

ENERGY MODELLING PLATFORM – LATIN AMERICA AND THE CARIBBEAN | 2023

Chachimbiro Geothermal Power Project in Ecuador

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1. Context

- Financial analysis for the first geothermal power plant in Ecuador using energy available in The Andes.
- Electricity generation is based on hydropower (over 70%) which entails risks in terms of security of supply.
- It is relevant to assess options for diversifying the electricity mix.
- Poverty in Ecuadorian rural areas was about 43% by 2020 [1] and the development of new energy infrastructure will help to create jobs and spark local economies.
- The impact of factors such as construction period, electricity generated and operation and maintenance costs are evaluated to determine the profitability of the project.

2. Aim

- To determine the financial conditions that can enable the participation of the private sector in the Chachimbiro Geothermal Power Project.

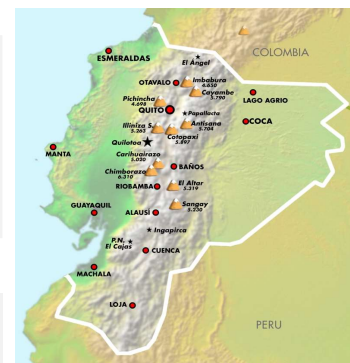


Figure1. Higher Volcanoes in Ecuador

3. Methods & Scenarios

- This assessment was carried out by means of the FINPLAN software and supported by data collection, sensitivity analysis of single variables to structure different scenarios from the investor standpoint.
- A selling price of electricity adjusted to inflation through the life of the project is the basis of this assessment.

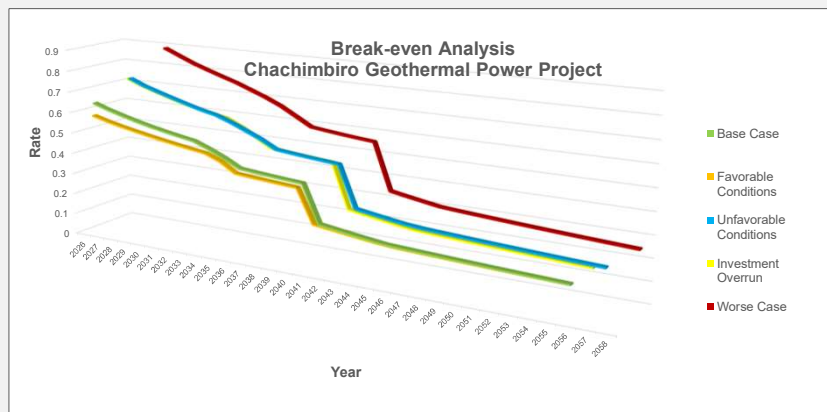
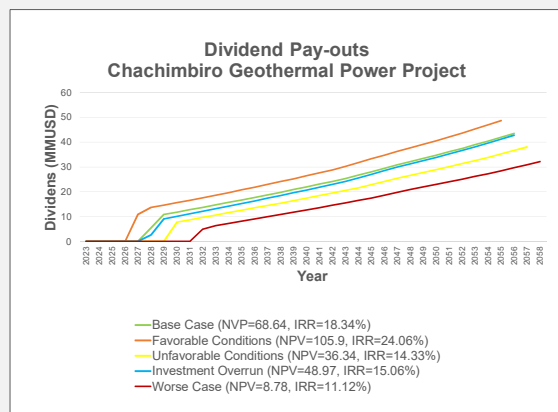
EXPLORATION PHASE AS FISCAL ASSISTANCE		
Cost 80 MMUSD		
FINANCIAL PARAMETERS FOR INVESTMENT PHASE		
Variable	Value	Unit
Capacity	50	MW
Capital Cost	170	MMUSD
Construction Period	3	Years
Debt-Equity Ratio	65:35	-
Export Credit	56%	Out of total investment
Interest Rate for Export Credit	4.5%	-
Term of Export Credit	15	Years
Interest Rate for Commercial Loans	6%	Spread above inflation
FINANCIAL PARAMETERS FOR OPERATION PHASE		
Variable	Value	Unit
Operation Starting	2027	-
Years of Operation	30	Years
Selling Price	0.105	USD/KWh + Inflation
Operation & Maintenance Cost	7.15	MMUSD/year
Electricity production	300	GWh/year

Scenarios

Besides the Base Case, the following financial scenarios were investigated:

Scenario Name	Scenario Description	Key Assumptions
Favorable Conditions	Cumulative impact from a positive 10% variation of four variables	Completion of the plant in 2 years, 10% less in O&M (6.43 MMUSD/year), 10% less interest rate for Export Credit (4%) and 10% more electricity sold (313.5 GWh/year)
Unfavorable Conditions	Cumulative impact from a negative 10% variation of four variables	The power plant completed in 4 years, 10% more in O&M (7.86 MMUSD/year), 10% more interest rate for Export Credit (5%) and 10% less electricity sold (256.5 GWh/year)
Investment Overrun	Changes in the budget that increases 20% the total cost of the project	The power plant ends up costing 204 MMUSD. It is 34 MMUSD more than initially estimated
Worse Case	Cumulative impact from a negative 20% variation of four variables	The power plant completed in 5 years, 20% more in O&M (8.58 MMUSD/year), 20% more interest rate for Export Credit (5.4%) and 20% less electricity sold (228 GWh/year)

4. Results



5. Policy insights, conclusions and future work

Conclusions:

- Contractually-guaranteed selling prices adjusted to inflation may provide enough returns to enable the participation of the private sector.

Limitations:

- Limited information on the specifics of the type of generating technology to better estimate certain costs.

Policy insights:

- Fiscal assistance and increasing subsidies to keep tariffs unvariable under current pricing policy.
- A roadmap and legislation that suit the geothermal sector is required.

Future work:

- Breakdown the costs and lifetime of the components of the geothermal power plant to determine if additional investments are required during the operation phase of the project.
- Incorporate to the analysis a scenario considering waste heat recovery.

6. References

- [1] INEC. (2022), Encuesta Nacional de Empleo, Desempleo y Desempleo, Junio 2022. Boletín Técnico N°11-2022-ENEMDU.
- [2] Kaltschmitt, M., Streicher, W., & Wiese, A. (2007). Renewable Energy Technology, Economics and Environment (4th ed.). Springer.
- [3] ESMAP. (2012), Geothermal Handbook: Planning and Financing Power Generation. Technical Report 002/12

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A Cost-benefit analysis of Policy, Programs and Projects (C3PO) that is Retrievable, Reusable, Repeatable, Reconstructible, Interoperable and Auditable (u4RIA)