

Green Technologies, Human Psychology, and Education: Evidence from Uzbekistan's National Sustainability Transition

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Abstract

Uzbekistan is undergoing a rapid and ambitious green technology transition, committing to derive 54% of its electricity from renewable sources by 2030 and investing approximately USD 2.90 billion in clean energy in 2024 alone. While the technical and macroeconomic dimensions of this transformation have been extensively documented, its psychological and educational implications remain underexplored. This paper examines how green technology adoption influences human psychological well-being, pro-environmental attitudes, and motivational orientations among Uzbek citizens, students, and business professionals. Drawing on Attention Restoration Theory, Stress Recovery Theory, and Self-Determination Theory, and integrating empirical evidence from national education programmes, business sector case studies, and international development initiatives, the paper demonstrates that Uzbekistan's green transition is simultaneously an environmental, psychological, and pedagogical phenomenon. Findings indicate that green technology environments positively affect cognitive performance and psychological resilience, while targeted sustainability education programmes are cultivating ecological literacy and green entrepreneurial identity across the country. Implications for national education policy, corporate sustainability strategy, and future cross-cultural research are discussed.

Keywords: green technologies, psychological well-being, sustainability education, Uzbekistan, green economy, pro-environmental behaviour, business sustainability, ecological literacy.

1. Introduction

Uzbekistan stands at a pivotal juncture in its developmental trajectory. Since the adoption of the Green Economy Transition Strategy in 2019, the country has pursued an accelerating programme of renewable energy deployment, smart infrastructure development, and environmental modernisation. By 2024, Uzbekistan had attracted approximately EUR 30 billion in energy sector investment since 2017, increasing total electricity generation from 60 billion kWh to 85 billion kWh, and achieving a renewable energy share of 23% of total power generation [1, 2]. In December 2025, the government launched 42 new green energy projects valued at EUR 9.46 billion, targeting a 54% renewable share by 2030 [1].

This remarkable physical transformation is reshaping not only the country's energy infrastructure but also the psychological

and educational environments in which Uzbek citizens live, study, and conduct business. Environmental psychology has long established that the built environment, energy systems, and natural elements present in everyday settings exert substantial influence on human behaviour, mood, cognitive performance, and social attitudes [3]. However, the psychological and educational dimensions of large-scale national green transitions — particularly in Central Asian contexts — remain inadequately studied.

This paper addresses this gap by examining three interrelated dimensions of Uzbekistan's green technology transition: (1) its effects on the psychological well-being and motivational orientations of the population; (2) its integration into formal and non-formal educational systems; and (3) its influence on business culture and entrepreneurial identity. By situating this

analysis within an internationally recognised theoretical framework and grounding it in Uzbekistan-specific empirical evidence, the paper aims to contribute both to global environmental psychology scholarship and to policy dialogue on sustainable development in Central Asia.

2. Uzbekistan's Green Technology Transition: National Context

Uzbekistan's green economy transition is guided by the National Strategy for Transition to a Green Economy 2019–2030, whose targets were substantially revised

upward in 2024 to reflect accelerated progress [4]. The country's renewable energy market reached 3.15 GW of installed capacity in 2024, with projections indicating growth to 6.95 GW by 2030 at a compound annual growth rate of 13.73% [5]. Clean energy investment reached USD 2.90 billion in 2024, representing a 43% increase from USD 2.03 billion in 2023 [6].

Table 1 summarises key statistical indicators of Uzbekistan's green energy transition, providing the empirical baseline for the psychological and educational analyses presented in subsequent sections.

Table 1. Key Indicators of Uzbekistan's Green Technology Transition (2018–2030)

Indicator	2018	2022	2024/2025	Target 2030
Renewable energy share (%)	10–12%	14%	23%	54%
Total electricity generation (bn kWh)	60	67	85	~120
Clean energy investment (USD bn)	—	~1.2	2.90	>9.46*
Renewable capacity (GW)	1.84	~2.5	3.15	21+
Green-trained teachers	—	—	50,000†	100,000+
Students in climate education	—	—	1.3 mln†	—

Sources: [1, 2, 4, 5, 6, 7, 8]. *2025 announced investment figure. †UNDP-MoPSE joint programme data.

Key investment partners include ACWA Power (Saudi Arabia), Masdar (UAE), TotalEnergies (France), and Voltalia (France), reflecting Uzbekistan's growing integration into global green technology value chains [5]. In July 2024, a USD 350 million, 500 MW photovoltaic solar plant was launched in the Besharyk region, with projected annual generation of 1.6 billion kWh [5]. Over 20 universities now offer degrees in electrical engineering, power systems, and renewable energy technologies, with institutions such as Tashkent State Technical University and

Fergana State Technical University playing leading roles [9].

3. Theoretical Framework

Three complementary psychological theories frame this analysis. Attention Restoration Theory (ART), developed by Kaplan and Kaplan [10], holds that natural and green environments restore directed attentional capacity depleted by urban and cognitive demands. As Uzbekistan's urban areas increasingly incorporate green infrastructure — including smart parks, biophilic building designs, and solar-powered public spaces — ART predicts

measurable improvements in the attentional functioning and cognitive performance of urban residents.

Stress Recovery Theory (SRT), proposed by Ulrich [11], posits that exposure to natural elements triggers involuntary affective responses that facilitate rapid physiological and psychological recovery from stress. IoT-enabled smart buildings and green-certified workplaces, which maintain optimal indoor air quality and thermal comfort through renewable energy systems, create environments that approximate the restorative conditions described by SRT.

Self-Determination Theory (SDT), developed by Deci and Ryan [12], identifies three universal psychological needs — autonomy, competence, and relatedness — whose satisfaction supports intrinsic motivation and sustained behaviour change. Sustainability education programmes that involve students in authentic green technology projects, such as those being implemented under Uzbekistan's national climate education initiative, satisfy these needs and thereby cultivate durable pro-environmental motivation and ecological identity.

4. Psychological Effects of Green Technologies on Uzbek Citizens

4.1 Environmental Quality, Stress, and Psychological Well-Being

Uzbekistan's historical environmental challenges — including desertification, air pollution from fossil fuel dependence, and the ecological legacy of the Aral Sea disaster — have imposed significant psychological burdens on the population, including elevated rates of environmental anxiety and eco-grief, particularly in Karakalpakstan and western regions [13]. The government's green transition strategy explicitly addresses environmental remediation as a component of improved quality of life, recognising the psychological

as well as physical health benefits of cleaner energy and urban greening.

Smart building technologies powered by renewable energy are being deployed in new urban developments in Tashkent and other major cities, incorporating natural ventilation systems, biophilic design elements, and real-time environmental monitoring. Consistent with SRT, research in comparable transition economies indicates that residents of green-certified residential environments report significantly lower perceived stress, improved sleep quality, and higher life satisfaction compared to residents of conventional buildings [14]. As Uzbekistan's 300 mahalla neighbourhoods receive rooftop solar installations under the government's micro-solar programme — targeting 30,000 low-income families — these psychological benefits are being extended to previously disadvantaged populations [1].

4.2 Pro-Environmental Identity and Behaviour Change

The visible installation of renewable energy infrastructure in Uzbek communities — solar panels on schools, wind turbines on urban peripheries, and smart energy meters in residences — creates environmental cues that influence psychological self-perception and normative behaviour. Research in environmental psychology demonstrates that when community members can observe and interact with green technologies in their immediate environment, they are more likely to develop pro-environmental identities and engage in conservation behaviours [15].

Uzbekistan's introduction of a national carbon credit trading system, reported at COP-30 in 2025 and accounting for 23 million tons of verified greenhouse gas reductions, represents a structural mechanism that reinforces pro-environmental behaviour at the individual and corporate level through economic incentives aligned with psychological

principles of behaviour modification [1]. The government's real-time energy consumption monitoring software, developed with UNDP support and deployed in residential buildings, further enables citizens to receive corrective feedback that enhances environmental self-efficacy [7].

5. Educational Implications: Green Technology in Uzbek Schools and Universities

5.1 National Climate Education Initiative

The most significant educational intervention in Uzbekistan's green transition is the joint UNDP–Ministry of Preschool and School Education (MoPSE) programme targeting 1.3 million school students aged 15–18 across seven regions of the country, including the Republic of Karakalpakstan, Bukhara, Navoiy, Khorezm, Samarkand, Kashkadarya, and Surkhandarya [8]. The programme integrates climate change knowledge, green skills, and sustainability competencies into the formal upper secondary school curriculum through the 'Climate Box' toolkit, representing one of the largest climate education initiatives in Central Asia.

A total of 50,000 teachers have received training in climate pedagogy, participatory instructional methods, and AI-assisted teaching tools under this initiative [8]. Furthermore, 800 Young Green Ambassadors have been established as a network of youth environmental leaders who co-design and implement community sustainability projects, providing authentic leadership experiences that develop environmental agency consistent with SDT's emphasis on autonomy and relatedness [8].

5.2 Vocational and Higher Education

At the vocational level, 12 training centres offer two specialised courses — one on renewable energy technologies and one on climate-smart agriculture — to approximately 4,000 young people

annually, directly linking green technology skills to employment outcomes and career identity [8]. This aligns with Uzbekistan's 'Uzbekistan 2030' Strategy, which explicitly targets the alignment of educational outputs with green economy labour market demands [7].

At the higher education level, over 20 universities now offer programmes in renewable energy, electrical engineering, and sustainable systems [9]. In 2025, a historic MoU signed at Power Uzbekistan 2024 between the National Research Institute for Renewable Energy Sources (NIREs), EUROSOLAR Uzbekistan Energy, and the Academy of Sciences of the Republic of Uzbekistan established a dedicated centre for innovative renewable energy education, workforce training, and applied research [5]. This institutional architecture creates a pipeline through which ecological literacy and green technical competence are developed systematically across educational levels.

5.3 Digital Education and Psychological Outcomes

Uzbekistan's 'One Million Uzbek Programmers' initiative — which has produced over one million certified IT graduates and launched a 'Five Million AI' phase in late 2025 — demonstrates the country's capacity for large-scale technology education mobilisation [16]. The integration of AI tools and digital platforms into sustainability education creates the conditions for adaptive, personalised learning experiences that can make abstract climate and energy concepts concretely relevant to individual learners, enhancing intrinsic motivation as predicted by SDT [12].

The InfoTeach-2025 forum provided online AI training to more than 5,000 teachers and 700 regional administrators, illustrating how digital education infrastructure is being deployed to build sustainability competence across the educational workforce [16].

Research in comparable contexts indicates that students who engage with digital simulations of renewable energy systems demonstrate significantly higher ecological literacy scores and stronger environmental identity compared to peers in conventional curriculum environments [17].

6. Business Dimension: Green Technologies and Organisational Psychology

6.1 Corporate Sustainability and Employee Well-Being

Uzbekistan's green transition is not confined to the public sector. The country's revised investment climate, including the 2024 Law on Energy Saving and Energy Efficiency, mandates energy audits for large enterprises and establishes efficiency standards that incentivise private sector adoption of green technologies [9]. As Uzbek businesses respond to these regulatory drivers and to growing international ESG (Environmental, Social, and Governance) investor expectations, the psychological dimensions of workplace sustainability are becoming strategically significant.

Research in organisational psychology consistently demonstrates that employees in green-certified and sustainable workplaces report higher levels of job satisfaction, organisational commitment, and psychological well-being, driven by perceptions of value alignment and meaning at work [18]. For Uzbek enterprises competing for international investment and export market access, the psychological benefits of green workplace transformation represent not merely a welfare consideration but a competitive advantage in talent attraction and retention.

6.2 Green Entrepreneurship and Ecological Identity

The emergence of green entrepreneurship as a distinctive business identity is a significant psychological development in Uzbekistan's private sector. The

government's support for small-scale renewable energy initiatives — including the 40 micro-hydro plants with 40 MW collective capacity that generated 120 million kWh in 2025, and the programme targeting 65 additional MW of micro-hydropower — creates economic opportunities that simultaneously reinforce entrepreneurial identity and pro-environmental self-concept [1].

Psychological research on green entrepreneurship identifies ecological identity — the degree to which individuals perceive environmental stewardship as central to their professional self-concept — as a key predictor of sustainable business innovation and resilience [19]. As Uzbekistan's business community increasingly operates within a policy environment that links commercial success to environmental performance, the cultivation of ecological entrepreneurial identity through business education and mentorship programmes becomes a strategic priority for sustainable economic development.

6.3 Psychological Barriers to Green Technology Adoption in Business

Despite the positive trends documented above, psychological barriers to green technology adoption persist in Uzbekistan's business sector. Research in the Central Asian context highlights limited environmental awareness, risk aversion towards new technology investments, and scepticism regarding the long-term reliability of renewable energy systems as significant psychological impediments to private sector green transition [20]. Uzbekistan's energy intensity remains approximately 50% above the global average — and roughly three times higher than in advanced economies — reflecting deeply embedded industrial practices and technological path dependencies that are resistant to rapid change [9].

Addressing these psychological barriers requires targeted interventions at the organisational level, including sustainability leadership development programmes, green technology demonstration projects that build managerial confidence and competence, and industry networks that provide social proof and peer normative pressure consistent with social cognitive theory [15]. Several international partners — including GIZ, UNDP, and USAID — are currently supporting curriculum development and pilot projects in this domain, providing models that Uzbek educational and business institutions can adapt and scale [9].

7. Discussion

The evidence synthesised in this paper reveals that Uzbekistan's green technology transition is unfolding simultaneously across environmental, psychological, educational, and business dimensions in ways that are deeply interconnected. The country's ambitious renewable energy targets — backed by USD 2.90 billion in clean energy investment in 2024 and a national goal of 54% renewable electricity by 2030 — create the physical conditions for the psychological and educational transformations documented in this review [1, 6].

Three principal findings merit emphasis. First, green technologies are reshaping the psychological environments of Uzbek citizens through improved environmental quality, reduced ecological anxiety, and enhanced opportunities for pro-environmental agency. Second, Uzbekistan's national climate education initiative — reaching 1.3 million students and 50,000 teachers — represents one of the most comprehensive attempts in Central Asia to institutionalise ecological literacy as a core educational outcome, with measurable implications for the development of environmental identity and intrinsic sustainability motivation. Third, the

business sector is emerging as a critical arena in which green technology adoption, organisational psychology, and entrepreneurial identity intersect in ways that have significant implications for both individual well-being and national economic development.

Important limitations of this analysis must be acknowledged. The review draws primarily on programme-level data and international reports; longitudinal empirical studies measuring psychological outcomes directly in Uzbek green technology contexts remain scarce. Regional disparities within Uzbekistan — particularly between urban centres such as Tashkent and rural or remote communities — mean that the psychological and educational impacts of green transition are likely to be unevenly distributed. Future research should employ mixed-methods designs, including surveys, physiological stress measures, and ethnographic approaches, to capture the heterogeneity of psychological responses to Uzbekistan's green transformation.

8. Conclusion

This paper has examined the psychological and educational dimensions of green technology adoption in Uzbekistan, situating the country's remarkable national sustainability transition within an evidence-based theoretical framework drawn from environmental psychology and motivational science. The analysis demonstrates that Uzbekistan's green technology investments are not merely infrastructure projects: they constitute psychological environments, educational contexts, and business ecosystems that shape how citizens think, feel, learn, and work.

The convergence of large-scale renewable energy deployment, a national climate education initiative reaching over one million young people, and a business regulatory environment that increasingly links commercial performance to environmental responsibility creates a

uniquely fertile context for the emergence of psychologically resilient, ecologically literate, and sustainably oriented citizens and professionals. Realising this potential, however, requires deliberate attention to the psychological dimensions of green transition — including the reduction of eco-anxiety, the development of ecological identity, and the removal of psychological barriers to green business adoption.

As Uzbekistan positions itself as a regional leader in the green economy transition, its experience offers valuable lessons for other Central Asian and developing nations navigating the intersection of environmental, psychological, and educational transformation. Future empirical research comparing psychological outcomes across Uzbekistan's regions and demographic groups will be essential for refining policy and educational interventions in this rapidly evolving context.

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