

Hydrogen and Energy Storage Technologies in the Service of Decarbonisation



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Product-level solutions and a representation partnership opportunity in Kazakhstan

The world's energy system is undergoing a profound transformation, and one of the most important questions of this transition is not where to obtain clean energy, but how to store it economically and deliver it to the point of use. As renewable energy spreads, production and consumption increasingly fail to coincide in time, which is why energy storage — and hydrogen, as a clean energy carrier and industrial feedstock — is set to become a defining industry of the coming decade. The Hungarian Private Joint-Stock

Company GEOA Innovations offers product-level, patent-protected solutions in precisely this field, spanning from hydrogen production through storage and pressure management to industrial and transport use. The company is now actively seeking partners and representatives in Kazakhstan — potentially within an exclusive arrangement — to introduce these solutions locally. The purpose of this article is to show why this opportunity is timely precisely in Kazakhstan, and what ready-to-use, fully supported cooperation model GEOA offers to its local partners.

1. Kazakhstan: an exceptional opportunity in the energy transition

Kazakhstan's energy position represents both a challenge and an exceptional opportunity. As one of the world's leading oil and gas producers, the country stands at the threshold of an ambitious energy transition. In 2023,

presidential decree enshrined the target of carbon neutrality by 2060, and in 2024 a dedicated hydrogen strategy was adopted, setting out the build-up of at least 10 GW of hydrogen production capacity by 2040. A key aim of the strategy is for a significant share of hydrogen technologies — around 20 per cent — to be produced domestically, with

local know-how, by 2040. Official estimates put the total investment requirement of the decarbonisation transition at around USD 610 billion.

The country intends to raise the share of renewable energy to 15 per cent by 2030 and 50 per cent by 2050 by integrating the growing volumes of solar and wind power into the grid, however, this requires large-scale

energy storage — one of the most conspicuously missing elements today of the Kazakh system. Together, these goals outline precisely the three factors that GEOA's partnership addresses: economical energy storage, locally deployable and manufacturable technology, and preserving the value of existing hydrocarbon infrastructure within the green transition.

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Kazakhstan's energy transition and the global hydrogen market outlook

Key indicators for the 2060 carbon-neutrality goal and the growth of the hydrogen economy

KAZAKHSTAN'S ENERGY TRANSITION		GLOBAL HYDROGEN MARKET - OUTLOOK	
Carbon-neutrality target	2060 enshrined in law (2023)	Current hydrogen production	~97 Mt/yr mostly fossil-based
Hydrogen production capacity 2040 target	≥ 10 GW	Share of low-emission H ₂	< 1% of total production
Domestic technology manufacturing 2040 target	20%	Low-emission H ₂ 2030 forecast	49 Mt/yr
Decarbonisation investment need	~USD 610 bn	Announced electrolyser capacity 2030	230-520 GW
Renewable energy share	15% → 50% 2030 → 2050	H ₂ refuelling-station market 2030-2035	tens of bn USD
Current renewable capacity	~2.5 GW solar + wind	H ₂ in global energy demand 2050 · IEA	10-15%

Sources: Kazakhstan's 2060 carbon-neutrality strategy (2023) and national hydrogen strategy (2024); International Energy Agency (IEA); Climate Action Tracker; GEOA Innovations market analyses (2025–2026).

Table 2



2. PrJSC GEOA Innovations: a ready, integrated technology portfolio

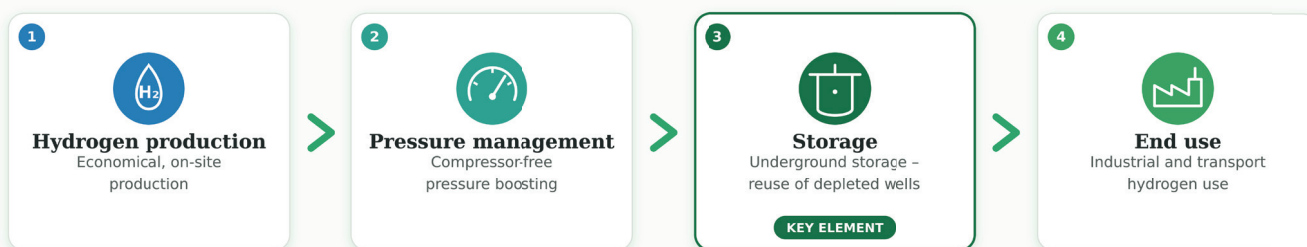
PrJSC GEOA Innovations offers not a single device but an integrated, mutually reinforcing technology portfolio covering several key elements of the hydrogen-based energy chain. The company's strength is that its

developments do not remain theoretical: these are product-level solutions, partly already tested and advancing towards industrial validation, protected by a unified patent portfolio. The platform is therefore not a collection of components but a coherent system whose elements can be deployed individually or together, according to the partner's needs.

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GEOA's integrated energy value chain

A single, coherent system from hydrogen production to industrial and transport use



COMPLEMENTARY, INTEGRATED SOLUTIONS



Patent-protected technology portfolio · patent coverage in 54 countries

Figure 1

3. The business value of the portfolio

Underground hydrogen and energy storage — with particular significance for the reuse of depleted wells.

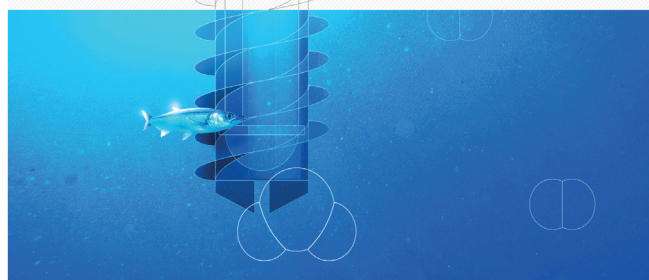
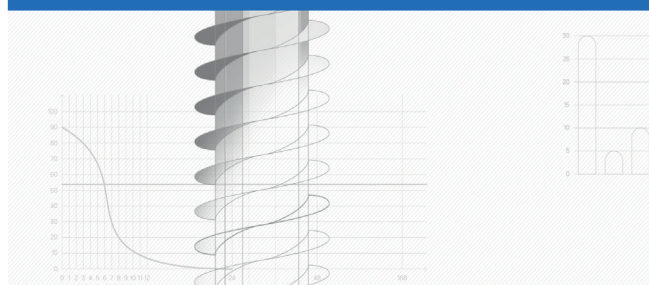
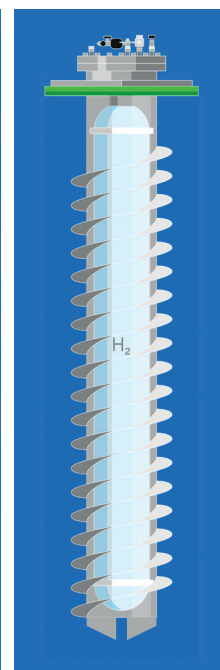
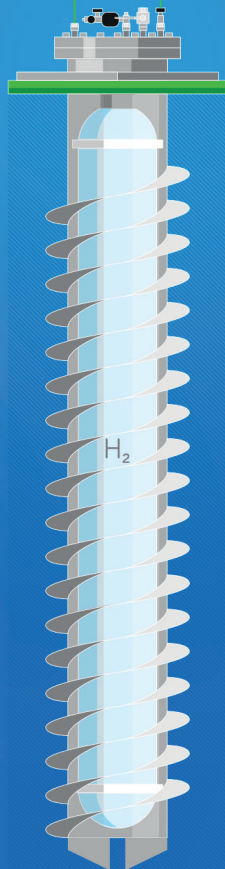
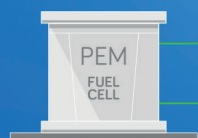
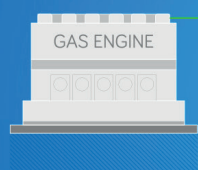
The most important element of the portfolio is an economical, large-scale underground hydrogen and energy storage solution. A key variant of the technology has been developed specifically for the energy-purpose reuse of out-of-service, depleted oil and gas wells. Its business significance is twofold: first, by reusing existing well infrastructure it enables substantial investment savings — on the order of 60–80 per cent — compared with greenfield development; second, the mandatory reclamation obligations attached to depleted wells can be partly or wholly offset, turning an existing financial liability into investment value. In a hydrocarbon superpower such as Kazakhstan, where the stock of depleted wells is exceptionally large, this represents an opportunity of strategic scale. Storage also directly supports the grid integration of renewable energy.

Economical hydrogen production and pressure management.

The portfolio's hydrogen-production solution aims to reduce investment and operating costs materially relative to the market average, which at larger scale can translate into an investment advantage of several tens of millions of euros. The compressor-free pressure-boosting solution, in turn, replaces one of the most costly points of hydrogen infrastructure, lowering maintenance needs and operating costs — all integrated with the storage system.

Decentralised refuelling infrastructure, CO₂ utilisation and heat generation.

Together, these solutions form a fully integrated, on-site hydrogen refuelling infrastructure that removes dependence on centralised production and road transport, and can therefore be scaled quickly and in a decentralised manner. The portfolio is complemented by a CO₂-utilisation technology that turns industrial carbon dioxide into a



GEOA's integrated value chain: hydrogen production, storage, pressure management, industrial and transport use, CO_2 utilisation and decentralised heat generation.

revenue opportunity on the carbon-allowance market, and by a decentralised, fossil-free heat-generation solution for both residential and industrial use.

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Overview of the GEOA product portfolio

Technology, business value and main application area

TECHNOLOGY	BUSINESS VALUE	MAIN APPLICATION AREA
Underground hydrogen and energy storage <i>(GeoAkku)</i>	Economical, large-scale storage. Reusing depleted oil and gas wells delivers 60–80% investment savings and turns redamation obligations into investment value.	Energy storage, grid integration of renewables and security of supply; reuse of depleted wells.
Hydrogen production <i>(Geo-hydrogen generator)</i>	Economical, on-site production with a significant investment (CAPEX) advantage over the market average.	Decentralised green-hydrogen production for industrial and energy use.
Pressure management <i>(compressor-free pressure boosting)</i>	No mechanical compressor; lower maintenance and operating costs, and higher stored energy density.	Hydrogen storage, refuelling infrastructure and industrial use.
Decentralised refuelling infrastructure	A fully integrated, on-site system that removes transport dependence and scales quickly on a licensing basis.	Hydrogen-based transport: refuelling of commercial vehicles and passenger cars.
CO₂ utilisation <i>(mineralisation)</i>	Turning carbon emissions from a cost into revenue on the carbon-allowance market, producing a saleable industrial feedstock.	Hard-to-decarbonise industries: cement, steel, chemicals.
Decentralised heat generation <i>(Karbitherm)</i>	A flexible heat-generation solution independent of fossil energy carriers.	Residential and industrial heat supply.

The solutions are patent-protected, in the patent systems of 54 countries in total.

Table 1

4. Proven maturity and patent protection

GEOA's solutions rest on a strong foundation of credibility. The storage technology is under patent protection — confirmed by an official opinion of the European Patent Office (EPO) — and is under registration in the patent systems of 54 countries in total, covering the decisive majority of the world's markets. The industrial relevance of the technology is also underpinned by a concrete partnership: a strategic framework agreement concluded with PrJSC MVM, a leading player in the Hungarian energy sector, aims to prepare the industrial-scale validation of the storage technology with the involvement of the Budapest University of Technology and Economics. The development is therefore not a general promise but a response tied to real industrial demand and to measurable success criteria.

Representation and partnership opportunity in Kazakhstan

PrJSC GEOA Innovations is seeking representatives and partners in Kazakhstan to introduce its product-level solutions and patent applications locally — potentially within an exclusive territorial cooperation. The essence of the offer is that the local partner needs neither to master the depths

of the technology, nor to build manufacturing capacity: GEOA provides a turnkey, fully supported cooperation. Within this framework the partner receives the following:

- Full training for operating the solutions and introducing them to the market.
- The control system – the handover of a ready-to-use control system that runs the solutions.
- Supervision of the control system – continuous, remote professional monitoring and support during operation.
- Background manufacturing – GEOA fully provides the manufacturing of all product components, so the partner does not need to build its own production.
- Delivery: the manufactured products and components are delivered to the representative through a reliable supply chain.

For the local partner, this model means low entry risk, rapid market entry and GEOA's continuous professional backing, while also aligning with Kazakhstan's goal of having an ever-larger share of hydrogen technologies realised locally, with domestic involvement. Through the option of exclusivity, the partner can secure a defining, long-term position in a rapidly growing market.

The Kazakhstan representation model: what GEOA provides to the partner — full training, the control system and its supervision, component manufacturing, and delivery.

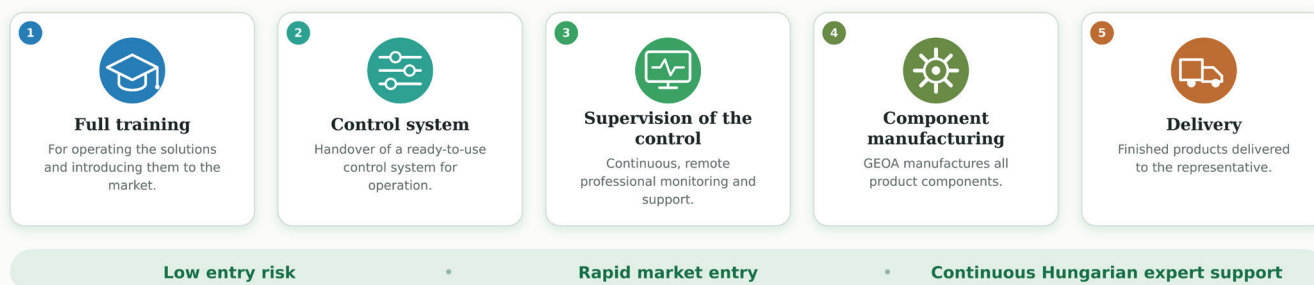
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The Kazakhstan representation model

Turnkey, fully supported cooperation – with the option of exclusivity



WHAT DOES GEOA PROVIDE TO THE PARTNER?



GEOA Innovations Zrt. · Kazakhstan representation and partnership model

Figure 2



Summary

Hydrogen-based energy transition is one of the greatest industrial and business opportunities of the coming decade, and Kazakhstan — with its extensive hydrocarbon resources, ambitious decarbonisation goals and its drive to build domestic technological capacity — could be one of its key markets. PrJSC GEOA Innovations' product-ready, patent-protected solutions and its comprehensive, turnkey representation model offer a form of cooperation in which the local partner can enter a strategically important, growing market at low risk and with the continuous support of the Hungarian developer. The dialogue facilitated by the Embassy of Hungary in Astana can lay down the foundation for this mutually beneficial, long-term Hungarian-Kazakh cooperation.

Sources:

GEOA Innovations Zrt. capital-market, valuation and market materials (2025–2026); International Energy Agency (IEA) hydrogen-market data; Kazakhstan's 2060 carbon-neutrality strategy (2023) and national hydrogen strategy (2024).