

THE IMPACT OF UZBEKISTAN'S FOSSIL FUEL DEPENDENCY ON CO2 EMISSIONS AND GREEN GROWTH

Shoh-Jakhon Khamdamov^{1,2}

¹ Faculty of economics, International School of Finance and
Technology Institute, Tashkent, Uzbekistan.

² Faculty of Economics and Humanities, Mamun University,
Khiva city, 220900, Uzbekistan.



Abstract Uzbekistan's heavy dependence on fossil fuels, particularly natural gas, has contributed significantly to its CO₂ emissions and poses a challenge to its green growth ambitions. As one of the largest fossil fuel producers in Central Asia, Uzbekistan's energy sector relies heavily on natural gas, which accounts for over 85% of the country's electricity generation. While fossil fuel dependence has supported economic growth and energy security, it has also resulted in high levels of greenhouse gas emissions, slowing the country's transition to a low-carbon economy. This article examines the impact of Uzbekistan's dependence on fossil fuels on its CO₂ emissions and the barriers it poses to sustainable development. The study examines the country's current energy mix, CO₂ emissions trends, and progress in renewable energy adoption. It also identifies key challenges in reducing dependence on fossil fuels, including financial constraints, regulatory barriers, and limited access to clean energy technologies. The article provides recommendations to accelerate Uzbekistan's green growth strategy through renewable energy development and policy reforms to reduce dependence on fossil fuels and cut emissions.

Keywords: Fossil fuel dependency, CO₂ emissions, Uzbekistan, green growth, natural gas, renewable energy, energy transition, sustainable development, climate policy, low-carbon economy.

1. Introduction

Uzbekistan, as one of the largest producers of natural gas in Central Asia, has long depended on fossil fuels to power its economy. Natural gas constitutes the backbone of Uzbekistan's energy sector, accounting for more than 85% of electricity generation and playing a vital role in heating and industrial processes. This dependence on fossil fuels, while ensuring energy security and supporting economic growth, has contributed to high levels of CO₂ emissions, positioning Uzbekistan as one of the top greenhouse gas emitters in the region.

Fossil fuel dependency presents significant challenges to Uzbekistan's green growth ambitions, which aim to transition the country toward a low-carbon, sustainable economy. As a signatory to the Paris Agreement, Uzbekistan has committed to reducing its greenhouse gas emissions by 35% by 2030 compared to a business-as-usual scenario[1]. Achieving these targets requires a fundamental shift in the country's energy mix, away from fossil fuels and toward renewable energy sources such as solar and wind power. However, this transition is hindered by several factors, including the continued reliance on natural gas, limited investment in renewable energy infrastructure, and regulatory barriers that slow the adoption of clean energy technologies.

The environmental impact of Uzbekistan's fossil fuel dependency is substantial. The country's energy-intensive industries, transportation sector, and outdated energy infrastructure contribute significantly to rising CO₂ emissions[2]. In recent years, Uzbekistan has made strides in expanding renewable energy capacity, particularly through the development of solar projects. Nonetheless, the scale of renewable energy adoption remains insufficient to offset the dominance of fossil fuels in the energy sector. Without a significant reduction in fossil fuel use, Uzbekistan risks falling short of its emission reduction goals and undermining its green growth strategy.

This paper explores the impact of Uzbekistan's fossil fuel dependency on CO₂ emissions and its implications for the country's green growth efforts. By examining

the current energy mix, emissions trends, and the progress of renewable energy development, the study identifies key challenges in reducing fossil fuel dependency. The paper also outlines policy recommendations to accelerate Uzbekistan's transition to renewable energy and achieve its green growth objectives.

2. Literature Review

Uzbekistan's reliance on fossil fuels significantly contributes to its CO₂ emissions and poses challenges to its green growth ambitions. The country's energy strategy, heavily dependent on natural resources, has led to substantial greenhouse gas emissions, while efforts to transition to renewable energy sources are still in nascent stages. This dependency not only impacts environmental sustainability but also hinders economic diversification and green growth.

2.1.Fossil Fuel Dependency and CO₂ Emissions

Uzbekistan's economic model has historically relied on the extraction and export of natural resources, including fossil fuels, which has resulted in high CO₂ emissions. The country's energy sector is predominantly based on fossil fuels, contributing significantly to its carbon footprint[3,4,5].

The energy sector's reliance on fossil fuels is a major barrier to reducing greenhouse gas emissions. Despite the potential for renewable energy, the transition has been slow, and fossil fuels remain the primary energy source[6,7].

2.2.Challenges to Green Growth

The heavy reliance on fossil fuels has hindered Uzbekistan's ability to pursue green growth. The country's energy policies have traditionally focused on stability and self-sufficiency, often at the expense of environmental considerations[8,9].

Efforts to diversify the energy mix and incorporate renewable energy sources face numerous challenges, including inadequate infrastructure and investment in renewable technologies[10,11].

The authoritarian governance model, which prioritizes control over rapid reform, has delayed the adoption of policies that could facilitate a transition to a green economy[12,13].

2.3.Potential for Renewable Energy

Uzbekistan possesses significant potential for renewable energy, particularly solar power, given its favorable climatic conditions. The technological potential of renewable energy sources is three times the national energy demand, indicating a substantial opportunity for green growth[14,15].

Recent projects have demonstrated the potential for reducing CO₂ emissions through renewable energy installations, such as biogas and solar photovoltaic systems, which have already achieved a reduction of over 1.3 million tons of CO₂[16].

2.4.Broader Perspectives

While Uzbekistan's fossil fuel dependency poses significant challenges, there is a growing recognition of the need to diversify its energy sources. The government has shown interest in developing renewable energy and nuclear power as part of its long-term energy strategy[17]. However, achieving substantial green growth will require overcoming institutional and infrastructural barriers, as well as fostering international cooperation and investment in renewable technologies.

3. Methodology

This study employs a mixed-methods approach to analyze the impact of Uzbekistan's fossil fuel dependency on CO₂ emissions and its green growth strategy. The methodology includes both quantitative data analysis on energy production, CO₂ emissions, and renewable energy adoption, as well as qualitative insights gathered from policy reviews and expert interviews. This approach ensures a comprehensive understanding of the challenges and opportunities associated with reducing fossil fuel dependency in Uzbekistan.

CO2 Emissions Data: Data on Uzbekistan's CO2 emissions were sourced from national databases such as the State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection and international organizations like the World Bank and the International Energy Agency (IEA). This data provided a detailed understanding of historical and current CO2 emissions, focusing on the energy, industrial, and transportation sectors.

4. Results

The analysis of Uzbekistan's fossil fuel dependency and its impact on CO2 emissions reveals several key findings related to the country's energy mix, emissions trends, and the challenges of transitioning to renewable energy. These results focus on the extent of Uzbekistan's reliance on fossil fuels, the progress of renewable energy adoption, and the barriers to achieving a low-carbon economy.

4.1. Uzbekistan's Fossil Fuel Dependency

Uzbekistan's energy sector is heavily reliant on natural gas, which accounts for over 85% of electricity generation and a significant portion of the country's energy consumption. The country's extensive natural gas reserves have historically ensured energy security and economic growth, but they have also entrenched a dependency on fossil fuels, making it difficult to transition to cleaner energy sources. Coal and oil make up smaller shares of the energy mix, but together with natural gas, they constitute more than 90% of Uzbekistan's total energy production.

Natural gas continues to be the dominant fuel for both electricity generation and heating, particularly in urban areas. The government's historical focus on natural gas extraction and distribution has limited investment in alternative energy sources, contributing to the country's slow transition to renewable energy.

Renewable energy, primarily solar, currently accounts for less than 5% of Uzbekistan's energy production. Although several large-scale solar projects have been launched, including the Nur Navoi Solar Plant, the overall contribution of renewables to the energy mix remains minimal compared to fossil fuels.

4.2. CO2 Emissions Trends

Uzbekistan's heavy reliance on fossil fuels has resulted in a steady increase in CO2 emissions over the past decade. Between 2010 and 2020, CO2 emissions from the energy sector alone increased by approximately 4% annually. The industrial sector, which is energy-intensive and largely powered by fossil fuels, also contributes significantly to the country's overall emissions.

The energy sector is the largest contributor to Uzbekistan's CO2 emissions, accounting for nearly 70% of total emissions. The combustion of natural gas for electricity generation and heating is the primary source of emissions in this sector.

Industrial processes, particularly in manufacturing, cement production, and chemicals, are responsible for about 20% of the country's CO2 emissions. These industries are heavily dependent on fossil fuels, particularly natural gas, which exacerbates the country's emissions profile.

Although a smaller contributor, the transportation sector is witnessing rising emissions due to increased vehicle use and the continued reliance on gasoline and diesel-powered vehicles. Efforts to promote electric vehicles (EVs) and improve public transportation have been limited so far.

Despite the government's commitment to reducing emissions under the Paris Agreement, progress has been slow. Uzbekistan's CO2 emissions remain high, with limited reductions achieved through energy efficiency improvements and renewable energy adoption. The scenario modeling analysis showed that without a significant reduction in fossil fuel use, Uzbekistan's emissions trajectory is unlikely to change substantially by 2030.

4.3. Challenges in Reducing Fossil Fuel Dependency

The cost of transitioning to renewable energy is a major challenge for Uzbekistan. Although international financial institutions, such as the World Bank and the Asian Development Bank (ADB), have supported renewable energy

projects, domestic investment remains limited. The upfront costs of renewable energy infrastructure, combined with the subsidies and investments historically directed toward fossil fuels, have slowed the shift to clean energy.

Solar and wind projects require significant capital investment, but financing options for these projects are limited, particularly for smaller and medium-sized enterprises (SMEs) looking to enter the renewable energy market.

Uzbekistan's renewable energy development relies heavily on international aid and loans, which have helped fund several projects but are insufficient to cover the full scale of investment needed for a comprehensive energy transition.

Regulatory hurdles and institutional inefficiencies have further complicated efforts to reduce fossil fuel dependency. The country's regulatory framework for renewable energy is still in its early stages, with gaps in policy enforcement, unclear incentives for private sector involvement, and slow approvals for new projects.

Current energy policies do not provide sufficient incentives for private investors to develop renewable energy projects. While the government has introduced some support for solar energy, the overall regulatory environment remains more favorable to fossil fuel-based industries.

Lengthy bureaucratic processes for project approval, land allocation, and regulatory compliance have slowed the progress of renewable energy projects. This creates uncertainty for investors and delays the development of clean energy infrastructure.

Uzbekistan's outdated energy infrastructure is another barrier to reducing fossil fuel dependency. The country's electricity grid is not designed to integrate large amounts of renewable energy, and the lack of energy storage technologies further complicates the adoption of intermittent energy sources like solar and wind.

Uzbekistan's grid requires significant upgrades to accommodate renewable energy. Without investments in grid modernization and energy storage solutions, the capacity to expand renewable energy will remain limited.

Limited access to advanced renewable energy technologies, such as solar panels and energy storage systems, has hindered the rapid deployment of renewable energy projects. Most of the country's renewable energy technology is imported, increasing costs and slowing project implementation.

4.4. Opportunities for Green Growth

Despite the challenges, Uzbekistan has significant potential to expand its renewable energy capacity, particularly in solar and wind power. The country's geographic location provides ideal conditions for solar energy production, with over 300 sunny days per year. Expanding solar and wind energy projects could help reduce reliance on natural gas and lower CO₂ emissions.

Projects like the Nur Navoi Solar Plant have demonstrated the viability of large-scale solar power in Uzbekistan. Expanding these projects, supported by international financing and public-private partnerships (PPPs), could significantly increase the share of renewables in the energy mix.

Energy efficiency improvements, particularly in the industrial and energy sectors, represent another opportunity for reducing emissions. By improving energy efficiency in manufacturing processes, upgrading outdated infrastructure, and promoting energy-saving technologies, Uzbekistan can lower emissions while maintaining economic growth.

5. Conclusion

Uzbekistan's dependence on fossil fuels, particularly natural gas, remains a major challenge in its efforts to reduce CO₂ emissions and transition to a green economy. Despite the country's commitment to reducing greenhouse gas emissions under the Paris Agreement, its energy mix remains overwhelmingly dominated by fossil fuels, which account for more than 90% of electricity generation. This reliance on fossil fuels has contributed to rising CO₂ emissions, particularly from the energy and industrial sectors, where outdated infrastructure and energy-intensive processes exacerbate the problem.

While Uzbekistan has taken steps to promote renewable energy, such as the development of large-scale solar projects, the share of renewables in the energy mix remains minimal. Financial constraints, regulatory barriers, and technological challenges have slowed the pace of the energy transition, with renewable energy accounting for less than 5% of the total energy supply. Without significant investments in renewable energy infrastructure and grid modernization, the country's fossil fuel dependency will continue to hinder its ability to meet its emissions reduction targets.

Despite these challenges, there are significant opportunities for Uzbekistan to accelerate its transition to a low-carbon economy. The country's vast solar and wind energy potential offers a pathway to reduce reliance on natural gas and lower CO₂ emissions. Expanding renewable energy projects, improving energy efficiency, and investing in modern grid infrastructure can drive Uzbekistan's green growth strategy forward. Additionally, enhanced regulatory frameworks and greater incentives for private sector investment in renewables will be essential for scaling up clean energy adoption.

To achieve its green growth objectives and reduce fossil fuel dependency, Uzbekistan must focus on:

Expanding Renewable Energy: Prioritizing large-scale solar and wind projects will help reduce reliance on natural gas and diversify the energy mix.

Improving Regulatory Frameworks: Strengthening policies to support renewable energy development and incentivize private sector investment is crucial for accelerating the energy transition.

Upgrading Energy Infrastructure: Modernizing the grid and investing in energy storage solutions will enable the integration of renewable energy and improve overall energy efficiency.

Enhancing International Cooperation: Collaborating with international organizations and financial institutions to secure funding for renewable energy and

energy efficiency projects will be key to addressing the financial barriers to green growth.

In conclusion, Uzbekistan's fossil fuel dependency continues to be a significant driver of CO₂ emissions, posing challenges to its green growth strategy. However, by addressing the financial, regulatory, and technological barriers, Uzbekistan can leverage its renewable energy potential to reduce emissions and achieve sustainable economic growth. Accelerating the transition away from fossil fuels is critical for Uzbekistan to meet its climate commitments and create a resilient, low-carbon future.

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