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Central Asia's Untapped Heat: A New Geothermal Frontier



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This Month's Hot Spot

The Subsurface Revolution in the Heart of Eurasia

For decades, Central Asia has been synonymous with vast fossil fuel reserves. However, as the global energy landscape shifts toward decarbonization and resilience, a new narrative is emerging from beneath the steppe and mountains. Central Asia is often discussed as a single energy region, but it is, in reality, a mosaic of geologies, climates, and energy systems. This diversity is a strength, allowing geothermal energy to be tailored to heat-dominant systems, industrial clusters, and urban centers. This special feature explores how five nations are moving beyond a one-size-fits-all approach to design bespoke geothermal pathways.



Geothermal Steps onto the Strategic Agenda

Central Asia stands at an important crossroads in its energy transition. A region historically defined by oil, gas, and hydropower is now beginning to look deeper—literally—at the heat beneath its surface. From the deserts of Uzbekistan to the tectonically active corridors stretching toward the Tien Shan and Pamir ranges, geothermal energy is emerging as a credible new pillar of long-term energy security and diversification.

Until recently, geothermal in Central Asia remained largely an academic topic, discussed in geological surveys but rarely translated into policy or projects. That is now starting to change. Governments are seeking ways to reduce reliance on fossil fuels, manage growing electricity demand, and build resilient domestic energy systems. In this context, geothermal offers something unique: clean, locally available, and firm energy that can operate independently of seasonal weather patterns.



From Geological Curiosity to Energy Strategy

Uzbekistan is taking a leading role in this shift. The country's first international geothermal forum marked a turning point—bringing together ministries, researchers, international experts, and industry actors to explore how geothermal could be integrated into national energy planning. What was once a niche topic has now entered mainstream energy discussions, supported by concrete assessments of subsurface potential and growing political interest.

At the same time, geothermal in Central Asia is not just a national story: it is a regional one. Shared geological structures, common development challenges, and interconnected energy systems mean that progress in one country can accelerate learning across borders. From Kazakhstan's sedimentary basins to high-temperature prospects in Kyrgyzstan and Tajikistan, the region holds a diverse geothermal portfolio that could support heating, power generation, and industrial applications.

This edition of GLOBAL_GT brings these threads together. We begin with Uzbekistan's landmark geothermal forum, highlighting how national ambition is translating into institutional action. We then explore what the data tells us about the country's subsurface potential and technical readiness. Finally, we step back to look at the broader regional picture—examining how geothermal could evolve into a strategic energy pathway for Central Asia as a whole.

Together, these stories show a region at the very start of its geothermal journey. The heat is there. The science is advancing. The political conversation has begun. What comes next will determine whether Central Asia becomes a follower - or a future leader - in geothermal development.



Why Uzbekistan Can Lead



By the International Geothermal Association Representative Zemfira Djemileva

Uzbekistan is entering a decisive phase of its energy transition. The country is experiencing strong and sustained economic growth, and with it a rapid increase in energy demand. Forecasts suggest that total energy consumption could nearly double by 2035. This is not only a question of expanding capacity; it is a strategic challenge of ensuring that the energy system remains reliable, resilient, and environmentally sustainable over the long term.

As articulated by President Shavkat Mirziyoyev, Uzbekistan approaches the climate agenda not as an external obligation, but as an integral part of national development. The country has set out clear ambitions: increasing the share of green energy to 40 percent, moving gradually toward carbon neutrality, and—over time—developing an export potential for clean energy. Crucially, this transition is framed as realistic and economically grounded, rooted in Uzbekistan's own resources and competitive advantages. In this strategic context, geothermal energy fits not as an add-on, but as a system solution.

Beyond Electrons: The Value of Baseload Heat

Much of the global energy debate remains focused on electricity generation alone. Yet for countries with growing populations, cold winters, hot summers, and expanding industrial activity, the real challenge lies in meeting total energy demand: heating, cooling, industrial heat, agriculture, and water systems.

This is where geothermal energy stands apart

Unlike solar and wind, geothermal energy provides continuous, baseload supply— independent of weather, seasons, or time of day. It complements variable renewables and strengthens grid stability, while simultaneously offering direct heat for district heating networks, public buildings, industrial processes, and greenhouse agriculture.

For Uzbekistan, this is not theoretical. It is structural.

A Subsurface Advantage Already in Place

Uzbekistan is endowed with significant geothermal resources distributed across much of its territory. Importantly, this geological potential is matched by something many countries lack: decades of subsurface knowledge.

Extensive oil and gas exploration has generated a large inventory of drilled wells, seismic data, and basin understanding. This creates a unique opportunity to repurpose existing infrastructure and data for geothermal development—reducing exploration risk, lowering capital costs, and accelerating deployment timelines.

International experience shows that such conditions are ideal for a phased geothermal strategy: starting with low- and medium-temperature applications where economic returns are fast and risks are manageable, and gradually building toward more advanced systems.

District Heating, Industry, and Agriculture: The Near-Term Wins

In the near term, the most compelling opportunities for geothermal in Uzbekistan lie in direct heat use. District heating systems can dramatically reduce dependence on natural gas, particularly in urban centers. Industrial facilities can decarbonize process heat. Greenhouse agriculture can expand year-round production while improving energy efficiency and food security.

These are not long-horizon bets. Globally, geothermal heat projects are among the fastest-payback investments in the energy transition, delivering tangible economic and environmental benefits at the local level.

From Resource to Asset: The Role of Partnership

Geothermal energy is not only a technical endeavor. It is an institutional one.

Successful geothermal development requires coordination across ministries, regulators, utilities, private developers, research institutions, and financiers. Clear licensing frameworks, risk-mitigation instruments, access to subsurface data, and long-term heat and power market design all play a decisive role.

The International Geothermal Association highly values the constructive dialogue already underway with Uzbekistan's institutions and companies. As a global platform representing more than 110 countries, the IGA stands ready to support Uzbekistan with international best practices, capacity building, and technical expertise - from early pilot projects to large-scale deployment.

A Strategic Asset for the Long Term

Geothermal energy has the potential to become a cornerstone of Uzbekistan's energy system: strengthening energy security, supporting sustainable economic growth, reducing emissions, and improving air quality for communities.

Perhaps most importantly, it aligns fully with the country's own development logic: grounded, sovereign, and forward-looking.

Central Asia is often described as a region of transition. In geothermal energy, Uzbekistan has the opportunity to be a region of leadership.



What the Data Tells Us About Geothermal in Uzbekistan



Evidence-based insights informed by technical analysis presented by Dave Waters

The case for geothermal energy in Uzbekistan is not speculative. It is grounded in decades of subsurface data, regional energy system analysis, and a clear understanding of where geothermal delivers the greatest value.

Dave Waters' technical assessment provides a crucial bridge between geological potential and commercial reality. Rather than asking whether Uzbekistan has geothermal resources, the analysis focuses on a more important question: where, how, and at what scale geothermal can be deployed most effectively within the national energy system.

Geothermal Must Be Read as Part of the Energy System

One of the central messages of the analysis is that geothermal should not be framed in isolation.

Uzbekistan already benefits from strong solar and hydro resources, with wind and nuclear also part of the forward-looking energy mix. Geothermal's role is therefore not to compete head-on with these sources, but to complement them—particularly where stability, heat, and long operating lifetimes matter most.

International examples, including large-scale geothermal heating systems in China and Iceland, demonstrate that geothermal performs best when integrated into wider energy systems, supporting electricity, heat, cooling, and water management simultaneously.

Heat Demand and Resource Overlap Is the Real Opportunity

A defining strength of Uzbekistan’s geothermal profile is the alignment between geothermal resources and heat demand.

Analysis of population density, building volume, and urban centers shows a strong overlap between:

- areas of high heat and cooling demand, and
- sedimentary basins with favorable geothermal characteristics.

This matters because geothermal heat economics are driven not only by temperature, but by proximity to demand. District heating, industrial heat, and public infrastructure can all be supplied efficiently where demand density is high—often at shallower depths and lower costs than power-focused geothermal projects.

Depth Is a Choice, Not a Goal

A key insight from the presentation is that deeper is not automatically better.

While temperature increases with depth, drilling costs rise sharply, imaging resolution decreases, and reservoir permeability often declines. This creates a trade-off between temperature, flow rate, cost, and operational longevity.

In many Uzbek basins, commercially viable geothermal applications exist at moderate depths—particularly when combined with modern heat pump technologies. These allow lower-temperature resources to be upgraded efficiently for heating and cooling, significantly expanding the usable resource base.

This system-oriented approach favors:

- lower upfront risk,
- faster deployment, and
- scalable replication across multiple locations.



Heat Flow: Abundant and Well-Documented

Multiple independent datasets confirm that Uzbekistan has no shortage of heat flow potential.

Heat flow mapping across the country—drawing on work by Andreyev (2020), Sidorova (2023), and others—shows extensive zones with favorable geothermal gradients. Crucially, many of these coincide with areas already explored for oil and gas.

This is where Uzbekistan holds a comparative advantage: data richness.

Where oil and gas exploration has occurred, geothermal developers inherit decades of well logs, seismic surveys, temperature measurements, and pressure data. This dramatically reduces exploration uncertainty and lowers the barrier to entry for both domestic and international investors.



Oil and Gas Data as a Geothermal Accelerator

The analysis reinforces a global lesson: geothermal thrives where subsurface knowledge already exists.

Uzbekistan’s oil and gas basins—such as the Amu Darya and Fergana basins—are not only hydrocarbon provinces; they are geothermal datasets waiting to be reinterpreted. Existing wells can support feasibility studies, pilot projects, and in some cases direct repurposing.

This creates a powerful opportunity for:

- faster project development,
- lower exploration risk, and
- skills transfer from oil and gas to geothermal.

Water, Heat, and Climate Resilience

Geothermal potential also intersects with Uzbekistan’s climate and water challenges.

The analysis highlights links between geothermal resources, saline groundwater systems, and regions exposed to climate stress. This opens the door to integrated solutions—such as geothermal-supported desalination, thermal energy storage, and resilient heating and cooling systems—that strengthen adaptation as well as mitigation.

From Data to Investment: Why Access Matters

One of the clearest conclusions is that maps alone are not enough.

While national heat flow maps provide a useful overview, investor confidence is unlocked through access to detailed well and seismic data at specific locations. International experience—such as national geothermal databases in Europe—shows that transparent data access can dramatically accelerate project pipelines.

For Uzbekistan, structured access to subsurface data could become one of the most powerful tools to attract private capital and scale geothermal development.

Evidence Supports Action

Taken together, the evidence is clear:

- Uzbekistan has abundant geothermal resources.
- These resources align well with heat and cooling demand.
- The country possesses exceptional subsurface data from oil and gas exploration.
- Moderate-depth, system-integrated geothermal solutions offer the fastest and lowest-risk pathway to deployment.

The challenge is no longer whether geothermal belongs in Uzbekistan’s energy future—but how quickly the system can move from analysis to action. 

Geothermal Across Central Asia



Central Asia is often discussed as a single energy region. In reality, it is a mosaic of geologies, climates, energy systems, and institutional starting points. This diversity is not a weakness—it is a strength.

Geothermal energy does not require a one-size-fits-all model. It thrives precisely because it can be tailored: to heat-dominant systems, industrial clusters, agricultural regions, and urban centers. Across Central Asia, five countries illustrate how different geothermal pathways can emerge from shared subsurface potential.

Kazakhstan: Scaling Heat at System Level

Kazakhstan's defining geothermal opportunity lies in scale.

With cold winters, large urban centers, and extensive district heating networks, the country has one of the strongest heat-demand profiles in the region. Much of this demand is currently met with coal and gas, creating both emissions pressure and air quality challenges.

Geothermal can play a decisive role here—not necessarily through high-enthalpy power generation, but through large-scale geothermal heat, integrated with district heating, thermal energy storage, and hybrid systems. Kazakhstan's extensive subsurface

data from decades of oil and gas activity further strengthens the case for rapid feasibility assessment and pilot development.

The pathway: *System-scale geothermal heat to decarbonize cities and stabilize winter energy demand.*



Azerbaijan: Leveraging Oil & Gas Expertise

Azerbaijan enters the geothermal conversation with a unique asset: deep subsurface capability.



The country's long-standing oil and gas expertise—both onshore and offshore—translates directly into geothermal readiness. Skills in drilling, reservoir management, reinjection, and subsurface risk management are already embedded in institutions and companies.

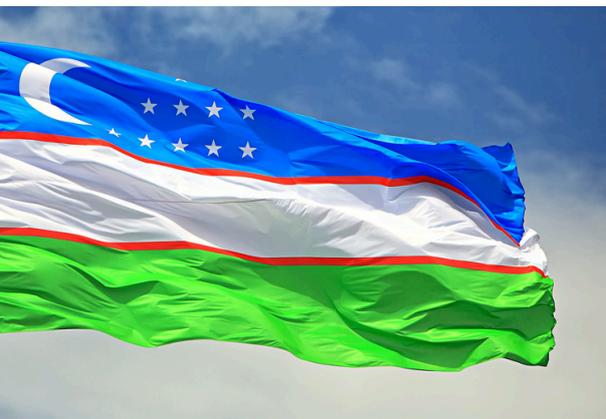
This positions Azerbaijan well for industrial geothermal applications, hybrid systems, and repurposing of existing wells and infrastructure. Rather than starting

from scratch, geothermal can be framed as a logical extension of subsurface stewardship and energy system optimization.

The pathway: *Geothermal as a natural evolution of oil and gas competence—focused on industry and system integration.*

Uzbekistan: Building the First Replicable Models

Uzbekistan stands out as a policy-driven geothermal frontrunner.



Clear political commitment to energy transition, combined with strong state institutions and a rich subsurface dataset, makes Uzbekistan an ideal testbed for first-of-a-kind regulated geothermal projects. The strongest near-term opportunities lie in district heating, public infrastructure, industry, and greenhouse agriculture—applications that deliver fast economic and social returns.

Crucially, Uzbekistan has the opportunity to move early on framework design: licensing, data access, and risk-sharing mechanisms that can later be replicated across the region.

The pathway: *Early deployment + smart regulation = a regional reference model.*

Turkmenistan: Quiet Pilots, Strategic Efficiency

Turkmenistan's energy system is dominated by gas, and energy security is not the immediate driver it is elsewhere. This changes the geothermal equation.

Here, geothermal's value lies less in large-scale rollout and more in targeted efficiency gains: industrial heat, process optimization, and localized applications where geothermal can free up gas for higher-value uses.

Discreet pilot projects—technically solid, economically rational, and institutionally contained—are likely the most effective entry point.

The pathway: *Selective geothermal deployment focused on efficiency, not disruption.*



Tajikistan: Decentralised Resilience

Tajikistan presents a different geothermal profile altogether.

Mountainous terrain, dispersed populations, and strong climate vulnerability point toward small-scale, decentralised geothermal solutions. Here, geothermal can support community heating, public buildings, and local resilience—particularly in regions where grid reliability and winter heating are critical challenges.



While projects may be smaller in scale, their social impact can be significant, especially when aligned with climate adaptation and regional development goals.

The pathway: Geothermal for resilience, decentralisation, and community-level impact.

Why a Regional Approach Matters

What unites these five countries is not identical geology or policy; but shared opportunity.



A regional geothermal approach allows Central Asia to:

- share technical standards and data methodologies,
- align regulatory learning curves,
- build investor confidence through scale and consistency, and
- develop a pipeline of projects rather than isolated pilots.

This is where international platforms and regional cooperation matter most: turning individual country efforts into a coherent geothermal narrative for Central Asia.

Geothermal energy will not look the same in Kazakhstan as it does in Tajikistan. And it shouldn't. But taken together, these pathways point to a region that is far better positioned for geothermal leadership than is often assumed.

Central Asia does not need to copy existing geothermal markets. It can design its own. ■

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