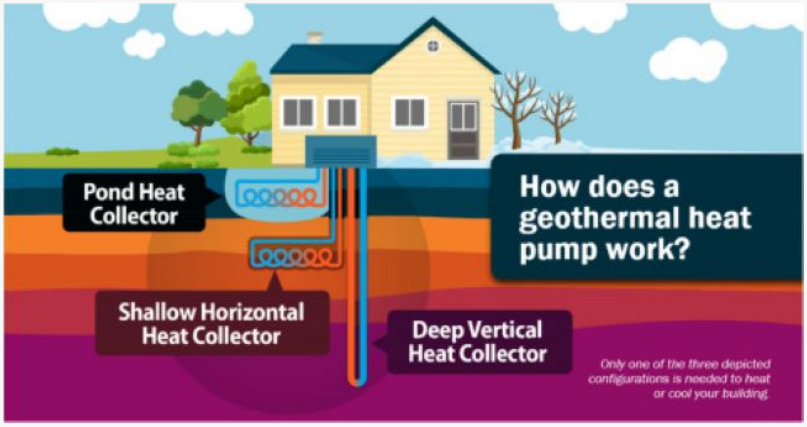
Geothermal energy has the potential to reshape global power supply

The largely untapped potential of thermal energy sources could transform the future of global energy if fully harnessed.



Operation of a geothermal heat pump. From US Department of Energy. Geothermal heat pumps, https://www.energy.gov/energysaver/geothermal-heat-pumps [accessed 11.04.25]. Credit: Geothermal Systems in the Energy Transition Era (2026). DOI: https://doi.org/

SHARJAH, EMIRATE OF SHARJAH, UNITED ARAB EMIRATES, January 26, 2026 /EINPresswire.com/ -- Through a detailed mapping of the operating principles of current geothermal systems, scientists are pointing to vast, largely hidden potential capable of meeting the growing demands of an energy-hungry world.

But despite the hopes that geothermal energy will play a transformative role in reshaping the global power supply, researchers warn that a “significant knowledge gap” continues to hinder the effective deployment of this abundant but largely untapped source.

The optimistic outlook is highlighted in a new book titled Geothermal Systems in the Energy Transition Era, which offers “detailed assessments of geothermal power plants, absorption chillers, and heat pumps.”

The book “reviews the use of geothermal heat pumps in residential, commercial, and agricultural applications [in addition to] the advances and challenges in geothermal freshwater production.” (https://doi.org/10.1016/C2024-0-00994-0)

The authors dwell on “prospects of dry rock geothermal energy.” They investigate and discuss “applications of machine learning methods for modeling and optimization of geothermal energy systems.”

The insights the authors provide position geothermal energy as a cornerstone in the global

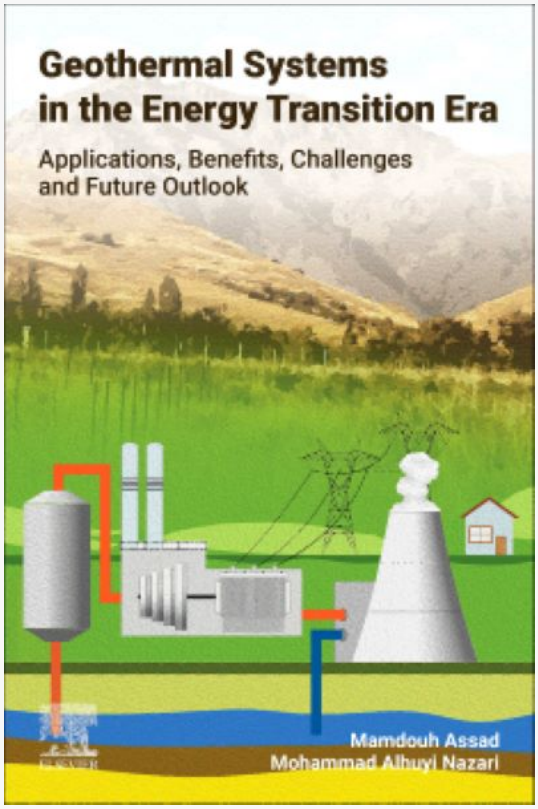
energy future and not just as a supplementary source; if fully exploited, it could meet at least 15% of global electricity demand by 2050.

Innovation, design, and performance

When asked about the major takeaways of the book, the lead author, Mamdouh Assad, Professor of Thermodynamics and Energy Systems at the University of Sharjah, emphasized the central role of energy systems and analyses. He said, “They are used to find the most effective performance of geothermal energy systems.”

Professor Assad explained that the book’s 13 chapters present detailed mathematical formulations of all types of geothermal power plants, heat pumps, and absorption chillers. “We provide students and industry professionals with a holistic understanding of this dynamic field and its significant impact.”

The book’s main contribution lies in the numerous design concepts it introduces for geothermal energy systems. These concepts are firmly grounded in thermodynamics and heat transfer, including “material on absorption chillers and heat pumps driven by geothermal energy sources.”



The book is titled ‘ Geothermal in the Systems in the Energy Transition Era’. Credit: Geothermal Systems in the Energy Transition Era (2026). DOI: https://doi.org/10.1016/C2024-0-00994-0

The authors also acknowledge a persistent gap in knowledge regarding the full potential of thermal energy systems to transform the world’s power supply into cleaner alternatives.

“This is partly due to the limited number of academic programs in renewable energy related to geothermal energy and the relatively new nature of many geothermal energy technologies, leading to a shortage of expertise,” the authors note.

The book seeks to address this gap by offering “a comprehensive understanding of the potential and challenges within this evolving field.” It directly responds to the “difficulty students, researchers, and engineers face in finding suitable resources that summarize key geothermal energy technologies.”

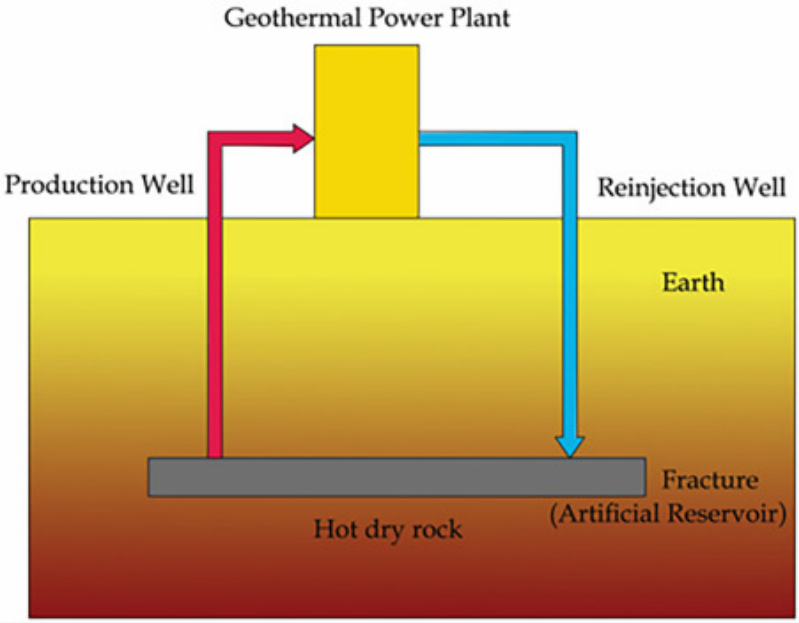
Exponential expansion

The statistics cited by the authors point to exponential growth in the deployment of thermal energy as a sustainable and renewable source. They reveal that global consumption surged from

approximately 20,000 GWh in 1980 to more than 1 million GWh in 2023.

A 2024 report by the energy watchdog, the International Energy Agency (IEA), further underscores this momentum, noting that continued technological innovation and cost reductions in the building of heat energy facilities are expected to boost thermal energy's share of global electricity consumption to as much as 15%.

This expansion would require the deployment of as much as 800 GW of geothermal capacity worldwide—roughly equivalent to the combined electricity consumption of India and the United States, the report says.



Schematic of enhanced geothermal system configuration. Adapted courtesy of Sakai Y. Advanced geothermal steam turbines. In: Advances in steam turbines for modern power plants. Elsevier; 2017. p. 455–86. https://doi.org/10.1016/B978-0-08-100314-5.00019-1.

The authors also call for the integration of the various geothermal systems currently used for thermal energy power generation. They specifically cite thermodynamic analysis of all types of geothermal power plants and geothermal heat pumps for cooling and heating, as well as water/lithium bromide single-effect absorption chillers.

Mohammad Nazari, Professor of Renewable Energy and Environmental Engineering at the University of Tehran, argues that increased reliance on machine learning-based intelligent methods could significantly lower computational costs and lead to time savings.

"By using these methods," Prof. Nazari, the co-author, said that it becomes possible to accurately model different geothermal energy technologies and systems, for example, heat pumps, power plants, etc. Furthermore, the developed model based on these approaches would be applicable to the optimization of these systems."

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