right margin of the Paute River.	It can be develop along the left or right side of the river.
Desing Flow Rate	150 m³/s	180 m³/s (150 m³/s from Sopladora + 30 m³/s from the intermediate basin).
Principal Structures	Interconnection chamber, 9.900m long conduit tunnel, balancing chimney, pressure pipe in a vertical shaft, machine room to house 5 Pelton units with a 3,000m long discharge tunnel.	Regulation dam, conduction tunnel (6.800m on the left side or 6.589m on the right side), balance chimney, machine house with 6 Pelton units, discharge tunnel (3.132m on the left side or 3.000m on the right side).
Installed Power	443 MW	574 MW (left side) / 566 MW (right side)
Advantages	Complete underground development	Greater fall height on the left side, greater operational flexibility.
Disadvantages	Loss of operational flexibility, dependence on the upstream central, risk of cascading blackouts (2300 MW out of the system in case of failure).	The need to build a regulating dam, greater complexity in design and construction.

## Financial Information

Scope B2	
CAPEX (Referential)	\$ 1.349'000.000
OPEX (Referential)	\$ 331'200.000
Total value of the project	\$ 1.680'200.000

NOTE: It is important to indicate that the investment amounts reflected in this alternative are referential, as they originate from an initial profile of the project. This amount will be updated as the phases of the APP cycle progress; that is, pre-feasibility and feasibility respectively.

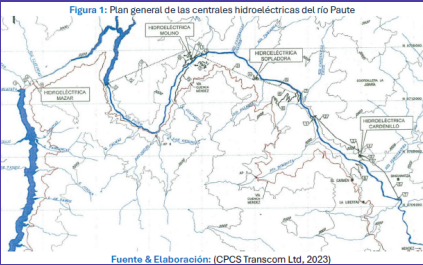
## Implementation time in years

Technical Alternative	
Construction	Operation and Maintenance
6 years 3 months.	23 years 9 months.

## Location

Provinces:
Azuay and Morona Santiago

Cantons:
Sevilla de Oro and Santiago de Méndez



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