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Turkiye's Geothermal Energy Potential: Investment Opportunities and Exploration Methods

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INTRODUCTION

Turkiye holds one of the richest geothermal resources in Europe and ranks among the top ten countries worldwide in installed geothermal power capacity. Its unique geological setting—situated on active tectonic zones with high heat flow and widespread hydrothermal systems—creates a favorable environment for both electricity generation and direct use applications. Over the past two decades, Turkiye's geothermal sector has evolved rapidly, supported by policy incentives, private investment, and technological advancement.

Despite significant development, much of the country's geothermal potential remains untapped, particularly in western Anatolia and along major fault systems where deep, high-enthalpy reservoirs are inferred. Current exploration efforts increasingly rely on integrated geoscientific approaches combining geological, geophysical, and geochemical methods with advanced data analytics and modeling tools. These techniques enhance the understanding of subsurface systems, reduce exploration risk, and open new opportunities for sustainable resource development.

As global demand for clean and baseload renewable energy grows, Turkiye's geothermal sector presents attractive prospects for investors and strategic partners. This paper provides an overview of Turkiye's geothermal energy potential, reviews current exploration methodologies, and outlines investment opportunities that can contribute to both national energy security and international climate goals.

METHODS

This study integrates geological, geophysical, and geochemical datasets to evaluate Turkiye's geothermal energy potential and identify investment-grade prospects. The methodological framework consists of four main stages:

Geological Assessment: Regional and structural geology maps were reviewed to delineate tectonic zones, fault systems, and volcanic centers associated with geothermal activity. Lithological and stratigraphic data were analysed to define reservoir and cap rock units.

Geophysical Analysis: Gravity, magnetic, and resistivity data were examined to infer subsurface structures and heat sources. Magnetotelluric (MT) and seismic surveys were used to image deep conductive zones and identify potential geothermal reservoirs.

Geochemical Evaluation: Geothermal fluids and gas samples from existing wells and surface manifestations were analyzed for temperature estimations (using geothermometers), reservoir composition, and recharge characteristics.

Integration and Modeling: The datasets were integrated using Geographic Information Systems (GIS) and 3D modeling software to generate geothermal favorability maps. These models guided the identification of high-potential zones suitable for further exploration and investment.

This multidisciplinary approach reduces exploration risk, enhances resource characterization, and provides a reliable basis for evaluating both technical and financial feasibility in Turkiye's geothermal sector

RESULTS

The integrated analyses revealed numerous high-potential geothermal zones across western, central, and eastern Turkiye. The combination of geological structures, high heat flow, and favorable reservoir characteristics indicates that Turkiye possesses significant untapped geothermal resources suitable for both electricity generation and direct-use applications.



Figure 1. Geothermal resources and volcanic areas map in Turkiye (MTA)

Geological and geophysical studies, 3D modeling, GIS-based favorability mapping, and data from deep drilling all demonstrate that the Büyük Menderes, Gediz, Simav, and eastern Anatolian basins represent the regions with the highest potential. These areas are supported by active faulting and well-defined hydrothermal systems. In addition, new target zones indicating the presence of deep, high-enthalpy systems have been identified along the Central Anatolia and East Anatolian Fault Zone.

Geochemical analyses confirmed the existence of geothermal fluids with temperatures exceeding 200°C in several regions, indicating strong connections to deep magmatic heat sources. Integration of magnetotelluric and gravity data significantly improved reservoir boundary estimation and enhanced the precision of drilling targets.

These findings demonstrate that Turkiye's geothermal resource base is both extensive and diverse. Combined with a supportive regulatory framework and growing investor interest, the results strongly emphasize Turkiye's potential to become a major global geothermal energy producer within the next decade.

DISCUSSION

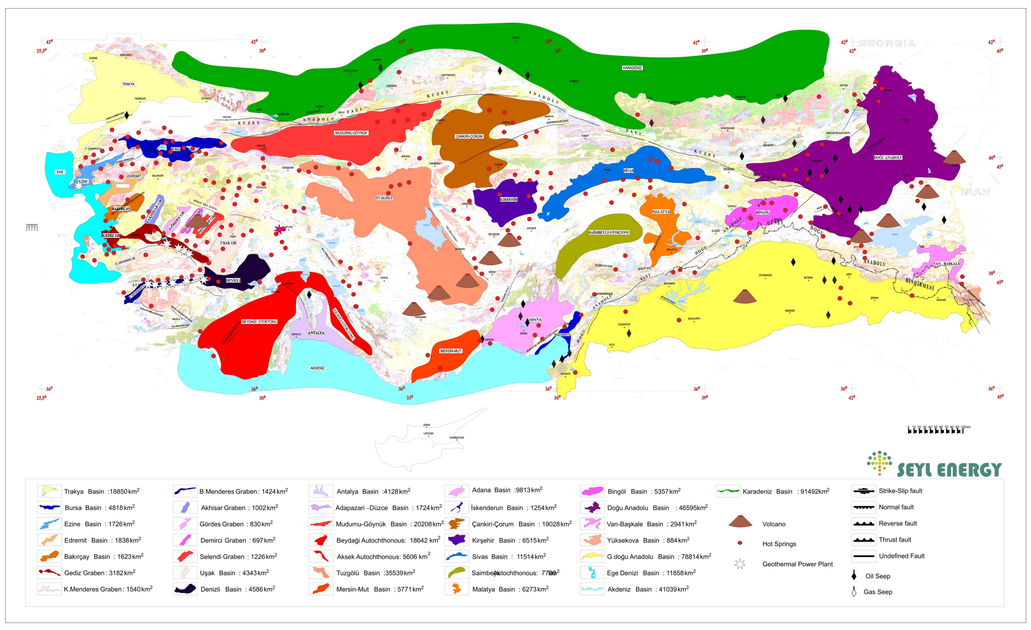


Figure 2. Geothermal resources, volcanic areas and basin map of Turkiye)

Turkiye occupies a strategic position that combines scientific depth, technical capability, and strong investment potential in geothermal energy. The country's geological diversity and high heat flow provide vast opportunities for both high-enthalpy power generation and direct-use applications. Many promising geothermal zones across Türkiye remain insufficiently explored, offering significant potential for new discoveries and future investments.

An integrated approach combining geology, geophysics, and geochemistry enables more accurate identification of new reservoir zones. This methodology enhances drilling success rates, optimizes exploration costs, and supports stronger, data-driven investment decisions.

The investment environment is maturing through robust incentive mechanisms, strong local engineering capacity, and advancing technological collaborations. Emerging fields such as hybrid energy systems, Enhanced Geothermal Systems (EGS), and geothermal-based agriculture create innovative business models that strengthen both energy security and economic diversification.

As Türkiye's renewable energy targets expand, combined with growing international partnerships in finance and technology, the country is positioned to become a globally competitive hub for sustainable and high-value geothermal development. Strategic collaborations established during this transition period could transform Türkiye into a key center for next-generation geothermal investments.

CONCLUSION

Türkiye's geothermal resources represent one of the most promising pillars of its renewable energy future. The country's favorable geological setting, combined with increasing technical expertise and supportive regulatory frameworks, creates a strong foundation for sustained geothermal growth.

By expanding exploration activities—especially in underexplored basins—Türkiye can unlock significant untapped potential for both electricity generation and direct-use applications. Continued collaboration between the public sector, private investors, and research institutions will be essential to accelerate project development and maximize efficiency.

With its unique combination of natural potential, technological capability, and strategic location, Türkiye has the opportunity to position itself as a leading geothermal energy hub in the wider region—contributing to clean energy security, economic growth, and global climate goals.

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