Decarbonization perspectives for Central Asia: emission trends, potentials, barriers and opportunities for cooperation

George Safonov
Institute for Sustainable Development and International Affairs (IDDRI), France
Mikhail Safonov
Economist, Sustainable Infrastructure Project in Asia (SIPA/OECD), Kazakhstan

Abstract

Central Asia is confronting significant climate change impacts while simultaneously solving complex socio-economic and environmental challenges. The region's population and GDP growth have contributed to improved well-being but have also led to rising carbon emissions and intensified ecological and pollution issues in the last two decades. Historically reliant on its vast fossil fuel reserves, including coal, gas, and oil, Central Asia faces a critical dilemma: continue its dependence on hydrocarbons or transition toward green economy models and decarbonization. There is a high risk of undermining global efforts to combat climate change as incremental carbon emissions may reach over 100 billion tons of CO2-equivalent, if all hydrocarbons in the region are burned unabatedly. To pave the way for a sustainable future, Central Asia must utilize opporunities for sustainable regional cooperation, invest in zero-carbon energy, embrace innovative low-carbon technologies and nature-based solutions. Achieving carbon neutrality will require not only sustained collaboration among Central Asian nations but also strong partnerships with international stakeholders. These efforts are essential to ensure the region's long-term environmental sustainability and economic resilience, ultimately fostering a greener, more prosperous future for generations to come.

Keywords: Central Asia, climate change, greenhouse gas, decarbonization, sustainability, carbon neutrality, regional cooperation.
JEL Classification Codes: Q420, Q430, Q540, Q560, O210, O530.

1. Climate Change Impacts and Policy Response in Central Asia

Central Asia is one of the most climate-vulnerable regions globally. Over the past three decades, temperatures have risen by 1.5°C - more than double the global average of 0.7°C.[1] This alarming trend has triggered severe environmental consequences, including accelerated glacier melting, which has reduced glacier coverage by nearly 30% since the 1980s. This decline threatens water availability, with the region nearing "water-insufficient" status. By 2050, reduced water flow in the Amu Darya and Syr Darya river basins could slash regional GDP by 11%.[2] Water stress is critical, with 82% of resources under strain due to droughts, desertification, and high agricultural and energy demands. It is expected that Kazakhstan, for instance, will face temperature increases of 2-3°C by 2050 and 3-6°C by 2090[3], exacerbating these challenges.

Central Asian nations are addressing these issues through participation in global climate treaties, specifically the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, as well as adopting the domestic regulations and regional cooperation initiatives. Kazakhstan demonstrated a leadership by adopting the Concept of transition to green economy in 2013, establishing the carbon regulation framework, including emission trading scheme (in 2013), announcing the target of achieving the carbon neutrality by 2060 (in 2023), and participating in various international climate partnerships. The neighbouring Central Asia countries have also progressed in

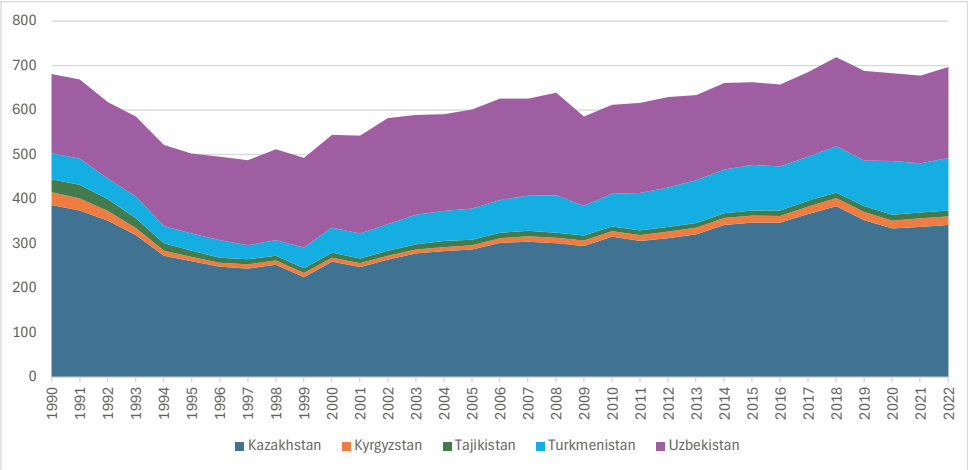
[1] Duenwald Ch., Abdih Ya., Gerling K. et al (2022) Feeling the Heat: Adapting to Climate Change in the Middle East and Central Asia, IMF, Departmental Papers, March 30, 2022.
[2] Vinokurov, E., Ahunbaev, A., Babajanyan et al. (2022) The Economy of Central Asia: A Fresh Perspective. Reports and Working Papers 22/3. Almaty, Bishkek, Moscow: Eurasian Development Bank.
[3] Kyrgyzbay K., Y. Kakimzhanov, J. Sagin (2023) Climate data verification for assessing climate change in Almaty region of the Republic of Kazakhstan, Climate Services, Volume 32, 2023, https://doi.org/10.1016/j.cliser.2023.100423.

expanding international cooperation and strategic planning of climate change mitigation and adaptation, though a lot remains to be done.

Central Asia accounts for approximately 2% of global greenhouse gas (GHG) emissions. As of 2022, Kazakhstan is the largest emitter in the region, contributing 49% of total emissions (excluding LULUCF), followed by Uzbekistan at 29% and Turkmenistan at 17% (Figure 1). Between 1990 and 1999, regional GHG emissions declined by 27%, primarily due to the economic downturn following the collapse of the USSR, which led to a sharp reduction in industrial and agricultural outputs, energy production and consumption. However, since 2000, population growth, industrial recovery, and rapidly rising GDP - driven largely by fossil fuel production and exports and industrial growth - have resulted in a 41% increase in regional emissions by 2022 compared to 2000 levels.

Central Asia's economies have historically relied on natural resources. Kazakhstan, Turkmenistan, and Uzbekistan dominate the region's fossil fuel production and exports, while Kyrgyzstan and Tajikistan mostly rely on hydropower. The energy sector is the largest emitter, contributing to over 70% of total GHG emissions in some countries. Agriculture and transport also play significant roles in carbon emissions.

Fig. 1 Greenhouse gas emissions for Central Asian countries (without LULUCF), 1990-2022, MtCO2e/year



Source: Climate Watch Data/PIK.

Table 1. Fossil fuel reserves in the countries of Central Asia.

Place in the world	Reserves	Amounts
	Coal	**Mtons**
10	Kazakhstan	28225
27	Uzbekistan	1516
33	Kyrgyzstan	1070
41	Tajikistan	413
	Total	34002
	Natural gas	**BMcf**
6	Turkmenistan	265000
15	Kazakhstan	85000
19	Uzbekistan	65000
	Total	415000
	Crude oil	**Mbarrels**
12	Kazakhstan	30000
44	Turkmenistan	600
79	Kyrgyzstan	40
	Total	30640

Source: IEA.

The region holds vast fossil fuel reserves, which are considered as valuable assets and a cheap source of energy (Table 1). However, if all conventional and unconventional fossil fuel reserves were extracted and burned without any mitigation, total GHG emissions could exceed 100 billion tonnes of CO_2e - approximately 30 times the EU's annual net emissions. To avoid such an immense environmental impact, effective strategies for deep decarbonization in Central Asia must be developed and implemented.

Over the past decade, most countries in the region have announced and adopted strategies for transitioning to a green economy and sustainable development. However, their experience has shown that executing these plans is highly challenging. Beyond political commitments, success requires large-scale transformations of socio-economic models, substantial investments, technology transfers, and innovation.

In line with their Paris Agreement commitments, Central Asian countries have established nationally determined contributions (NDCs) aimed at control of GHG emissions and increasing carbon sequestration. Key priorities include expanding renewable energy, enhancing energy efficiency, and modernizing infrastructure. At the same time, regional cooperation is essential for overcoming cross-border challenges, mobilizing climate finance, and exchanging best practices to accelerate the transition to a low-carbon economy.

Kazakhstan: Constrained but Ambitious

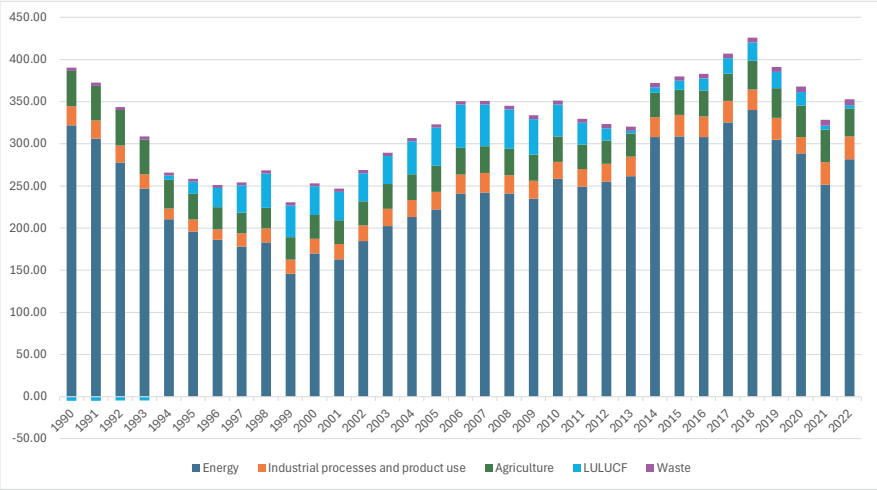
Kazakhstan, the largest economy in Central Asia, is positioning itself as a regional leader in green and low-carbon development. From 1990 to 1999, national net GHG emissions (with LULUCF) dropped significantly by 40% (Figure 2). However, between 2000 and 2022, net GHG emissions grew by 53%, or at an average rate of nearly 2% per year, reaching 8% below 1990 level in 2022.[4]

The energy sector is a cornerstone of Kazakhstan's economy. Its electricity network connects domestic provinces and integrates with the energy systems of neighbouring Russia, Kyrgyzstan, and Uzbekistan. Coal remains the dominant source for electricity and heat generation. Most power plants rely on outdated technologies that have exceeded their design lifespan. The recent estimates show that about 60% of key power plant equipment was depreciated, with some facilities experiencing even higher deterioration rates.[5] The country's electricity and heat distribution systems are also severely outdated, leading to significant energy losses. In some regions, distribution inefficiencies account for up to 35% of total electricity losses, highlighting the urgent need for modernization and infrastructure upgrades.

Kazakhstan's energy sector faces additional challenges, including methane emissions, which are a significant contributor to its GHG output (14% of energy-related emissions). Efforts are underway to implement projects aimed at reducing methane leaks and improving overall emission control. The inclusion of methane in the national emissions trading system (ETS) and participation in the Global Methane Pledge (GMP) initiative further underscore these efforts.

Another key focus is the development of nuclear energy, potentially leveraging Kazakhstan's huge uranium reserves. A

Fig. 2 GHG emissions by category of sources in Kazakhstan (with LULUCF), 1990-2022, MtCO2e/year



Source: National GHG Inventory Submission of Kazakhstan, 2024.

[4] Kazakhstan. GHG inventories, 2024 Common Reporting Table, 17 Dec 2024. https://unfccc.int/documents/644965

[5] Decree of the Government of Kazakhstan No. 260, 28.3.2023 on adoption of the Concept of Fuel and Energy Complex Development in Kazakhstan in 2023-2029.

decision on constructing the nuclear power plants was supported by a referendum in 2024. Potential reactor suppliers include France, Russia, South Korea, and China, with operations expected by 2035.

The «Hydrogen Energy Development Concept until 2040» envisions pilot hydrogen production projects, hydrogen-powered transport, and industrial applications by 2030, signalling the country's commitment to diversifying its energy mix and advancing low-carbon technologies. The draft of this document is currently under public discussion.

In the recent decades, Kazakhstan's economic growth has spurred activity in the transport sector, increasing vehicle numbers and fossil fuel use. The sector, heavily reliant on fossil fuels, is a significant source of GHG emissions, contributing 10% of energy emissions. Road transport dominates at 75%, followed by aviation (12%) and rail/water transport (13%). The prevalence of outdated vehicles exacerbates CO2 emissions, while rail transport, crucial for domestic and international supplies, suffers from aging infrastructure.

Agriculture is the second-largest emitter in the country, producing 33 MtCO2e per year (as of 2022), primarily from livestock's methane emissions. The sector is both impacted by and contributing to climate change, affecting water availability, land degradation, and deforestation. The forest management, afforestation and reforestation, modern agroforestry solutions and land use practices can contribute significantly to reaching the decarbonization goals of the country. The initiative of expanding carbon farming was announced by Kazakhstan's President Tokaev in 2024, aiming to effectively utilize the vast land resources, especially in the areas affected by degradation and desertification.

Kazakhstan's «Strategy for Achieving Carbon Neutrality by 2060» sets an ambitious target for the country. It estimates $500-610 billion in investments for decarbonization programs and projects, with about 4% expected from governmental funds. Over half of funds should come from reallocating existing investment plans, while the rest should be sourced from new investments. By 2030, $10 billion is needed to kickstart decarbonization efforts.[6]

The Strategy prioritizes transitioning from coal to renewables, hydrogen, biofuels, and synthetic fuels. Key goals include developing solar, wind, geothermal, and nuclear energy; enhancing energy efficiency; deploying carbon capture technologies; promoting electric and hydrogen transport; and building carbon infrastructure. A roadmap for implementation is under development by a government working group.

Another highly important strategic document - the «National Infrastructure Plan» - aims to boost GDP through 204 projects in energy, transport, digital infrastructure, and energy and water management. It focuses on modernizing railways, reducing water losses, and lowering environmental impacts. Gasification is another priority, aiming at 60% of the population to be connected to natural gas. By 2030, full regional coverage is planned, supported by a doubling of gas consumption from current levels.

Kazakhstan's evolving climate policy demonstrates its commitment to combating global climate change and meeting international obligations. Through strategic investments, infrastructure modernization, and innovative energy solutions, the country is positioning itself for a sustainable, low-carbon future.

Kyrgyzstan: Hydropower, Energy Emergency and Agriculture

Kyrgyzstan is an emerging economy distinguished by its abundant water resources. National economy relies heavily on sectors that are particularly vulnerable to climate change, such as agriculture and hydropower, highlighting the need for sustainable resource management and climate adaptation strategies.

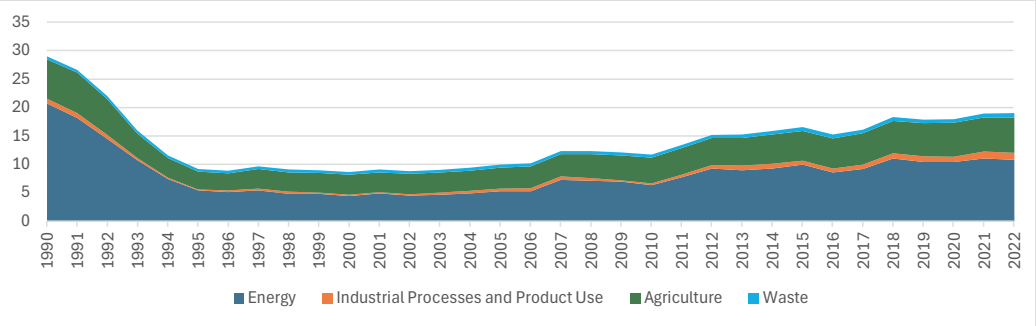
GHG emissions in Kyrgyzstan saw a steep decline of nearly 70% between 1990 and 1996. However, from 1997 to 2022, emissions more than doubled (Figure 3). The primary sources of emissions are the energy sector, which accounts for approximately 60% of total GHG emissions (excluding LULUCF), and agriculture, contributing around 35% (as of 2022).

Kyrgyzstan's energy sector relies on coal, oil, and hydropower. While over half of its electricity is domestically produced, shortages necessitate energy imports, particularly coal. Natural gas plays a minor role due to limited reserves. Water resources support domestic energy needs and regional projects with Kazakhstan, Uzbekistan, and Tajikistan. However, seasonal imbalances cause hydropower surpluses in summer and shortages in winter, requiring energy imports from Russia, Kazakhstan, and Uzbekistan.

Energy production contributes 60% of Kyrgyzstan's greenhouse gas emissions, with coal accounting for 39% and oil 46%. Infrastructure deterioration and rising energy demand from population and industrial growth worsen the situation. In response, a state of emergency in the energy sector was declared in August 2023 to address climate change, reduced water

[6] Presidential Decree of the Republic of Kazakhstan No. 121, 2.2.2023, on approval of the Strategy for Achieving Carbon Neutrality in the Republic of Kazakhstan by 2060.

Fig. 3 GHG emissions by category of sources in Kyrgyzstan (without LULUCF), 1990-2022, MtCO2e/year



Source: Climate Watch Data/PIK.

inflows, and limited capacity until 2026.

The transport sector is responsible for 30% of energy-related GHG emissions. Road transport dominates, with 75% of emissions in urban areas. Gasoline powers private vehicles, while diesel fuels agriculture, construction, and freight. Increasing vehicle numbers and growth of population drive fuel consumption.

To decarbonize, the government promotes transport electrification, focusing on urban public transport due to its stable routes. Tax and customs incentives for electric and hybrid vehicles support the shift to low-carbon transport, reflecting Kyrgyzstan's commitment to energy and environmental sustainability.

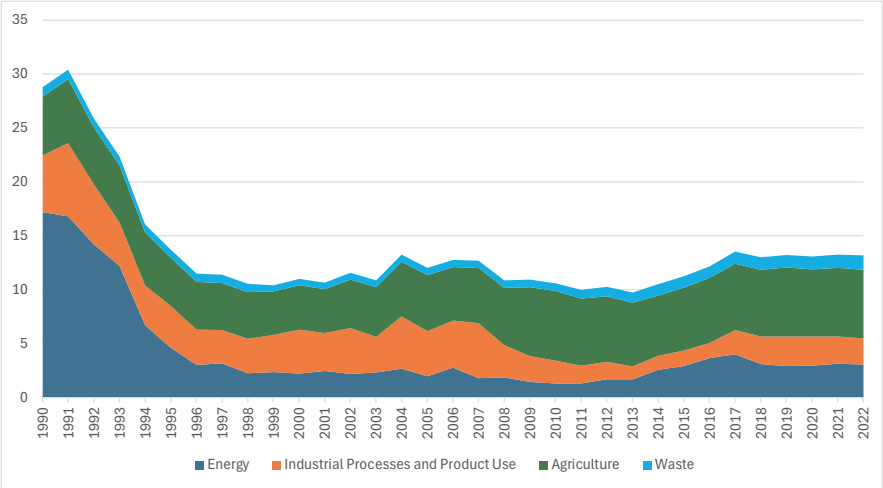
Agriculture is a meaningful source of GHG emissions. The country's NDC aims to cut emissions by improving livestock productivity, expanding organic farming, and utilizing manure for fertilizer and biogas. Significant mitigation potential exists in livestock farming, horticulture, and agroforestry.

Kyrgyzstan's green economy development strategy is guided by national policies like the 2018-2040 National Development Strategy and the Climate Investment Program. Renewable energy projects are expected to expand, particularly in small hydro, solar, wind power and bioenergy. Government plans for decarbonization also focus on energy efficiency, sustainable transport, reduced coal use, and eco-friendly agriculture. However, despite updated NDC goals, a comprehensive national decarbonization strategy is still lacking.

Tajikistan: Harnessing Hydropower Potential

Tajikistan, a developing economy rich in water resources, has 93% of its territory covered by mountains and supplies 60% of Central Asia's water.[7] National GHG emissions (without LULUCF) dropped down by almost threefold between 1990 and 1998 and were relatively stable afterwards with a slight increase in 2017-2022 (Figure 4). In recent years, agriculture is the main sources of GHG emissions in the country, followed by energy and industrial processes.

Fig. 4 GHG emissions by category of sources in Tajikistan (without LULUCF), 1990-2022, MtCO2e/year



Source: Climate Watch Data/PIK.

[7] Decree of the Government of the Republic of Tajikistan No. 482, 30.9.2022 on approval of the Strategy for Development of "Green" Economy in the Republic of Tajikistan for 2023-2037.

Hydropower dominates the energy sector; the country ranks 8th globally in hydro potential but utilizes nearly 5%. With 308 hydroelectric plants, the government prioritizes hydro expansion to achieve energy independence.

Despite hydropower dominance, coal and petroleum use have risen in recent decades, contributing to growing GHG emissions from energy, agriculture, industry, and waste. Transport emissions are high due to aging vehicles (15-20 years old on average) and reliance on diesel and gasoline. The government promotes electric transport through infrastructure development, railway electrification, and customs incentives for electric vehicles.

Agriculture, contributing 23% to GDP, employs 60% of the population and accounts for a large share of GHG emissions, mainly methane from livestock. The governmental plans include expanding drip irrigation, digitalizing agriculture, and boosting organic exports. Climate policies are guided by strategies like the Green Economy Development Strategy (2023-2037) and the National Development Strategy (to 2030).

Tajikistan aims to achieve 100% renewable energy production by 2037, primarily leveraging its vast hydropower potential, estimated at 527 TWh per year. Excess hydropower generated during the summer months could be utilized for green hydrogen production. Additionally, the country has significant solar energy potential, estimated at 25 billion kWh per year, making it a viable resource for development. The expansion of wind energy generation is also anticipated in select regions. Bioenergy is expected to complement solar, reducing methane emissions while providing rural energy.

Despite ambitious emission targets based on 1990 levels, Tajikistan lacks an official carbon neutrality strategy. Addressing this gap will be crucial for its sustainable development goals.

Turkmenistan: Natural Gas Dominance

Turkmenistan is a developing economy, with approximately 80% of its territory covered by deserts and semi-deserts. It has the driest and hottest climate in Central Asia. The country holds 7% of the world's natural gas reserves.

National GHG emissions (without LULUCF) nearly halved between 1990 and 1997. However, emissions then surged rapidly, surpassing 1990 levels by twofold by 2022 (Figure 5). The energy sector is the primary contributor to the country's GHG emissions, accounting for over 90% of the total.

Energy production is based on natural gas and oil, with surplus electricity exported to China. Electricity for domestic use is generated entirely from natural gas, supported by a well-developed gas infrastructure. As a result, Turkmenistan has high carbon dioxide and methane emissions, making it the third-largest GHG emitter in Central Asia. Despite its reliance on fossil fuels, Turkmenistan has significant renewable energy potential, particularly in solar and wind power, but the sector remains underdeveloped.

Transport is the third-largest source of emissions, with cars accounting for 90% of pollution in the sector. To reduce emissions, the government prioritizes modernizing infrastructure, expanding public transport, adopting cleaner fuels, and electrifying railways. Agriculture contributes over 11% of GDP and accounts for 12% of total emissions. The sector heavily relies on artificial irrigation (95%), with increasing water shortages threatening sustainability. Climate adaptation strategies focus on optimizing water use and promoting efficient irrigation techniques.

Turkmenistan is committed to reducing emissions in the oil and gas sector. In its 2022 updated NDC, the country set a target to cut emissions by 20% by 2030 compared to 2010. It plans to achieve this through domestic and international financial support, regulatory improvements, and capacity building. The National Climate Change Strategy, updated in 2019, aims to enhance energy efficiency, limit CO2 emission growth, and establish a National Clean Climate Fund.

The 2021 Law "On Renewable Energy Sources" marked a step toward diversifying energy production. The National Renewable Energy Development Strategy targets solar and wind projects, converting power plants to combined-cycle technology, saving gas and reducing emissions. Bioenergy development is also under consideration, with biogas projects for processing household waste.

Environmental initiatives include large-scale afforestation projects under the National Forestry Program, with over 100 million trees planted in the last 20 years. Turkmenistan's climate policy emphasizes energy efficiency, sustainable resource use, and compliance with international climate commitments, aiming for long-term environmental and economic resilience.

Uzbekistan: Cheapest Renewables, Green Economy Transitionn

The Republic of Uzbekistan, with its rapidly developing and resource-rich economy, is an outstanding player in Central Asia. It has cross-border transmission lines with Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan, enabling regional energy integration and supporting decarbonization efforts.

GHG emissions (without LULUCF) remained relatively stable in 1990-2022 (Figure 6). The energy sector is the primary contributor to the country's GHG emissions, accounting for 76% of the total, followed by agriculture (nearly 15%).

Uzbekistan almost fully meets its energy needs domestically, relying primarily on natural gas and oil. Thermal power plants

(TPPs) dominate electricity production, accounting for 85% of the total, while hydropower contributes nearly 10%.

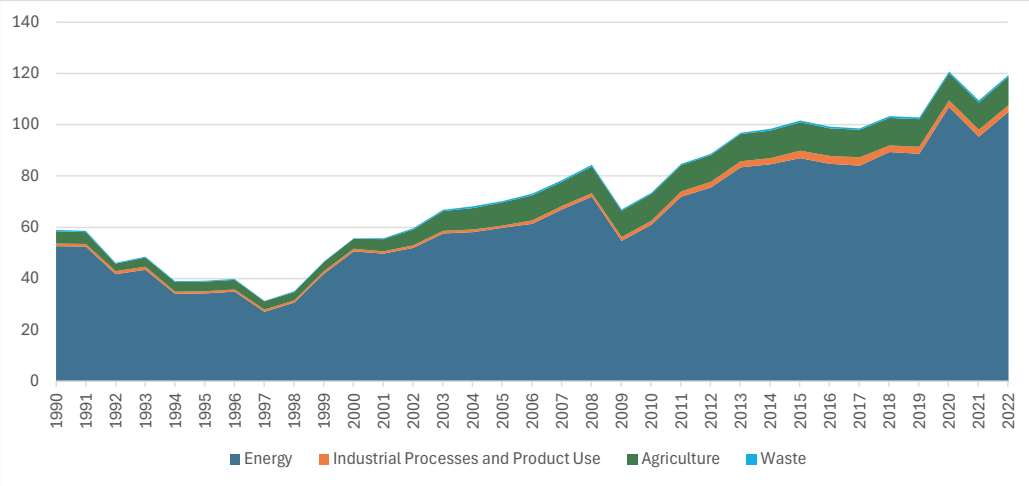
The outdated infrastructure exacerbates inefficient energy use. To tackle this challenge, Uzbekistan is actively pursuing the development of renewable energy sources, with a particular focus on hydropower. The country has ambitious plans to double its installed hydropower capacity by 2030. Additionally, Uzbekistan is implementing numerous renewable energy projects, including solar and wind power plants, as part of its broader strategy to transition to cleaner energy. By 2030, Uzbekistan aims to increase the share of renewables in its energy production to 40%, marking a significant step toward a more sustainable energy future.

The transport sector is another significant emitter, contributing 6% of total emissions, primarily from road transport in urban areas. To reduce emissions, Uzbekistan is transitioning to electric vehicles, specifically for public transport, which is expected to cut CO2 emissions by 35% in the near term..

Agriculture is a vital sector heavily reliant on irrigated farming. Cotton production is a major focus, with Uzbekistan ranking sixth globally in production and second in exports. The “Uzbekistan-2030” Strategy includes measures to reclaim degraded land, improve water efficiency, and expand water-saving technologies, aiming to cover 2 million hectares of irrigated land with drip irrigation.

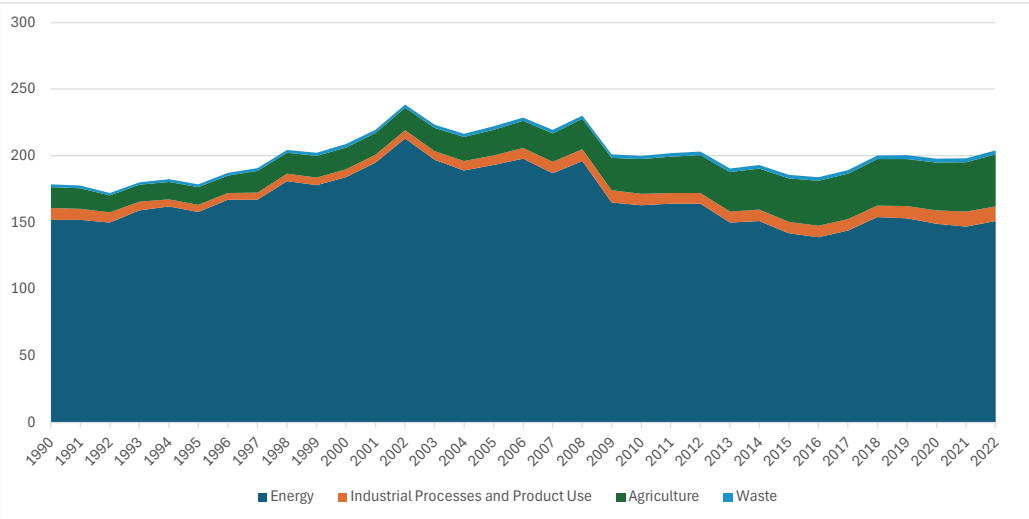
In 2019, Uzbekistan has adopted the «Strategy for Transition to a Green Economy» until 2030, aiming to reduce CO2 emissions per unit of GDP, improve energy efficiency, and increase renewable energy use. The updated NDC targets a 35% reduction in GHG intensity of GDP by 2030 compared to 2010 levels, achieved primarily through energy-saving technologies and climate financing.

Fig. 5 GHG emissions by category of sources in Turkmenistan (without LULUCF), 1990-2022, MtCO2e/year



Source: Climate Watch Data/PIK.

Fig. 6 GHG emissions by category of sources in Uzbekistan (without LULUCF), 1990-2022, MtCO2e/year



Source: Climate Watch Data/PIK.

A roadmap for carbon neutrality, developed with EBRD and Japanese support, outlines three phases: modernization of the gas energy complex (2020-2030), transition to low-carbon energy (late 2020s-2040s), and achieving net-zero carbon by 2050 (though the government considers reaching this goal by 2055) through solar, wind, nuclear, and hydroelectric power.

To address its growing energy demand, Uzbekistan is actively diversifying its energy mix. The country's plans include the construction of wind and solar power plants, as well as potentially developing a nuclear power plant by 2030. Uzbekistan is also taking a pioneering role in green hydrogen energy, having adopted a national hydrogen strategy with support from international partners.

Collective Actions and Regional Cooperation

To align with the objectives of the Paris Agreement and decarbonize their economies, the countries of Central Asia must undertake substantial and coordinated efforts. A critical step in this process involves evaluating the goals outlined in their strategic documents and ensuring they are both ambitious and achievable. Developing national decarbonization plans based on accurate, up-to-date data is essential to create realistic pathways for reducing greenhouse gas emissions. This approach will enable Central Asian nations to effectively transition toward sustainable, low-carbon economies while addressing the unique challenges and opportunities within the region.

An analysis of energy sector strategies reveals major transformations in Uzbekistan and Kazakhstan. These nations aim to reduce their reliance on thermal power generation by expanding renewable energy sources, hydrogen, and, possibly, nuclear. Meanwhile, Kyrgyzstan and Tajikistan focus on advancing hydropower and other renewables while implementing energy-efficient technologies.

A key priority for regional energy sector development is increasing the share of renewables in the energy mix. Hybrid energy systems that integrate various renewable sources - such as small hydro, solar, wind, and geothermal - present the most promising opportunities. Their integration into the regional energy grid is essential for efficiency and sustainability.

The development of low-carbon hydrogen is another vital component in achieving carbon neutrality. According to UNECE estimates, Central Asia has untapped hydrogen production potential that requires further research. Countries with substantial natural gas reserves, such as Turkmenistan, are well-positioned to develop hydrogen energy. Uzbekistan has already initiated work on a national hydrogen strategy with international collaboration, while Kazakhstan is still in the discussion phase. Kyrgyzstan and Tajikistan have the potential to produce hydrogen from surplus hydropower, and Turkmenistan's hydrogen energy development will depend on interest from its gas and oil importers.

One common challenge for Central Asian countries is transportation and logistical constraints. Aging energy infrastructure and limited access to international markets hinder progress. Recognizing the importance of infrastructure development, regional governments should make concerted efforts to modernize their energy systems.

Decarbonizing the regional economy requires strong scientific and methodological support. Developed nations' advancements in energy efficiency, renewables, and technological innovation provide valuable insights. The international scientific networks, such as the Deep Decarbonization Pathways initiative, can provide valuable support to Central Asian think tanks and research institutions in finding practical solutions for low-carbon transitions, leveraging each country's competitive advantages while fostering innovation, talent development, and alignment with global efforts on mitigation of climate change.

Regional cooperation is essential for effective decarbonization. The initiative to develop a unified strategy, proposed by Kazakhstan and approved at the July 2024 Shanghai Cooperation Organization (SCO) summit[8], represents a step toward coordinated low-carbon energy development.

The strategy outlines a decade-long energy roadmap, emphasizing electricity system integration, renewable and low-carbon energy expansion, nuclear power, energy efficiency, and knowledge exchange. These measures aim to reduce greenhouse gas emissions both nationally and regionally.

Central Asia also possesses significant carbon sequestration potential, specifically in afforestation, forest management, agroforestry, pasture management and sustainable and climate-smart land use. Implementing climate change adaptation and land-use improvement programs can contribute to effective decarbonization of the regional economies. AFOLU sectors have already been identified as essential to meeting the NDC targets and carbon neutrality goals. The country leaders have recently announced their afforestation initiatives, such as the 2 billion trees initiative in Kazakhstan and the 1 billion trees programmes in Uzbekistan and Mongolia.

The international support in decarbonization is critical for the region, as many NDC targets depend on funding from foreign partners and financial institutions. Investments in renewable energy, low-carbon technologies, and climate adaptation projects are essential to secure sustainable and just transition to decarbonized economy. The gradual shift to green

[9] Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan are SCO members.

energy, widespread adoption of low-carbon solutions, and enhanced environmental responsibility are fundamental steps toward tackling climate challenges and achieving regional decarbonization.

Conclusions

Central Asia faces significant climate challenges, but its nations are undertaking some proactive proactive steps to address them. Through regional cooperation, investment in renewables, and innovative low-carbon technologies, the region is positioning itself for a sustainable future. Achieving carbon neutrality will require continued collaboration, both within the region and with international partners, to ensure long-term environmental and economic resilience.

中央アジアにおける脱炭素化の展望：排出動向、可能性、障壁、協力の機会

持続可能な開発と国際問題研究所（IDDR），フランス　**ジョージ・サフォノフ**
持続可能なインフラプロジェクトin Asia (SIPA/OECD)，カザフスタン　**ミハイル・サフォノフ**

要　旨

中央アジアは、深刻な気候変動の影響に直面しながら、複雑な社会経済的および環境的課題の解決を迫られている。この地域の人口増加とGDP成長は生活の質を向上させてきたが、一方で炭素排出量の増加や環境・公害問題の深刻化も招いている。石炭、ガス、石油などの豊富な化石燃料資源に依存してきた歴史を持つ中央アジアは、今、化石燃料への依存を続けるのか、それともグリーン経済モデルと脱炭素化へ移行するのかという重要な岐路に立たされている。化石燃料の使用を抑制しなければ、同地域の排出量は累計1,000億トン以上のCO2換算に達し、地球規模の気候変動対策を損なうリスクがある。

持続可能な未来を切り開くためには、中央アジアは地域協力を優先し、再生可能エネルギーへの投資、革新的な低炭素技術や自然を活用した解決策を積極的に導入する必要がある。カーボンニュートラリティの達成には、中央アジア諸国間の継続的な協力だけでなく、国際的な関係者との強固なパートナーシップも不可欠である。これらの取り組みは、同地域の長期的な環境の持続可能性と経済的回復力を確保し、次世代に向けたより環境に優しく、繁栄した未来を築くために不可欠である。

キーワード：中央アジア、気候変動、温室効果ガス、脱炭素化、持続可能性、カーボンニュートラリティ、地域協力