2025 / ANNUAL SUSTAINABILITY REPORT

SDG 7 | Affordable and Clean Energy

Khazar University · Baku, Azerbaijan

REPORTING PERIOD JANUARY–DECEMBER 2025

Institutional Approach

Khazar University supports the move towards affordable and clean energy through research, engineering education, campus efficiency planning and international cooperation. In 2025, researchers and students exchanged knowledge on renewable power, energy storage and smart electricity systems, while the University continued its longer-term work on responsible energy use.

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Energy-related research articles published in 2025	Energy Seminars, 29 Apr–1 May	Erasmus+ 3E-Partnership consortium

7.1 Research on clean energy

In 2025, Khazar University contributed to **148 Scopus-indexed research articles and reviews related to SDG 7 (Affordable and Clean Energy)**, including 139 research articles and nine review papers. These publications addressed renewable energy development, energy efficiency, environmental sustainability, and technologies that support cleaner and more reliable energy systems.

Energy transition and sustainable energy policies

A major research direction focused on how countries can gradually move towards cleaner energy sources while maintaining economic stability.

In *Application of the Z-Information-Based Scenarios for Energy Transition Policy Development*, Nuriyev, Nuriyev, and Mammadov (2025) examined possible pathways for Azerbaijan's energy transition. The researchers developed scenarios to compare different combinations of traditional and renewable energy sources, including solar, wind, and hydropower. The study provides a framework for considering energy-policy decisions when future economic and technological conditions are uncertain.

Other research examined the relationship between clean energy and environmental sustainability. Kartal et al. (2025) investigated how clean energy consumption, economic activity, and productive capacity relate to environmental conditions in China. Another study by Kartal, Mukhtarov, and Hajiyeva (2025) explored how renewable and nuclear energy consumption interact in developed countries. These studies contribute to understanding the economic and environmental considerations involved in expanding clean energy use.

Solar and wind energy technologies

Khazar-affiliated researchers also contributed to studies exploring how renewable energy systems can operate more efficiently.

Saady et al. (2025) investigated ways to improve solar-powered water-pumping systems. Their research examined control technologies designed to make better use of available solar energy and improve pumping performance. Such systems are relevant to agricultural irrigation and water supply in locations where conventional electricity infrastructure may be limited.

Echiheb et al. (2025) studied control methods for wind turbines operating under changing wind conditions. The research examined approaches to improving turbine performance and maintaining stable operation, contributing to the development of more efficient wind energy technologies.

Integrated renewable energy and resource efficiency

Research also explored how a single renewable energy source could support several essential services.

Li et al. (2025) investigated a geothermal energy system capable of supporting electricity generation, heating, freshwater production, and hydrogen generation. The study used mathematical modelling to examine how these functions could be combined more efficiently.

Castillo et al. (2025) investigated approaches to evaluating supercapacitor technologies for renewable energy systems. These devices can store and release electrical energy quickly, making them relevant to energy storage and power-management applications.

Energy efficiency and sustainable industry

Reducing unnecessary energy consumption was another area of research.

Krishankumar et al. (2025) examined how manufacturers can evaluate investments in energy-efficient technologies. The study developed a decision-making approach to support the comparison of different investment options and their potential contribution to more sustainable industrial operations.

Further research by Kartal et al. (2025) explored how green finance, clean energy production, energy prices, and geopolitical risks relate to efforts to reduce carbon emissions across economic sectors.

Institutional research capacity

Khazar University's Energy Systems Research Center supports research in renewable energy, electricity networks, energy conversion, and energy management. The Center provides an institutional platform for interdisciplinary research and collaboration on energy-related challenges.

Overall, these research contributions demonstrate Khazar University's engagement in the scientific, technological, and economic aspects of sustainable energy development. By examining energy policy, renewable power generation, resource efficiency, and energy technologies, the University contributes knowledge relevant to improving energy systems and supporting the transition towards cleaner energy sources.

Selected Research Publications (2025)

1. **Nuriyev, M., Nuriyev, A., & Mammadov, J. (2025).** *Application of the Z-Information-Based Scenarios for Energy Transition Policy Development.* Energies, 18(6), 1437. DOI
2. **Kartal, M. T., et al. (2025).** *The effect of productive capacity changes, income, and clean energy on ecological sustainability in China by novel KRLS approach.* Scientific Reports, 15, 33642. DOI
3. **Kartal, M. T., Mukhtarov, S., & Hajiyeva, N. (2025).** *Investigation of displacement between main clean energy types: Evidence from leading developed countries through quantile approaches.* Renewable Energy, 238, 121988. DOI
4. **Kartal, M. T., et al. (2025).** *Efficiency of green bond, clean energy, oil price, and geopolitical risk on sectoral decarbonization: Evidence from the globe by daily data and marginal effect analysis.* Applied Energy, 392, 125963. DOI
5. **Saady, I., et al. (2025).** *Improving photovoltaic water pumping system performance with PSO-based MPPT and PSO-based direct torque control using real-time simulation.* Scientific Reports, 15, 16127. DOI
6. **Echiheb, F., et al. (2025).** *Experimental evaluation of an advanced predictive control technique for variable-speed wind turbine systems.* International Journal of Electrical Power & Energy Systems, 168, 110668. DOI
7. **Li, X., et al. (2025).** *Thermodynamic analysis and optimization of an optimized geothermal-driven quadruple-production system for sustainable power, heat, freshwater, and hydrogen production.* Renewable Energy, 245, 122847. DOI
8. **Castillo, O., et al. (2025).** *Assessing carbon-neutral supercapacitors in renewable energy systems with self-improving agent-based molecular fuzzy intelligent algorithms.* Scientific Reports, 15, 28234. DOI
9. **Krishankumar, R., et al. (2025).** *Analysis of energy efficiency investments in smart manufacturing via double hierarchy linguistic structure-based hybrid decision-making model.* Energy, 334, 137807. DOI

The Energy Systems Research Center brings together research on renewable energy, energy management, energy conversion and electricity networks. These activities strengthen the University’s contribution to academic discussion and applied energy research.

7.2 University measures towards affordable and clean energy

Khazar University’s Climate Action Plan sets out measures to reduce reliance on conventional energy and work towards net-zero emissions by 2050. Its energy goals include more efficient heating, lower natural-gas use, efficient lighting and equipment, and future solar installations. Several actions carry 2025 target dates within the plan.

The University also announced an energy-efficiency upgrade plan following an assessment of energy waste on campus. Proposed improvements cover LED lighting, insulation and heating, ventilation and air-conditioning systems. Together, the climate plan and the upgrade initiative outline practical steps towards more efficient university buildings.

7.3 Energy use density

Campus energy efficiency is addressed through the University's energy assessment and published plans for more efficient buildings. These activities provide a basis for tracking the energy used in University buildings and evaluating future improvements. The assessment and upgrade plans provide a starting point for evaluating energy use across University facilities and measuring improvements over time.

7.4 Energy and the community

In 2025, Khazar University shared clean-energy knowledge through teaching, seminars and international engagement. The Fall 2025 Renewable Energy course (CHE 490) covered solar and wind technologies and applied design work; the Electrical Power Systems course (ETR 535) addressed electricity networks and alternative energy systems.

From 29 April to 1 May, the Energy Seminars series brought together faculty, students and researchers to discuss renewable power, energy storage, AI-based energy control and smart grids. A seminar on piezoelectric energy harvesting on 7 November examined technologies for converting mechanical movement into electricity.



On 10 March, a seminar on "Harnessing AI to Advance Sustainability and Green Skills" at Dunya School explored the role of technology in sustainability.



Khazar also continued its participation in the Erasmus+ 3E-Partnership, supporting international work on energy-efficiency curricula and planned Energy Labs. Professor Ingilab Ahmadov attended the IEA EU4Energy Forum on Clean Energy

Storage in Copenhagen on 11–12 June.



Scientific exchanges with Fudan University and a December cooperation meeting expanded discussion of possible future work on energy technologies.





7.5 Low-carbon energy use

The University's climate planning identifies solar power and reduced dependence on conventional energy sources as long-term priorities. Research and training in 2025 also explored wind, solar, storage and other low-carbon technologies. These activities connect the University's long-term energy priorities with teaching and research into cleaner energy options.

Selected Activities in 2025

2025	ACTIVITY
10 Mar	AI, sustainability and green-skills seminar
14 Mar	Energy-transition policy research publication

29 Apr–1 May	Energy Seminars international series
11–12 Jun	IEA EU4Energy Forum on clean-energy storage
29 Sep	Research article on clean energy and ecological sustainability
7 Nov	Piezoelectric energy-harvesting seminar
8–18 Dec	Academic research exchange at Fudan University
23 Dec	Fudan University cooperation meeting and MoUs

2025 Overview

During 2025, Khazar University contributed to clean-energy research and education, convened technical discussions on emerging energy technologies, and participated in international partnerships. These documented activities complement its standing energy-efficiency and climate commitments, supporting continued work on lower-carbon energy systems and responsible campus operations.