

## Comprehensive Analysis of the Geothermal Potential of the Paipa–Iza Complex (Colombia) Through a Systematic Review of International Analogs

Arnul D. Paz A., Arian M. Sarmiento O.

arnul.paz@uamerica.edu.co

arian.sarmienrto@uamerica.edu.co

**Keywords:** Low-to-medium enthalpy geothermics, International analogs, Paipa–Iza complex, Binary cycles – ORC, Direct heat uses, Colombian Eastern Cordillera, Energy diversification.

### ABSTRACT

The Paipa–Iza geothermal system, located in Colombia's Eastern Cordillera, is one of the country's most promising geothermal projects and serves as a benchmark for the entire Andean region. Its surface hydrothermal manifestations exhibit average temperatures between 65 and 90 °C, placing it within the category of low-to-medium enthalpy systems. According to previous estimates, its electrical potential ranges between 5 and 10 MWe, making it a viable small-scale solution for power generation through binary technologies, as well as for direct uses such as heating, industrial applications, and process integration.

This study compiles the available geological, geochemical, and geothermal data for Paipa–Iza and compares them with analogous geothermal fields worldwide. Key cases were selected, including Aachen (Germany) and the Pannonian Basin (Hungary) for their thermal similarity and direct-use focus; Tuscany (Italy) for its development in non-recent volcanic contexts; and Cerro Prieto (Mexico) as a structural model of a fault-controlled sedimentary basin.

The comparison shows that Paipa–Iza shares critical tectonic characteristics with these systems, where secondary permeability plays a more decisive role than active magmatism. The analysis indicates that, while its electrical potential is modest compared to volcanic giants, its profile aligns perfectly with European models of binary generation and cascaded direct use. This analogy highlights the need to prioritize advanced exploration methods, such as 3D conceptual modeling and deep hydrogeological characterization, to reduce uncertainty in a reservoir that—unlike its deep-seated analogs—appears to be shallower.

Beyond its estimated installed capacity, Paipa–Iza serves as a natural laboratory for developing exploration methodologies under low-enthalpy conditions and with limited subsurface data—a typical scenario in Latin America. In this context, the complex is envisioned as a key pilot project for Colombia, with the potential to contribute to the country's energy diversification and its transition toward a low-carbon model, while strengthening international scientific cooperation in geothermal research.

### 1. INTRODUCTION

Geothermal energy is a renewable source capable of providing constant power generation and direct thermal applications. Grant et al., (1982), playing a significant role in energy systems that require baseload supply and emission reductions. Throughout history, commercial geothermal development has focused on high-enthalpy systems linked to active volcanic settings. Lippmann and Truesdell, (1983). In these locations, high temperatures and permeability allow for conventional electricity production. On the other hand, although low-to-medium enthalpy geothermal systems are widespread globally, their development has been less advanced, despite their potential for binary cycle technologies and direct heat uses.

In developing regions, the exploitation of medium or low-enthalpy geothermal systems is restricted by a lack of subsurface data. Gutiérrez-Negrín, (2021), a dearth of deep drilling, high levels of uncertainty in conceptual models, and economic limitations linked to initial exploration phases. These constraints are particularly relevant in Latin America, where geothermal development has primarily concentrated on high-temperature systems linked to active volcanic arcs, while other types of systems—controlled by conductive heat transfer or shallow hydrothermal circulation—remain underexplored.

Colombia displays a diverse set of geothermal manifestations extending across the Andean mountain ranges, reflecting its complex tectonic and magmatic evolution. Nevertheless, to date, none of these systems have reached a stage of commercial development for electricity generation. The Paipa–Iza geothermal complex, located in the Eastern Cordillera, stands out among identified prospects as one of the systems with the highest relative potential and the highest level of study. This complex features numerous hydrothermal surface manifestations, with temperatures ranging between 65 and 90 °C. Therefore, it can be classified as a low-to-medium enthalpy system.

It has been estimated that the Paipa-Iza complex has an electrical potential of between 5 and 10 MWe, which fits small-scale generation schemes based on binary cycles, in addition to a wide variety of applications for direct heat use. However, the system is in an early stage of exploration and has scarce information regarding reservoir geometry, petrophysical properties, heat sources, and fluid circulation models. This context generates a considerable level of uncertainty in assessing its potential and establishing strategies for its utilization.

Paz and Sarmiento.

In this scenario, the use of analogous geothermal systems is an important methodological tool for analyzing prospects with scarce information. Comparative analysis with well-documented international geothermal fields enables the transfer of knowledge regarding thermal conditions, geological characteristics, reservoir depths, development paths, and usage schemes. In the case of Paipa-Iza, comparison with low-to-medium enthalpy systems and hotter volcanic fields offers a reference framework that facilitates the identification of similarities, differences, and limitations of the Colombian system.

The purpose of this study is to carry out a comprehensive analysis of the geothermal potential of the Paipa-Iza complex, using a systematic and comparative review of geothermal analogs in other parts of the world. The objectives are:

- To contextualize the thermal and development properties of the Paipa-Iza complex within the international geothermal landscape.
- To determine the most relevant factors regulating its potential and constraints.
- To discuss the implications of these findings for formulating geothermal exploration and exploitation tactics in Colombia, as well as in other low-enthalpy systems with similar circumstances, based on the integration of available geochemical, geological, and geothermal data for Paipa-Iza, along with a global database of geothermal fields.

To place the Paipa-Iza geothermal system in the global context of geothermics, a global database of geothermal fields was created, and a subset of representative analogous systems was selected.

As shown in Figure 1, the selection of analogs covers diverse tectonic settings, ensuring that the geothermal model for Paipa-Iza is compared against both magmatic and sedimentary systems worldwide.



**Figure 1: Global distribution of geothermal fields and selection of analogous systems to the Paipa–Iza complex.**

## 2. GEOLOGICAL AND GEOTHERMAL CONTEXT OF THE PAIPA–IZA COMPLEX.

The Paipa–Iza geothermal system is located in the Eastern Cordillera of Colombia, a geological province characterized by a complex tectonic history linked to the interaction between the South American plate and the subduction of the Nazca plate. In the Eastern Cordillera, unlike the Central and Western ranges, the thermal regime is more moderate and is primarily regulated by conductive heat transfer, hydrothermal circulation through deep structures, and the presence of paleomagmatic bodies.

Structurally, the Paipa–Iza area is dominated by a fault system. Faults and Hinz, (2015), oriented mainly in NE–SW and NW–SE directions. This system has played a crucial role in the circulation of hydrothermal fluids. These structures act as zones of high secondary permeability, allowing hot fluids to rise from deep levels to the surface. The area benefits from a concentration of surface thermal manifestations due to the presence of lithological units with varying permeability and the intersection of fault systems.

Evidence of extinct Cenozoic volcanic and magmatic activity is geographically associated with the Paipa massif and the Iza–Paipa complex. Although there is no active volcanism in the area, the presence of shallow intrusives and a high geothermal gradient compared to the regional average suggests a residual heat source feeding the hydrothermal system. The geothermal system can be classified as a low-to-medium enthalpy hydrothermal system in this framework, where local convective circulation through permeable structures and conductive heat transfer are predominant.

The complex's exposed geothermal manifestations include hydrothermally altered areas, low-temperature fumaroles, and hot springs. The typical range of recorded surface temperatures is between 65 and 90 °C, with spatial variations reflecting active circulation of mixing meteoric water, controlled by geological structure in depth. With temperatures rising at depth and possible interaction with igneous and sedimentary rocks along the flow paths, the geochemical composition of the fluids suggests a mostly meteoric origin. Since no deep geothermal drilling has been done in the region, there is little information available about the deep reservoir.

However, based on previous geochemical, geological, and geophysical research, a reservoir has been suggested at intermediate depths—likely between 1,250 and 1,750 feet—with temperatures compatible with the use of binary cycles for electricity generation. The system's permeability is primarily controlled by fracturing within a rock matrix of low primary permeability.

In terms of geothermal classification, the Paipa–Iza complex exhibits characteristics typical of low-to-medium enthalpy systems developed in non-volcanic. Faults and Hinz, (2015), active tectonic environments. In these systems, exploitation potential depends heavily on structural control and the hydraulic continuity of deep faults. These qualities distinguish it from large high-enthalpy geothermal fields but allow for comparisons with many systems worldwide exploited for small-scale production and direct heat uses.

The combination of a moderate temperature regime, developed surface manifestations, and an appropriate structural framework positions the Paipa–Iza complex as a "natural laboratory" for investigating low-enthalpy geothermal systems in Andean contexts. However, the lack of subsurface data creates considerable uncertainty in potential estimation and exploration strategy design. This highlights the relevance of comparative approaches based on international analogs, which are developed in the following section.

### 3. METHODOLOGY.

The Paipa–Iza complex's geothermal potential was evaluated using a methodical four-stage framework intended to reduce subsurface uncertainty through global benchmarking.

#### 3.1. Data Gathering and International Database Development

To find geothermal fields on every continent, a thorough worldwide search was first carried out. A thorough database of more than 200 geothermal prospects was created by combining data from peer-reviewed scientific publications and technical reports. A bibliometric approach based on important technical variables was used to characterize each entry, including:

Framework for Geology and Structure. reservoir lithology, the tectonic setting, and the type of heat source (conductive or magmatic).

Thermodynamic parameters. include enthalpy classification and average reservoir temperature (°C).

Operational and engineering data. Reservoir depth (ft), fluid state (liquid-dominated versus steam), and primary energy conversion technology (Flash, Dry Steam, or Binary/ORC).

Development Status. End-use applications (direct thermal use versus electricity) and the project maturity index.

#### 3.2. Selection Criteria for Analog

To find the most representative analogs for Paipa-Iza, a filtering procedure was used on the global database. Three main criteria were used to prioritize the selection:

Structural Affinity. Locations with high secondary permeability in non-volcanic or extinct volcanic provinces.

Systems functioning in the low-to-medium enthalpy range (65–120 °C) exhibit thermal consistency.

Strategic Contrast. Despite having different thermal profiles, high-maturity fields (like Tuscany or Cerro Prieto) are chosen to set structural benchmarks.

#### 3.3. Synthesis and Comparative Analysis

Lastly, the available geochemical and geological data of the Paipa–Iza complex were cross-referenced with the data from the chosen analogs (Aachen, Pannonian Basin, Central Tuscany, Monte Amiata, and Cerro Prieto). Reservoir geometry, potential power capacity (MWe), and the best exploitation strategies, like cascaded direct use and Organic Rankine Cycles (ORC), could all be extrapolated thanks to this comparative analysis.

**Table 1. Technical Characterization and Comparison of International Geothermal Analogs.**

Geothermal Prospect	Country	Tectonic Setting	Temp. (°C)	Depth (ft)	Primary Technology	Potential (MWe)	Fluid	Recharge zone
Paipa–Iza	Colombia	Intraplate / Residual	65 – 90	1,250 – 1,750	Binary (ORC)	5 – 10 (Estimated)	Liquid-dominated	Meteoric
Cerro Prieto	Mexico	Rift / Transform Fault	200 – 350	~ 7,500	Double Flash	620	Liquid-dominated	Meteoric
Toscana Central	Italy	Convergent Margin	280	~ 5,000	Single Flash	700	Mixed	Meteoric

<b>Monte Amiata</b>	Italy	Volcanic / Magmatic	300	~ 9,514	Dry Steam	121	Mixed	Mixed
<b>Pannonian Basin</b>	Hungary	Sedimentary / Intraplate	80 – 100+	~ 5,249	Binary / Heat Exch.	25	Liquid-dominated	Meteoric
<b>Aachen</b>	Germany	Fold Belt	75	~ 9,000	Heat Exchange	9 (Thermal)	Liquid-dominated	Meteoric

#### 4. RESULTS

##### 4.1 Comparison with Analogous Geothermal Systems

###### 4.1.1 Thermal Characteristics and Reservoir Depth

The Paipa-Iza system is classified as a non-magmatic, low-to-medium enthalpy geothermal system based on the comparative analysis. The temperatures measured in the area, fluctuating between 65 and 90 °C, are consistent with hydrothermal systems where tectonic faults regulate fluid flow rather than a direct, active magmatic contribution, where secondary permeability dominates reservoir behavior. Faults and Hinz, (2015).

This temperature range aligns with the lower bounds found in selected intraplate analogs—specifically Aachen (Germany) and the Pannonian Basin (Hungary)—whose systems operate at temperatures starting between 80 and 90 °C. In contrast to purely conductive models, a comparison with the Tuscany system (Central Italy), which reaches 280 °C, indicates that Paipa-Iza exhibits features characteristic of a system with residual thermal input, where the primary heat transport mechanism is convection through fractured zones.

The thermal relationship between the study area and the global database is illustrated in Figure 2. This comparison of mean reservoir temperatures highlights that the Paipa-Iza complex aligns closely with the low-to-medium enthalpy profiles of the Pannonian Basin and Aachen. This thermal correlation justifies the adoption of binary cycle technologies (ORC) and cascaded direct-use schemes as the most viable development pathways for the Colombian Eastern Cordillera.



Figure 2: Mean reservoir temperature comparison between the Paipa-Iza geothermal system and selected international analogs.

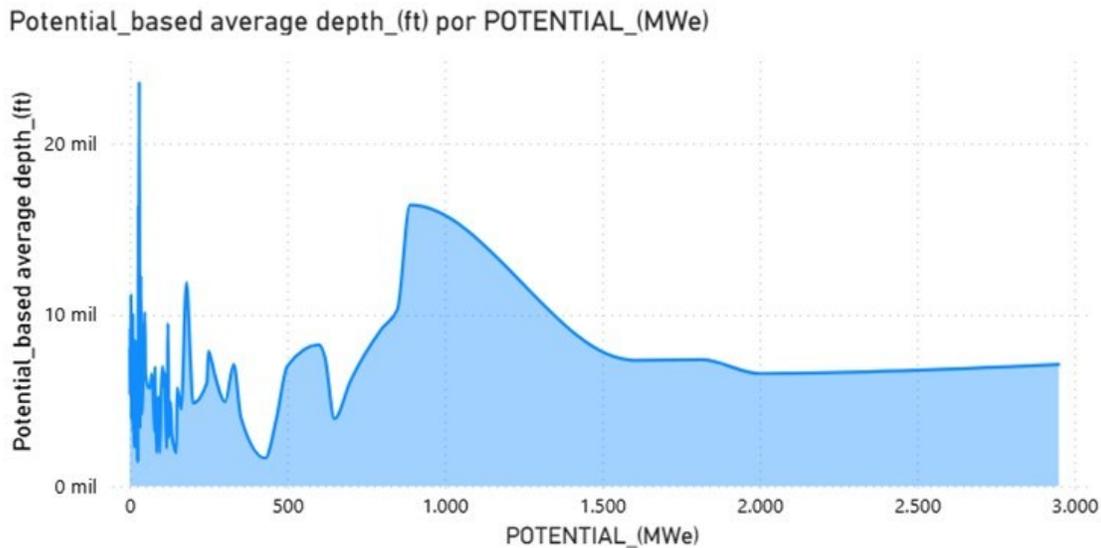
Although temperatures at the Cerro Prieto field (Mexico) are significantly higher (200–350 °C), its inclusion as an analog is structural, demonstrating the importance of deep hydrothermal circulation in sedimentary basins. Glowacka and Nava, (2000). It confirms the model of deep hydrothermal circulation in sedimentary basins, demonstrating that even with base temperatures like those of Paipa-Iza (65–90 °C), tectonic control is the key element for reservoir viability.

Regarding reservoir depth, the analysis reveals a major structural difference. Compared to similar systems that operate at much greater depths, the Paipa-Iza system is estimated to have a shallow geothermal resource, located between 1,250 and 1,750 feet. In contrast,

reservoirs in the Pannonian Basin and Central Tuscany (Italy) are located at 5,249 and 5,000 feet, respectively. Furthermore, systems such as Aachen (9,000 feet) and Monte Amiata (9,514 feet) show that deep drilling is required to harness the resource, while fields like Cerro Prieto (Mexico) require depths of 7,500 feet.

Despite the moderate temperatures, Paipa-Iza has a strategic advantage over its international counterparts because it can access resources at shallower depths (less than 2,000 feet), which could drastically lower drilling costs and risks. In contrast to the deep systems of Cerro Prieto or Aachen, the system shows that the cost-benefit ratio can be advantageous for direct uses even at temperatures between 65 and 90 °C because of the resource's shallower depth.

The operational efficiency of the proposed model is evaluated in Figure 3, which illustrates the relationship between geothermal potential (MWe) and average reservoir depth. The data indicates that while high-capacity systems like Cerro Prieto require significant drilling depths to maintain high-enthalpy production, the Paipa-Iza complex occupies a strategic niche. Its potential of 5–10 MWe at relatively shallow depths (under 2,000 ft) suggests a high benefit-to-cost ratio for initial investment. This correlation reinforces the feasibility of a modular development strategy, where lower drilling costs offset the medium-enthalpy nature of the resource, facilitating a faster path to commercial operation.



**Figure 3: Relationship between geothermal potential and average reservoir depth in global geothermal systems.**

#### 4.1.2 Geothermal Potential and Installed Capacity

In terms of global development, Paipa-Iza's geothermal potential is in the medium-to-low scale range. In contrast to consolidated fields like Cerro Prieto (Mexico), which achieve massive commercial production levels due to their high temperatures and vast extent, estimates for Paipa-Iza indicate an electrical potential between 5 and 10 MWe. This disparity in magnitude is consistent with the characteristics of a moderate-enthalpy system, where energy density is lower than that of large plate-boundary volcanic systems.

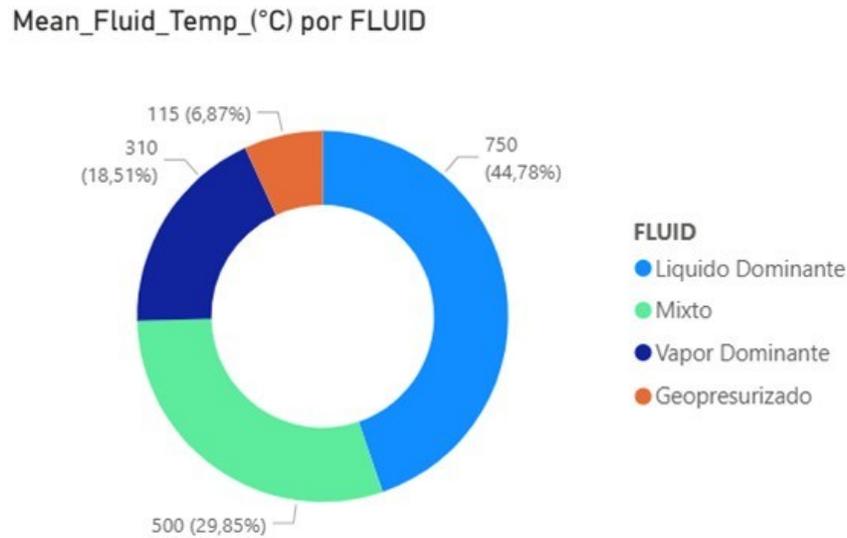
However, the study of European analogs confirms that a potential of this magnitude is fully compatible with technologically viable projects, with small-scale binary generation schemes. Arnason, (2000). The example of Tuscany (Italy) demonstrates that it is feasible to incorporate low-power binary generation cycles in medium-enthalpy settings, adapting to the reservoir's thermal conditions without requiring the production volumes of the Mexican fields.

Furthermore, experience in Aachen (Germany) and the Pannonian Basin (Hungary) shows that, within certain power limits, returns are maximized by prioritizing hybrid schemes or direct heat use as demonstrated by several European low-enthalpy projects. Arnason, (2000). Rather than relying solely on electricity generation. Therefore, the calculated 5–10 MWe for Paipa-Iza should not be viewed as a limitation, but rather as an indicator to follow a development model similar to that of Italy or Hungary, focusing on modular binary plants and cascaded thermal uses.

#### 4.1.3 Technology Types and Exploitation Schemes

The study of analogous systems demonstrates a strict correlation between the chosen energy conversion technology and reservoir enthalpy. Steam separation technologies are used for the analyzed high-enthalpy fields, used exclusively in high-temperature geothermal reservoirs Lippmann and Truesdell, (1983). Central Tuscany (Italy) utilizes single-flash cycles, while Monte Amiata (Italy) employs dry steam technology to capitalize on its predominant steam conditions. Cerro Prieto (Mexico) operates with double-flash plants. However, these schemes require significantly higher temperatures and pressures than those recorded in Colombia.

The integration of the Paipa–Iza complex into a sustainable energy matrix is further supported by the data shown in Figure 4. By comparing local thermal demands with the availability of medium-enthalpy fluids, a clear opportunity for 'cascaded use' emerges. Similar to the success stories in the Pannonian Basin and Aachen, the high-temperature primary loop can be utilized for electricity generation via ORC, while the residual heat (secondary loop) is channeled toward the local tourism and industrial sectors. This multi-stage approach, visualized in the current figure, not only improves the overall thermal efficiency of the system but also ensures the social and economic integration of geothermal energy into the regional development of Boyacá.



**Figure 4: Distribution of geothermal fluid dominance and implications for power conversion technology.**

In contrast, the models of Aachen (Germany) and the Pannonian Basin (Hungary) align with the technical affinity of Paipa–Iza. In these cases, the primary strategy consists of using the resource directly for heating and thermal processes, which optimizes the use of lower-temperature fluids.

Consequently, for Paipa–Iza, the technical feasibility of Flash-type plants is ruled out. Given the current thermal range (65–90 °C) and estimated potential, any power generation system (5–10 MWe) would rely solely on Binary technologies (ORC), which enable operation at intermediate temperatures through the use of organic working fluids. However, following the lessons learned from the Hungarian and German models, to ensure the project is economically sustainable, it should not depend exclusively on electricity. Instead, it must mandatorily integrate cascaded direct applications (such as those for thermal spas or agribusiness).

A global perspective of the geothermal classifications is synthesized in Figure 5, which situates the Paipa–Iza complex within the international landscape. The classification confirms that Paipa–Iza is a volcanic-hydrothermal system, characterized by its association with acidic volcanism and structurally-controlled fluid circulation. This dual nature allows it to share significant stratigraphic similarities with the sedimentary basins of the Pannonian region, while maintaining the thermal signatures of volcanic analogs like Tuscany. By identifying these global patterns, the analysis reinforces a development strategy that accounts for both the magmatic heat source and the high-permeability sedimentary reservoirs, providing a robust framework for reservoir management.

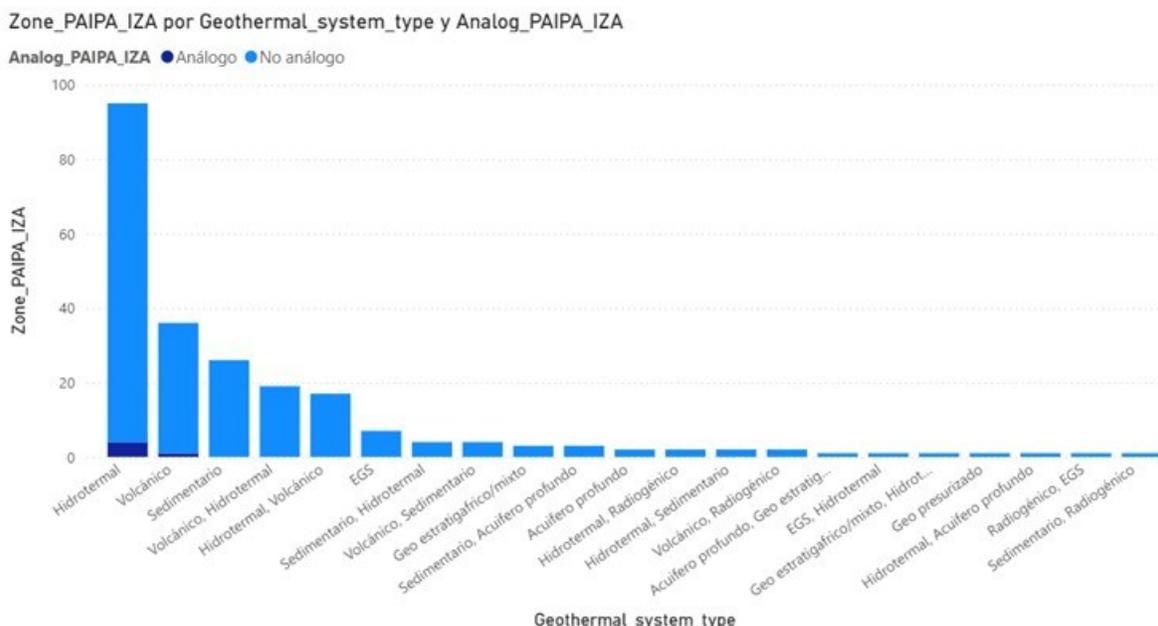


Figure 5: Global distribution of geothermal system types and classification of the Paipa–Iza system within international analogs.

4.1.4 Development Status and System Maturity

A comparison of maturity levels reveals a significant discrepancy between the Paipa–Iza system, which is still in its initial exploration and pre-feasibility phase, and its international counterparts, which operate as well-established fields. Cerro Prieto (Mexico) and the Tuscany/Monte Amiata (Italy) complex—both high-enthalpy systems—symbolize peak industrial maturity with decades of continuous operation and reservoir management experience. Gutiérrez-Negrín, (2010).

On the other hand, the analogs from the Pannonian Basin (Hungary) and Aachen (Germany) represent a different state of maturity, focused on optimizing the operational performance of direct uses and district heating. These examples demonstrate that sedimentary or low-enthalpy systems require development cycles distinct from those of volcanic systems. Instead of rapid mass exploitation, they have flourished through gradual integration with local energy demand.

Regarding Paipa–Iza, this comparison indicates that attempting to emulate the rapid evolution of large volcanic fields (such as Cerro Prieto) involves high risks due to the existing geological uncertainty. On the contrary, its status as a "blind" prospect or one with moderate manifestations benefits more from the European perspective. This approach involves progressing through scalable pilot projects (direct uses) that commercially validate the resource before making significant investments in electrical infrastructure. This strategy of progressive maturation is essential for converting theoretical potential into proven reserves.

Table 2 synthesizes the strategic relevance of each analyzed system, highlighting how their operational successes can be adapted to overcome the geological and financial uncertainties of the Paipa–Iza complex.

Table 2. Strategic Insights and Applicability of International Analogos to the Paipa–Iza Project

Analog System	Key Strategic Contribution	Technical Applicability to Paipa–Iza
Cerro Prieto	Structural framework of faulted basins.	Model for identifying secondary permeability zones.
Pannonian Basin	Optimization of low-to-medium enthalpy.	Validation of 5–10 MWe binary cycles (ORC).
Aachen	Integration of district heating and industrial use.	Justification for mandatory cascaded thermal applications.
Toscana/Amiata	Modular development in non-volcanic settings.	Strategy for progressive maturation via scalable pilots.

## 5. CONCLUSIONS

The Paipa–Iza system is confirmed to be a structurally controlled low-to-medium enthalpy system, where secondary permeability is the key operational factor. Paipa–Iza offers a significant comparative advantage over European analogs, as its reservoir is located at relatively shallow depths (1,250 – 1,750 feet), whereas European systems require deep drilling (over 5,000 feet) to reach commercial temperatures. This indicates that, despite moderate temperatures (65 – 90 °C), drilling and development costs can be substantially reduced, optimizing the project's cost-benefit ratio.

The comparison irrefutably rules out the use of steam technologies (Flash or Dry Steam) typical of high-enthalpy fields. Paipa–Iza's technological path should follow the Aachen and Hungarian models by establishing Binary Cycles (ORC) for baseload power production (estimated at 5 – 10 MWe). These must be mandatorily complemented by cascaded direct applications. This hybrid combination is not optional; it is indispensable for ensuring the financial sustainability of the project and its thermodynamic efficiency.

The industrial maturity level of fields like Cerro Prieto should not serve as the immediate benchmark for Paipa–Iza. Based on lessons learned from sedimentary analogs, a phased development is the superior strategy. It is recommended to begin with direct-application pilot projects (such as climate control, technical balneology, or agro-industrial drying) to validate the resource and build social acceptance. Subsequently, operations can expand to electricity production using modular plants, thereby reducing the investment risk associated with current geological uncertainty.

This research demonstrates that the lack of deep-well data at Paipa–Iza can be effectively mitigated by comparing it to well-characterized systems. Grant et al, (1982). The structural correlation with Cerro Prieto (faulted sedimentary basin) and the thermal correlation with the Pannonian Basin constitute a solid conceptual model. This model supports advancing toward more comprehensive phases, such as geophysical exploration (magnetotellurics) and the drilling of exploratory slim holes.

Ultimately, Paipa–Iza establishes itself not only as a local energy potential but also as the reference laboratory for low-enthalpy geothermics in Colombia. Its success will demonstrate that geothermal generation is feasible beyond active volcanic areas, enabling the exploitation of similar resources across the Eastern Cordillera and contributing to the effective diversification of the national energy matrix through a stable, low-impact renewable source.

The strategic benchmarking presented in Table 2 shifts the development paradigm for Paipa–Iza from a high-risk exploration model to a phased maturation strategy. By adopting the modular approach of the Pannonian Basin and the cascaded-use framework of Aachen, the project can achieve economic viability even in the early stages of exploration. This comparative evidence confirms that secondary permeability and low-to-medium enthalpy resources are not limitations, but rather opportunities for a more sustainable and socially accepted geothermal transition in the Colombian Eastern Cordillera.

## 6. REFERENCES

- Lippmann, M.: The Cerro Prieto and Salton Sea Geothermal Fields: A Comparative Study, Proceedings, Stanford Geothermal Workshop, Stanford University, Stanford, CA (1999).
- Lippmann, M.: Preliminary Simulation Studies Related to the Cerro Prieto Geothermal Field, Technical Report, Comisión Federal de Electricidad (CFE), Mexico (1978).
- Glowacka, E.: Subsidence and Ground Deformation in the Cerro Prieto Geothermal Field, Journal Paper, Springer, Berlin, Germany (2005).
- Colorado-Garrido, D., et al.: Exergy Analysis Using a Theoretical Formulation Applied to Geothermal Systems, Journal Paper, MDPI, Basel, Switzerland (2021).
- Gutiérrez-Negrín, L.C.A.: Geothermal Energy in Mexico: Update and Perspectives, Country Update Report, International Geothermal Association (IGA) (2021).
- Lippmann, M., et al.: Geological, Geophysical and Geochemical Characteristics of the Cerro Prieto Geothermal System, Proceedings, Stanford Geothermal Workshop, Stanford University, Stanford, CA (1990).
- Glowacka, E., Nava, F.A.: Geophysical Monitoring and Reservoir Response at Cerro Prieto, Journal Paper, Springer, Berlin, Germany (2000).
- Gutiérrez-Negrín, L.C.A., Quijano-León, J.L.: Development and Management of the Cerro Prieto Geothermal Field, Proceedings, World Geothermal Congress, International Geothermal Association (2015).
- Lippmann, M., Paredes, J.R.: Simulation and Validation of Production Behavior in High-Enthalpy Geothermal Reservoirs, Technical Report, Stanford University, Stanford, CA (1985).
- Colorado-Garrido, D., et al.: Thermodynamic and Exergy-Based Assessment of Geothermal Power Production, Journal Paper, MDPI Energies, Basel, Switzerland (2021).
- Elders, W.A., et al.: A Comprehensive Study of the Cerro Prieto Geothermal Field, Baja California, Mexico, Journal Paper, Geothermics, Elsevier, Amsterdam, The Netherlands (1984).
- Grant, M.A., Donaldson, I.G., Bixley, P.F.: Geothermal Reservoir Engineering, Book, Academic Press, New York, NY (1982).

- Faulds, J.E., Hinz, N.H.: Structural Controls on Geothermal Systems in Extensional Settings, Journal Paper, Geothermics, Elsevier, Amsterdam, The Netherlands (2015).
- Lippmann, M., Truesdell, A.H.: Fluid Geochemistry and Reservoir Processes in High-Temperature Geothermal Systems, Proceedings, Stanford Geothermal Workshop, Stanford University, Stanford, CA (1983).
- Gutiérrez-Negrín, L.C.A.: Current Status and Future Development of the Cerro Prieto Geothermal Field, Proceedings, World Geothermal Congress, International Geothermal Association (IGA) (2010).
- Henley, R.W., Truesdell, A.H., Barton, P.B.: Fluid–Mineral Equilibria in Hydrothermal Systems, Book, Society of Economic Geologists, Littleton, CO (1984).
- Árnason, K.: Geothermal Reservoir Modelling, Proceedings, World Geothermal Congress, International Geothermal Association (IGA) (2000).