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GREENING THE ECONOMY IN AFGHANISTAN – ROLE OF THE CRITICAL MINERAL MINING INDUSTRY

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GREENING THE ECONOMY IN AFGHANISTAN – ROLE OF THE CRITICAL MINERAL MINING INDUSTRY

ABSTRACT

This article explores the current state and future prospects of developing a green economy in Afghanistan, focusing on renewable energy and fossil resources. It also examines regional cooperation and Afghanistan's politico-economic relations with its neighbors, especially Uzbekistan.

Afghanistan has a significant potential for a green economy due to its reserves of lithium and rare earth metals, essential for modern green technologies. The country is rich in renewable energy resources, which could address environmental challenges, reduce fossil fuel dependence, and create new economic opportunities. This study looks into renewable energy infrastructure, sustainable agriculture, and related challenges and opportunities.

The paper starts by providing a literature review which analyzes the data on Afghanistan's geology, economy, and environmental issues. It conducts stakeholder analysis by collecting data on perceptions and expectations from local communities, environmental organizations, and industry experts. The analysis is conducted through reviewing the current mining sector policies and comparing them with successful international models to propose policy reforms.

Key areas for development include expanding renewable energy infrastructure, such as solar and wind power projects, and promoting sustainable agriculture practices. International organizations and donors are supporting these initiatives.

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In conclusion, Afghanistan's transition to a green economy is viable and beneficial, requiring sustained efforts from the government, international partners, and the private sector. Strategic investments and cooperation can unlock the full potential of Afghanistan's green economy, contributing to sustainable development and environmental protection.

Keywords: Afghanistan, Uzbekistan, Central Asia, green economy, energy, climate change, regional cooperation.

JEL Class: Q20, Q28, O13, O25, E22.

INTRODUCTION

Afghanistan is a country with vast renewable energy resources, including solar, wind, and hydro power, which present significant opportunities for the development of a green economy. With increasing global concerns about climate change and environmental degradation, transitioning towards a green economy has become imperative for sustainable development. This article examines the prospects and development of a green economy in Afghanistan, highlighting key areas such as renewable energy infrastructure and sustainable agriculture development.

Nowadays, it is clear that a green economy is defined as the one that aims to reduce environmental risks and ecological deficit as well as it aims at sustainable development. It seeks to achieve this development without degrading the environment, and the definition of this type of economy implies thoroughness as the «engine» for sustainable development. Furthermore, it completely covers the environmental, economic, and social perspectives.

It is intended to make a low carbon, asset-efficient and socially comprehensive economy by putting in resources for green development and improving vitality and asset efficiency (UNEP, n.d.).

The economy of Afghanistan has steadily improved in the last decade due to the return of many wealthy emigrants, the modernization of the agriculture sector, and the establishment of more trade routes with neighboring countries. This has also induced the research and programs directed at economic modernization including the implementation of green economy principles in the country (Cuiyun and Chazhong, 2020; Oral et. al., 2021)

One of the key pillars of a green economy in Afghanistan is the development of renewable energy infrastructure. The country has abundant solar and wind resources that can be harnessed to reduce reliance on fossil fuels and improve energy security. The government's Renewable Energy Policy and Action Plan, launched in 2019, outlines strategies to promote renewable energy projects and attract investments in this sector. International organizations and donors have also been supporting renewable energy initiatives in Afghanistan, further boosting the growth of this sector.

In addition to renewable energy, sustainable agriculture plays a crucial role in the development of a green economy in Afghanistan. The country has a long history of agriculture, but traditional farming practices have led to environmental degradation and food insecurity. Transitioning to sustainable agriculture practices, such as organic farming and improved water management, can help enhance food security, increase resilience to climate change, and protect the environment. Supporting small-scale farmers and promoting sustainable farming techniques are essential steps towards achieving a greener agricultural sector.

Agriculture is the backbone of Afghanistan's economy employing 43–52% of its population and contributing to one-third of the national income during 2011–2022 (Trading Economics, 2024a). It is largely based on subsistent farming and envisages the production of various crops, livestock, and horticulture, with a significant potential to drive economic development and enhance food security in the country. Although exact figures are missing, Afghanistan is known to produce a wide variety of cereals, vegetables, melons and gourds. At the same, International Financial Institutes i.e., Asian Development Bank is aiming to develop and expand horticulture and fruit production in the country (ADB, 2024). The country is also known for extensive poppy cultivation, which is seen as the main source of political instability and international condemnation of the country (Al-Jazeera, 2024).

However, despite the high potential, the sector faces numerous serious challenges including political instability, limited infrastructure, climate variability, regulatory uncertainty, and a lack of access to modern technology and markets.

Although 58% of Afghanistan's land is considered agricultural land, the area suitable for crop production comprises about 12% due to underdeveloped irrigation infrastructure and the lack of vital supply chains necessary for establishing farming and agricultural production (Trading Economics, 2024b). This includes irrigated and rain-fed areas where staple crops such as wheat, barley, rice, and maize are grown. Due to frequent droughts and the country's semi-arid climate, only a small portion of arable land is consistently productive, and water scarcity remains a major limitation. Arable land is concentrated in fertile river valleys, such as those around the Kabul, Helmand, and Amu Darya rivers, where irrigation systems support crop cultivation. The country envisages increasing exploitation of its agricultural production potential through the development of internal and riparian rivers, such as the Qosh Tepa canal on the Northern border with Uzbekistan, which is expected to increase the farming land in Northern Afghanistan by 50% (CabarAsia, 2024). This information reveals the huge potential for greening the Afghanistan economy and poses tasks in front of the Afghan society and its political leaders.

While the prospects for a green economy in Afghanistan are promising, there are also challenges that need to be addressed. Limited financial resources, lack of technical expertise, and security concerns pose obstacles to the development of renewable energy infrastructure and sustainable agriculture. Continued support from the government, international partners, and the private sector is crucial for overcoming these challenges and realizing the full potential of a green economy in Afghanistan. By investing in renewable energy projects, promoting sustainable agriculture practices, and fostering collaboration among stakeholders,

Afghanistan can pave the way towards a more sustainable and environmentally friendly future.

Energy in Afghanistan is provided by hydropower, followed by fossil fuels, solar power, and imports from the neighboring countries. Approximately 35% of Afghanistan's population has access to electricity. This covers only the major cities in the country, and hence, many rural areas do not have access to 24-hour electricity (UNEP, 2011).

Afghanistan currently generates over 600 megawatts (MW) of electricity from its several hydroelectric plants and uses fossil fuel as well as solar panels. Over 670 MW more is imported from neighboring Iran, Uzbekistan, Tajikistan, and Turkmenistan (DBPedia, n.d.).

Afghanistan has enough opportunity to implement a green economy. In the country's territory, there are strategic reserves not only of lithium – the building element of modern batteries used in the e-vehicle industry and as such, the basis of a new green economy. At the same time, the country possesses abundant rare earth metals and elements necessary for the green technologies' implementation. Nowadays, Chinese entrepreneurs are the first to reach these resources, as shown in the Table 1 (atnNEWS, 2022).

Table 1. Critical minerals in Afghanistan

Mineral	Applications	Estimated Reserves
Copper	Electrical wiring, renewable energy infrastructure	60 million tons
Lithium	Batteries for electric vehicles and electronics	Undiscovered potential, potentially rivaling Bolivia
Rare Earth Elements (REEs)	Magnets, wind turbines, lasers	1.4 million tons
Iron Ore	Construction, steel production	2.2 billion tons
Gold	Jewelry, electronics	Significant, but largely unexplored

Source: own compilation.

It should be noted that over the past decade, the concept of green economy is gaining more and more popularity in the background of the growing and irreversible influence of the anthropogenic factors. As a result, this topic is widely discussed at national, regional, and global levels in all countries across the world.

The history of geological discoveries in Afghanistan refers to the materials of the Soviet geological exploration of the 1980s, found in 2004 by Americans in the national archive.

Based on them, the US Geological Survey first carried out a two-dimensional gravimetric study from an airplane, and after the first promising results a three-dimensional complex one was conducted.

The results were “gathering dust” in the American archives until 2009, a Pentagon group of business projects in the controlled territories arrived from Iraq to Afghanistan. After that, field studies were carried out, and the specified report was compiled (The Washington Post, 2023).

The most significant discovery is probably the world’s largest lithium reserves in the soda salt marshes of Ghazni and neighboring provinces. They may be even more significant than the reserves of Bolivia, which is considered as the world’s largest lithium reserve.

The presence of lithium reserves and rare earth metals in Afghanistan presents significant opportunities for the development of a green economy in the country. These resources are essential to produce electric vehicles, renewable energy technologies, and other green technologies, making them crucial for the transition towards sustainable and environmentally friendly practices.

1. CRITICAL MINERALS AS A SOURCE OF GREEN ECONOMY DEVELOPMENT

Here are some key reasons why the presence of lithium reserves and rare earth metals in Afghanistan can drive the development of a green economy:

- Strategic Resources for Green Technologies:
  Lithium, rare earth metals, and other elements found in Afghanistan are critical components in the manufacturing of batteries, solar panels, wind turbines, and electric vehicles. As the global demand for these green technologies continues to rise, the availability of these resources in Afghanistan positions the country as a potential hub for sustainable energy production and in-novation.
- Economic Growth and Job Creation:
  The extraction and processing of lithium and rare earth metals can create new economic opportunities and employment prospects in Afghanistan. Developing a green economy centered around these resources can stimulate economic growth, diversify the country`s industrial base, and generate revenue through exports of value-added products.
- Energy Security and Independence:
  By harnessing its lithium reserves and rare earth metals to produce renewable energy technologies, Afghanistan can enhance its energy security and reduce dependence on fossil fuels. Investing in green technologies powered by domestically sourced resources can help the country achieve greater energy independence and resilience to external energy shocks.

- Environmental Benefits:
  Transitioning to a green economy based on renewable energy technologies can lead to significant environmental benefits, including reduced greenhouse gas emissions, improved air quality, and protection of natural ecosystems. By leveraging its lithium reserves and rare earth metals for sustainable development, Afghanistan can contribute to global efforts to combat climate change and preserve the environment.
- Technological Innovation and Collaboration:
  The presence of lithium reserves and rare earth metals in Afghanistan offers opportunities for technological innovation, research, and collaboration with international partners in the green technology sector (Shroder, 2015).

By fostering partnerships with industry leaders and academic institutions, Afghanistan can accelerate the adoption of green technologies and position itself as a player in the global green economy.

The existence of lithium reserves and rare earth metals in Afghanistan presents significant opportunities for the development of a green economy that is based on sustainable energy production, economic growth, energy security, environmental protection, and technological innovation.

By capitalizing on these resources and promoting green economic development strategies, Afghanistan can pave the way towards a more sustainable and prosperous future.

However, the authors raise valid points about the potential negative impacts of mineral extraction and processing, as well as the challenges associated with transitioning to a green economy. It is important to consider the social, environmental, and economic implications of resource extraction and ensure that development efforts are conducted responsibly and sustainably.

Indeed, the extraction of valuable minerals can have adverse effects on workers, communities, and ecosystems if not managed properly. It is crucial for Afghanistan to establish robust regulatory frameworks, environmental safeguards, and social responsibility measures to mitigate these risks and ensure that resource extraction activities do not harm local populations or the environment.

Furthermore, transitioning to a green economy requires significant investments in renewable energy infrastructure, technology development, and workforce training. The shift towards sustainable practices may require higher upfront costs and a more labor-intensive approach compared to traditional economic activities. This underscores the importance of strategic planning, capacity building, and international cooperation to support Afghanistan in its efforts to pursue a green development path.

Given the current challenges facing Afghanistan, including political instability, security concerns, and economic hardships, the road to developing a green economy will be challenging.

Addressing these complex issues will require a multi-faceted approach that involves government leadership, private sector engagement, civil society participation, and international support.

While the presence of valuable mineral resources in Afghanistan presents opportunities for economic development, it is essential to approach resource utilization with caution and consider the long-term implications for sustainable growth. By prioritizing responsible resource management, environmental protection, social equity, and green technology innovation, Afghanistan can work towards a more sustainable and inclusive economic future.

In addition, huge reserves of high-quality iron ores (2.2 billion tons), 60 million tons of copper reserves (more than half of Russian reserves) are discovered. Moreover, the location of neodymium, cobalt (used for magnets, special alloys), niobium (used in supercapacitors, superconductors), and other rare earth metals has been confirmed. All of this is of crucial importance to the modern world economy, especially during the current age of transition to green economy (BBC News, 2021).

According to the Washington Post, in a 2010 memo, the Pentagon's Task Force for Business and Stability Operations, which examined Afghanistan's development potential, called the country the "Saudi Arabia of Lithium".

A year later, the U.S. Geological Survey published a map showing the location of major deposits and highlighted the scale of the underground wealth, saying Afghanistan "could be considered as the world's recognized future main source of lithium" (Reuters, 2023).

If China gains control of Afghanistan's pristine lithium and rare earth reserves, it will be a crucial victory in the battle for resources with Europe and the United States.

In 2019, the United States imported 80% of rare earth metals from China. This figure is even higher for the European Union – 98% (The Washington Post, 2023).

There is a collective opinion that Afghanistan's new government (in the example of China) in the future should find balance between future economic growth and environmental protection. Also, they should remember that protecting productivity and improving the environment also equates to developing productivity.

It is expected that with further economic development and improvement of the welfare, the Afghan people will be more conscientious in promoting green, year – round, and low-carbon development.

Like any responsible government, the current Afghan government must fully understand the importance of enforcing ecological "red lines".

With the help of the world community, this country can vigorously develop a circular economy to reduce waste and resource consumption, reuse resources, and recycle waste in production, distribution, and consumption.

2. THE CURRENT SITUATION AND PATHS OF ENERGY SECTOR DEVELOPMENT

The energy sector in Afghanistan faces numerous challenges, including limited access to electricity, reliance on imported energy sources, and vulnerability to supply disruptions. Developing the energy sector in the country is crucial for improving living standards, promoting economic growth, and enhancing energy security.

Furthermore, the transition to a green economy presents opportunities to address these challenges while promoting sustainable development and environmental protection.

One key strategy for developing the energy sector in Afghanistan is to invest in renewable energy sources, such as solar, wind, and hydropower. These sources can provide clean, reliable, and affordable energy while reducing dependence on fossil fuels and mitigating greenhouse gas emissions. By harnessing renewable energy resources, Afghanistan can diversify its energy mix, enhance energy security, and promote environmental sustainability.

In addition to expanding renewable energy capacity, improving energy efficiency is another important aspect of developing the energy sector in Afghanistan. Implementing energy-efficient technologies and practices can help reduce energy consumption, lower costs, and minimize environmental impact. Investing in energy efficiency measures in buildings, transportation, and industry can contribute to a more sustainable and resilient energy system.

Furthermore, enhancing the resilience of the energy infrastructure is essential for ensuring reliable and secure energy supply in Afghanistan. Building robust transmission and distribution networks, upgrading aging infrastructure, and integrating smart grid technologies can help mitigate risks associated with power outages, grid instability, and natural disasters. Strengthening the resilience of the energy sector can support economic development, enhance energy access, and foster sustainable growth.

The development of the energy sector in Afghanistan is intricately linked to the prospects for transitioning to a green economy. By investing in renewable energy, promoting energy efficiency, and enhancing infrastructure resilience, Afghanistan can lay the foundation for a more sustainable and inclusive economic future. A green economy approach can create new opportunities for job creation, innovation, and investment while addressing social and environmental challenges.

By aligning energy sector development with green economy principles, Afghanistan can unlock the potential for sustainable growth, improve quality of life for its citizens, and contribute to global efforts to combat climate change.

The prospects for the development of a green economy in Afghanistan are significant, given the country's abundant renewable energy resources and the growing global focus on sustainability. Here are some key factors that indicate the presence of prospects for the development of a green economy in Afghanistan:

- Renewable Energy Potential:
  Afghanistan has ample solar, wind, and hydro power resources that can be harnessed to meet the country`s energy needs sustainably. The government's commitment to promoting renewable energy projects, as outlined in the Renewable Energy Policy and Action Plan, indicates a strong foundation for the development of a green economy in Afghanistan.
- International Support:
  International organizations and donors have been actively supporting renewable energy initiatives in Afghanistan, providing financial assistance, technical expertise, and capacity building. This external support demonstrates recognition of Afghanistan's potential for green economic development and opens up opportunities for collaboration and investment.
- Sustainable Agriculture Initiatives:
  The transition to sustainable agriculture practices in Afghanistan presents another avenue for green economic development. By promoting organic farming, improving water management, and supporting small-scale farmers, the country can enhance food security, protect natural resources, and create employment opportunities in the agricultural sector.
- Government Commitment:
  The Afghan government has shown a willingness to prioritize environmental sustainability and green economic development through policy initiatives and strategic planning. By continuing to invest in renewable energy infrastructure, promote sustainable agriculture, and create a conducive regulatory environment, the government can further drive the transition towards a green economy.
- Economic Diversification:
  Diversifying the economy through the development of green industries can help reduce dependence on fossil fuels, mitigate climate change impacts, and create new job opportunities in emerging sectors. The shift towards a green economy in Afghanistan has the potential to spur

innovation, attract investments, and drive economic growth in a sustainable manner.

In this way, the presence of abundant renewable energy resources, international support, government commitment, sustainable agriculture initiatives, and the potential for economic diversification all indicate strong prospects for the development of a green economy in Afghanistan. By capitalizing on these opportunities and addressing challenges through collaborative efforts, Afghanistan can pave the way towards a more sustainable and environmentally friendly future.

Notwithstanding with above, Afghanistan is an underdeveloped country with vast renewable and nonrenewable energy resources. Therefore, it has one of the least developed energy generation, transmission and distribution infrastructures. The energy production and consumption rates are low (Chart 1).

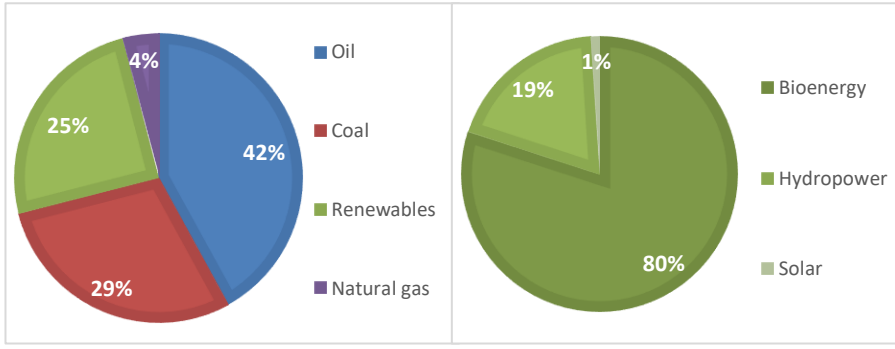

Chart 1. Total Primary Energy Supply in 2021

Source: IRENA (2021).

The country is exploring the potential of deploying modern sources of energy under the auspices of the international financial institutions and donor organizations. The authorities have been chasing a modest and fragmented sustainable energy policy until 2020, however, the generation capacities declined after 2020 (Table 2).

Table 2. Generation capacity and its change in Afghanistan during 2020

Capacity in 2020	MW	%	Capacity change (%) 2015-2020	Capacity change (%) 2019-2020
Non-renewable	277	43	17	0
Renewable	364	57	20	0.2
Hydro/marine	333	52	17	0
Solar	31	5	61	1.8
Wind	0	0	300	0
Bioenergy	0	0		0
Geothermal	0	0		0
Total	641	100	19	-0.1

Source: IRENA (2021).

No new generation capacity was added in 2020. In contrast, the next generation capacity change was +17MW from 2015 till 2020. The figures also indicate that 300MW wind power generation capacity vanished shortly after being commissioned during 2015–2020, not contributing to the overall generation of electricity. Such incidents send negative signals to the local and international stakeholders who are considering investing in renewable power generation in the country (Drishtiias, 2021).

It is believed that the country possesses a significant bioenergy potential. However, the most recent total generation and primary energy consumption capacity figures reveal no contribution from the bioenergy sources.

Along with the biomass sources, off-grid and distributed solar-PV systems have the highest potential in eradicating energy poverty in Afghanistan (IRENA, 2020).

Due to endowment of enormous hydraulic power, solar biomass, wind and geothermal resources, Afghanistan possesses all the necessary conditions to meet the Sustainable Development Goal (SDG) #7 on creating cheap and clean energy access until 2035 (IRENA, 2020).

Among the 20 largest partner countries in foreign economic activity, Uzbekistan has an active foreign trade balance (export exceeds are more than import) with four countries: Afghanistan, Kyrgyzstan, Tajikistan, and Turkey. The remaining 16 countries maintain a passive balance of foreign trade turnover.

That is, Afghanistan is one of the largest sales markets for Uzbekistan. In particular, in 2020, Uzbek export to this country amounted to US$ 776.7 million, while import was 334 times less – only $ 2.3 million. In January–June of 2021, the figures were US$ 350 million and US$ 1.4 million, respectively (IRENA, 2020).

3. OPPORTUNITIES FOR COOPERATION WITH UZBEKISTAN

Opportunities for cooperation with Uzbekistan in the energy sector present a promising avenue for promoting sustainable development and advancing the green economy in Afghanistan. Uzbekistan has made significant strides in developing renewable energy sources, such as solar and wind power, and has also shown a commitment to enhancing energy efficiency and reducing greenhouse gas emissions.

Collaborating with Uzbekistan on energy projects can provide Afghanistan with valuable expertise, technology, and investment opportunities to accelerate the transition to a green economy.

One potential area for collaboration is the development of renewable energy projects, such as solar-PV and wind farms in Afghanistan. Uzbekistan has experience in implementing large-scale renewable energy projects and can share best practices, technical know-how, and financing options with Afghanistan. By partnering with Uzbekistan on renewable energy initiatives, Afghanistan can expand its clean energy capacity, reduce reliance on fossil fuels, and contribute to environmental sustainability.

Another opportunity for cooperation is in energy efficiency. Uzbekistan has implemented energy efficiency programs in various sectors, including residential and public buildings, industry, and transportation, to reduce energy consumption and lower carbon emissions. By sharing knowledge and experiences in energy efficiency measures, Uzbekistan can support Afghanistan in improving energy efficiency standards, promoting sustainable practices, and reducing energy costs.

Furthermore, collaboration with Uzbekistan on enhancing energy infrastructure resilience can help strengthen the reliability and security of the energy sector in Afghanistan.

Uzbekistan has invested in upgrading its energy infrastructure, including transmission and distribution networks, to enhance resilience to natural disasters and other disruptions. By working together on infrastructure development and modernization, Afghanistan can improve energy access, promote economic growth, and build a more resilient energy system.

Establishing cooperation with Uzbekistan in the energy sector can also create opportunities for joint research and innovation in green technologies. Collaborative projects on renewable energy research, technology transfer, and capacity building can foster knowledge exchange, skills development, and technology adoption in Afghanistan. By leveraging Uzbekistan's expertise and resources, Afghanistan can accelerate the adoption of green technologies, drive innovation, and build a competitive advantage in the green economy.

Cooperation with Uzbekistan in the energy sector offers a range of benefits for Afghanistan's development of the green economy. By tapping into

Uzbekistan's experience, resources, and expertise, Afghanistan can advance its clean energy goals, improve energy efficiency, enhance infrastructure resilience, and promote sustainable growth. Establishing partnerships with Uzbekistan can create a win-win situation for both countries, leading to mutual benefits and shared progress towards a more sustainable and inclusive future.

Firstly, the current Afghan government should outline what it means for Afghanistan to strengthen its cooperation with Uzbekistan to "move towards new opportunities" by focusing on green recovery and bringing all stakeholders together.

Then, offer the Afghan leadership to work in this direction, including acting as a coordinator or intermediary, relying on honest business and management principles.

Secondly, under the auspices of development cooperation and donor organizations, a platform to discuss policies on renewable energy, energy efficiency, climate change mitigation, environmental protection, and other aspects, including Afghanistan's transition to a green economy should be created. It will contribute to the further development of society and the economy's resilience and reduce the pressure on the environment.

Finally, formulate priority areas and practical actions to support the Afghan government for green economic recovery after the COVID-19 pandemic to gain more weight in competition for those resources.

For families living in rural Afghanistan, there is no time to waste. Climate change is a genuine and current threat. Moreover, despite being one of the most vulnerable countries in the world to climate change, Afghanistan is one of the least equipped to deal with the consequences: increasing instances of natural disasters and extreme weather, damaging the natural resource base, and putting families' lives at risk.

With the US withdrawal from Afghanistan and the strengthening international sanctions against the Afghan economy, situation in Afghanistan has become more complicated.

For this situation to improve, internal and external legitimization of the current government is required.

However, the Taliban are still delisted. According to M. Kanischev, head of the ANSELM (US) energy efficiency and emission reduction research project, energy transition to the "green" path will require a sharp increase in the production of iron, copper, aluminum, nickel, lithium, cobalt, platinum, and silver, as well as rare earth metals (Ulyev et. al., 2021).

Their production growth can lead to the destruction of soil and rocks.

For example, lithium – one of the most important metals for renewable energy – is mined in more than half of cases in areas where the population already

has problems with water supply (Bolivia, Argentina, Australia, Chile). If the extraction is even more intensive, the reservoir pressure will increase.

A striking example is the Atacama Desert in Chile, which is growing, and the oases within it are disappearing. Lithium is mined there, and when it is extracted from the bowels, vast volumes of water are pumped out, which dries up the soil and deprives the nutrition of the local animals. A similar scenario is developing in Bolivia, China, Australia, and other regions where this metal is mined.

Another essential element for batteries is cobalt. The problem with this element is not of an ecological but of a socio-ecological nature.

More than 60% of the world`s cobalt production comes from the Democratic Republic of the Congo (Transport and Environment, 2019). It is mined without violating safety standards, although the metal and its compounds are toxic. Mining is done using forced labor of prisoners and often children.

Ethics and economics do not interact well, but energy transition was not originally based on economic principles, so it is impossible to ignore this.

It is important to acknowledge the environmental and socio-economic challenges associated with the extraction of minerals like lithium and other elements, particularly in regions like the Republic of Congo where mining activities can have detrimental impacts on ecosystems, local communities, and human rights. The inclusion of information on the dangers of lithium mining and other elements serves to highlight the complexities and trade-offs involved in the transition to a green economy, as well as the need for responsible and sustainable practices throughout the supply chain.

Even though minerals like lithium are essential for the development of renewable energy technologies, such as batteries for electric vehicles and energy storage systems, their extraction can have negative consequences if not managed properly. Issues such as water pollution, deforestation, land degradation, and social conflicts are common in mining operations, especially in developing countries where regulatory frameworks and enforcement mechanisms may be weaker.

It is crucial for countries like Afghanistan to consider these challenges and work towards mitigating the environmental and social impacts of mineral extraction.

This may involve implementing strict environmental regulations, promoting transparency and accountability in the mining sector, engaging with local communities and indigenous groups, and exploring alternative mining technologies that minimize harm to the environment.

While environmentally friendly mining technologies for minerals like lithium can be costly and technically challenging, investing in sustainable practices can yield long-term benefits by reducing environmental damage, enhancing social license to operate, and attracting responsible investors.

Collaboration with international partners, such as Uzbekistan or other countries with experience in sustainable mining practices, can also provide valuable insights and support for Afghanistan's efforts to develop a green economy.

Whereas the extraction of minerals like lithium presents environmental and socio-economic challenges, it is essential to address these issues in a holistic manner to ensure the sustainable development of the green economy.

By acknowledging the risks associated with mineral extraction and working towards responsible practices, countries like Afghanistan can harness the potential of these resources while safeguarding the environment and promoting social well-being.

We can visualize the scale of the growth in demand for lithium or cobalt using an example of the car market.

Now there are 1.3 billion cars in the world. Among them, there are only 11.2 million electric vehicles. It is projected that there will be 2.5 billion cars globally by 2050. Let us assume that all the growth will come from electric cars.

One battery for a conventional electric car will need at least 10 kilograms of lithium (1.5–2 times more for Tesla) and 11 kilograms of cobalt. On average, over 20 years, to provide 1.2 billion electric cars with batteries, the annual production of these metals should increase by 600 and 660 thousand tons, respectively (Luong et. al., 2022). Lithium extraction is at most 100 100 000 tons per year, and cobalt is 140 thousand tons.

So, there is a resource base: 80 million tons of lithium, cobalt – 25 million tons, and it is likely to grow, but it will be hardly possible to increase the production of these metals quickly. Furthermore, even more, to make their products safe for the environment.

Moreover, the figures given do not consider the growth in demand for lithium and cobalt for mobile technology and, as well as for solar and wind power plants.

According to M. Astapkovich, Senior Consultant of the Deloitte CIS Sustainability Services Group, the methodology for assessing the environmental impact from the disposal of components for renewable energy sources and batteries for electric vehicles is still being formed (Deloitte, 2024).

At the same time, scientists are actively developing methods for utilizing renewable energy components that have already been built in different parts of the world. He named waste blades from wind turbines and used lithium-ion batteries the most harmful to the environment.

There is information that solar panels create 300 times more toxic waste per unit of energy than nuclear power plants as an example (ibid). Let us suppose over the next 25 years, solar and nuclear power plants produce the same amount of energy, and waste accumulates on two football fields. In that case, nuclear waste will reach the height of Tower of Pisa (52 meters) and solar – the height of two Everest (16 kilometers).

CONCLUSIONS

Thus, the prospects for a critical mineral extraction industry in Afghanistan are promising, as the country has abundant renewable energy resources. Developing economy in Afghanistan could help reduce the country's dependence on fossil fuels, improve energy security, eradicate energy, fuel poverty, and create new job opportunities in the renewable energy sector. One key area for development is the expansion of renewable energy infrastructure, including solar and wind power projects.

The government has already taken steps to promote renewable energy, such as launching the Renewable Energy Policy and Action Plan in 2019. In addition, international organizations and donors have been supporting renewable energy projects in Afghanistan.

Another area with potential for growth is sustainable agriculture. Afghanistan has a long history of agriculture, and transitioning to more sustainable farming practices could help improve food security, increase resilience to climate change, and protect the environment. This could involve promoting organic farming, improving water management, and supporting small-scale farmers.

The development of a critical mineral extraction industry in Afghanistan holds great promise for addressing environmental challenges, reducing dependence on fossil fuels, and creating new economic opportunities.

By harnessing its abundant renewable energy resources and promoting sustainable agriculture practices, Afghanistan can achieve sustainable development while protecting the environment. Continued support from the government, international partners, and the private sector is essential for driving forward the transition towards a green economy in Afghanistan. With concerted efforts and strategic investments, Afghanistan can unlock the full potential of its green economy and pave the way for a more sustainable future.

The government`s efforts to promote renewable energy and sustainable practices, as well as the support from international partners and the private sector, are crucial for realizing the full potential of a green economy in Afghanistan.

It is essential to conduct sectoral review of the sectors of the national economy with a special emphasis on agricultural, power and service sectors. Another priority direction could be the exploration of the human capacity building sector with an aim of facilitating green-economy related training and skill-building.

Overall, establishing practical cooperation in Afghanistan and conducting a coordinated dialogue with the authorities of this country is necessary. Otherwise, the country will not be able to get out of the sectors of the illegal economy and will face an expansion of drug and weapons trafficking.

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