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Perspective of Sustainable Energy Transformation and Green Transition in Azerbaijan

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Abstract

Azerbaijan, located in the South Caucasus region of Eurasia, straddling West Asia and Eastern Europe, has lots of potential of green transition as it has large sources of solar, wind, hydropower, biofuel, and hybrid mode of energy. Though a producer and consumer of fossil fuel, the country is trying to diversify of its economy away from hydrocarbons, and is looking to increase the green energy, agriculture, logistics, tourism, and information, communication and technology (ICT) sectors. By marching towards sustainable energy production, Azerbaijan is working to expand its renewable energy sector. By 2030, Azerbaijan plans to install 1500 MW in renewables capacity, in part to support future export of green electricity and green hydrogen to European markets. The exploitation of greener energy resources, a significant departure from its conventional fossil fuel production and consumption, underscores its potential as a catalyst to the greener energy advocate in the days come. By leveraging its hydro, wind and solar resources, expertise, and organizational capacity, Azerbaijan can evolve as one of the largest green energy producer and consumption country in the long run, though it has challenges to adopt to greener energy and balance its economy at the same time. The Study done by Kuber Chalise, Senior Fellow at the Asian Institute of Diplomacy and International Affairs (AIDIA), in partnership with the Center of Analysis of International Relations (AIR Center), Azerbaijan, explores the green energy transition that could transform not only Azerbaijan's energy sector and contribute to climate goals but also position the country as a regional leader in sustainable energy.

I. INTRODUCING THE STUDY: Framing the Context

Over the last 50 years, the Earth's average surface temperature has increased by approximately 1.2°C (2.2°F) mainly due to human-induced factors like burning of fossil fuel, rapid urbanization and deforestation, according to the United Nations Framework Convention on Climate Change (UNFCCC). The byproduct of the blindfold industrial development by some countries is one of the main causes of the rise in temperature or global warming, which has posed threat to the whole human civilization. The most significant cause of the rise in Earth's temperature is the accumulation of greenhouse gases (GHGs) in the atmosphere, mainly carbon dioxide (CO2) as these gases trap heat and prevent it from escaping into space, leading to a warming of the planet.

Burning fossil fuels for electricity, transportation, and industry that releases large amounts of CO2, since the Industrial Revolution in the late 18th century, reduced the Earth's ability to absorb CO2. Apart from the Industrial Revolution, the burning of coal, oil, and natural gas (fossil fuels) for energy and transportation has also contributed to the rise in greenhouse gas concentrations due to growing global economy and industrialization in emerging economies has accelerated the greenhouse gases in the last 50 years, especially after the 1970s.

Deforestation, urbanization, and changes in agriculture pattern also contributed to the global warming. The loss of forests and rapid urbanization and huge infrastructure development created heat islands that absorb and retain more heat, especially in growing cities heating the Earth in the long-run. Due to which, the natural processes amplify the melting ice and snow. The loss of ice in the Arctic, glaciers and high Himalayas in Nepal, which has eight out ten highest mountains in the World covered with the snow throughout the year, reduced the Earth's ability to reflect sunlight, and created loss of lives and livelihood the people as the global warming brought ecological change.

Despite the negative global impact, there has been a growing demand for energy, especially in developing countries. The emerging economies have more challenges as one hand they need more energy produced from fossil fuels for their development, and on the other they also need to transit to greener economy for the safer earth.

In this context, supporting the green transition and accelerating the growth for Azerbaijan is key. Despite increasing use of renewable energy in recent years, the green transition is not a cakewalk as globally also the process is still not fast enough to significantly curb emissions in the short term.

Due to the 1.2℃ rise in temperature over the last 50 years there has been more frequent and intense heatwaves; melting ice caps and glaciers contributing to rising sea levels; shifts in weather patterns including more intense storms, floods, and droughts; changes in ecosystems and biodiversity with some species struggling to adapt to new conditions; ocean acidification affecting marine life; and human health impacts including increased risks of heat-related illnesses and the spread of diseases.

Such wide-ranging effects on the planet call for urgency in addressing climate change as it has already begun to have serious environmental, economic, and social consequences. Thus, Azerbaijan, as one of the producer and consumption country, which has its economic base on fossil fuel has more challenges to adopt to greener energy and balance its economy at the same time. Prospective of Sustainable Energy Transformation and Green Energy Transition in Azerbaijan is, thus a key to not only its economy but also to the economies depending on its fossil fuel.

The Focus on Green Energy

According to the United Nations Environment Program (UNEP), "A green economy leads to improved human well-being and social equity, while significantly reducing environmental risks and resource scarcity.

As the transition to a green economy entails redefining economic models and policies to ensure environmental sustainability while fostering economic growth and social well-being, it involves adopting practices that minimize carbon emissions, promote resource conservation, and encourage renewable energy sources. Thus, ensuring effective Green Economy policymaking requires a robust set of indicators to identify major issues, formulate appropriate policy responses and assess, and evaluate the potential policy impacts.

Minimizing the key factors that help increase in Earth's temperature is the buildup of greenhouse gases in the atmosphere, which trap heat, including Carbon dioxide (CO_2)- emitted by the burning of fossil fuels (coal, oil, natural gas) for energy production, transportation, and deforestation; Methane (CH_4)-released during agriculture (especially livestock digestion), landfills, and oil and gas extraction; Nitrous oxide (N_2O)- produced by agricultural activities, including fertilizer use; and Fluorinated gases- Synthetic gases used in industrial applications, refrigeration, and air conditioning- is easier said than done as Azerbaijan has played a significant role in the production and consumption of fossil

fuel, thereby transforming its economy and becoming a upper-middle-income economy has helped safeguard its sovereignty and territorial integrity.

But transition to green economy will take care of environment, apart from fighting pollution. While the damage isn't reversible, it can stop or slow any additional harm by tackling global warming, loss of biodiversity, deforestation, and desertification. The green transition refers to the shift toward a more sustainable and environmentally friendly economy. This transition is critical because it offers a pathway to a more sustainable, resilient, and equitable future. By addressing climate change, preserving biodiversity, improving public health, and creating economic opportunities, the green transition is not just an environmental necessity but also a social and economic imperative. The Green Transition helps;

Combating Climate Change: The green transition helps address the pressing issue of global warming. The burning of fossil fuels for energy and industrial processes that led to a dramatic increase in greenhouse gas emissions, particularly carbon dioxide (CO2) that contributes to climate change, resulting in rising global temperatures, more frequent extreme weather events, and disruptions to ecosystems can be addressed through transition to renewable energy sources like solar, wind, and hydropower and reducing carbon emissions leading to mitigating these impacts and limiting global temperature rise.

Biodiversity Preservation: Deforestation, pollution and climate change caused the loss of biodiversity worldwide, threatening to ecosystems and species, while many posing a risk to extinction. The green transition encourages the adoption of sustainable practices in agriculture, industry, and urbanization process that can help conserve natural habitats, protect wildlife, and restore balance to ecosystems.

Improved Public Health: Pollution created by fossil fuel-based energy production, transportation, and industrial processes have affected human health. Air pollution is linked to respiratory diseases, heart disease, and premature deaths, whereas a green transition, which promotes cleaner energy sources and more sustainable practices, can significantly improve air and water quality, thus leading to better public health outcomes.

Energy Security: Reliance on fossil fuels, particularly from politically unstable regions, poses significant risks to global energy security. Transitioning to renewable energy sources help reduce dependence on imported fuels, diversify energy supplies, and increase resilience to energy disruptions. It can also help stabilize global energy prices in the long term.

Economic Opportunities: The green transition offers huge economic potential. The renewable energy sector is rapidly growing, with job opportunities in solar, wind, energy storage, and electric vehicle (EV) industries. Transition to green technologies will help spur innovation, create new industries, and foster economic growth, while also providing a pathway to a more circular and sustainable economy.

Sustainable Resource Management: With increasing global population, demand for resources also increases. But natural resources like fossil fuels, freshwater, and certain minerals, are finite. The green transition promotes a circular economy, where resources are reused, recycled, and managed sustainably. It can help prevent the depletion of essential resources and reduce waste.

Global Equity and Justice: The effects of climate change disproportionately impact vulnerable communities, especially those in developing countries. These populations are often the least responsible for carbon emissions but face the greatest consequences. A green transition that incorporates sustainable development goals can help address this inequity by promoting fair and inclusive solutions for those most affected by climate change.

Meeting International Commitments: Countries around the world, through international agreements such as the Paris Agreement, have committed to reducing greenhouse gas emissions to limit global warming to well below 2°C, and ideally to 1.5°C, above pre-industrial levels. Achieving these targets requires a global transition to a low-carbon economy.

Long-term Sustainability: The green transition is necessary for ensuring the long-term sustainability of the planet and its ecosystems. Fossil fuel-based growth models are inherently unsustainable and destructive in the long run. By adopting green technologies and practices, societies can ensure that future generations inherit a livable, thriving world with the resources needed to continue development.

Azerbaijan has also thus, in its **'2022-2026 Social and Economic Development Strategy**' focused on green transition. Under the broader strategy Azerbaijan has '**Strategic Framework for clean environment and Green Growth Country**.' It reads as follows:

3.5. Strategic framework for clean environment and "green growth country"

Natural resources will be used in a sustainable and viable fashion. Environment-friendly industrialization will be promoted with an effective waste management system

developed to this end. The weather surveillance and environmental monitoring system will be upgraded. Biodiversity preservation, water bio-resource enhancement and aquaculture development will be provided, with forested areas and vegetation preservation enhanced. Consequently, country-wide vegetation area will be increased from 12% to 12,3%. Unusable lands will be decreased from 25% to 15%. Drinking water supply will increase from 70% to 85%, while irrigation water supply increases from 80% to 90%. Waste re-cycling coverage will be 20% (10% for rural areas). Protected natural areas (preserves) will have a share of 10,5% of the country's total lands. 65% of the forested areas will be inventoried. 30% of lands will be agrochemically analyzed.

Energy regulations will be improved and liberal market principles will be implemented. RES deployment will be expanded, with energy efficiency measures rolled out. Environment-friendly vehicles and other green technologies will be widely deployed to support climate action. Consequently, the government's financial burden in the energy sector will be reduced as subsidies are phased out. Share of RES in total installed capacity will be increased to 24% by 2026 (in line with the 30% target for 2030).

The Potential Transformation

The neighboring countries are Russia to the north, Georgia to the northwest, Iran to the south, Turkey to the west (via the Azerbaijani exclave of Nakhchivan AR to the northwest) and Armenia to the west and via the Azerbaijani exclave of Nakhchivan to the north and east. To the east, Azerbaijan is bordered by the Caspian Sea. With a total population of 10.2 million as of 1 November 2024, occupying around 86,600 sq-km, Azerbaijan's share of global oil production is 0.7%, its share of global gas production is 0.9% and its share of global emissions is 0.1% of CO2 emissions from combustible fuels. Thus, it is not one of the largest producer or consumer country.

Azerbaijan's GDP totaled $75 billion, according to the Center for Analysis of Economic Reforms and Communication (CAERC). Azerbaijan's economy is anchored in oil and gas production. According to the Ministry of Energy of the Republic of Azerbaijan, operational data for January-December 2023 states, Azerbaijan produced 48.3 bcm of natural gas. 12.9 bcm of gas production extracted from ACG, while 26.2 bcm from Shah Deniz and 0.8 bcm from Absheron. SOCAR produced 8.4 bcm gas during this period. Gas was transported with an increase of 3.2%, namely 1.5 bcm compared to 2022.

During this period, gas sales amounted to 23.8 bcm, which was 5.3 % more compared to the same period in 2022. 11.8 billion cubic meters of gas were sold to Europe, 9.5 billion cubic meters to Türkiye, and 2.5 billion cubic meters to Georgia. It should be noted that, during this period nearly 5.6 bcm gas was exported to Türkiye through TANAP.

Since the commissioning of the Azeri-Chirag-Gunashli and Shah Deniz till 1 January 2023, about 216.3 bcm of gas was produced from Azeri-Chirag-Gunashli and more than 209 bcm of gas from Shah Deniz. During this period, 148.1 bcm gas was exported from Shah Deniz.

Azerbaijan produced 30.2 million tons of oil (including condensate) in 2023. Azeri-Chirag-Gunashli accounted for 17.8 million tons of oil produced in the republic while Shah Deniz for 4.3 million tons (condensate) and Absheron for 0.3 million tons. SOCAR's oil output amounted to 7.8 million tons (including condensate).

During the reporting period, the volume of exported oil, including condensate, amounted to 25.2 million tons. Out of this, consortium accounts for nearly 22.1 million tons, SOCAR for 3.1 million tons.

Since its commissioning till 1 January 2024, more than 627.4 million tons oil (including condensate) were extracted from Azeri-Chirag-Gunashli and Shah Deniz. 584.7 million tons of crude oil were extracted from ACG, while about 44.5 million tons condensate from Shah Deniz. Till 1 January 2024, more than 627.3 million tons were exported. During January - December 2023, oil refining in the country amounted to 6.5 million tons.

Baku-Tbilisi Ceyhan (BTC) pipeline which is major oil export route exports Azerbaijani crude oil to international markets. Since the 1,768 km BTC pipeline became operational in June 2006 till the end of September 2024, it carried a total of around 4.4 billion barrels (about 583 million tonnes) of crude oil loaded on 5,786 tankers and sent to world markets. In addition, other volumes of Caspian regional crude oil and condensate (Kazakhstan, Turkmenistan, other SOCAR volumes produced in Azerbaijan) continue to be transported via BTC.

However, Azerbaijan has lots of potential of green transition as it has large sources of solar, wind, hydropower, biofuel, and hybrid mode of energy. Thus, Azerbaijan continues to promote diversification of its economy away from hydrocarbons, and is looking to increase the green energy, agriculture, logistics, tourism, and information,

communication and technology (ICT) sectors. By doing so, Azerbaijan is taking steps toward more sustainable energy production.

Azerbaijan has significant wind and solar potential, and the Azerbaijani government is working to expand its renewable energy sector. By 2030, Azerbaijan plans to install 1500 MW in renewables capacity, in part to support future export of green electricity and green hydrogen to European markets. Organizing COP29 (UNCCC) in Baku on November 11-22 is also one of the commitments of Azerbaijan's planned transformation to the greener energy from the fossil fuel.

The exploitation of greener energy resources, a significant departure from its conventional fossil fuel production and consumption, underscores its potential as a catalyst to the greener energy advocate in the days come. By leveraging its hydro, wind and solar resources, expertise, and organizational capacity, Azerbaijan can evolve as one of the largest green energy producer and consumption country in the long run.

Moreover, involvement in fossil fuel production and consumption since long and abrupt disengagement from the traditional resources could bring some concerns and deviation hitting the economy. Therefore, a comprehensive examination of Azerbaijan's involvement in the exploitation of greener energy resources thereby pushing the economic growth in the same tempo with better understanding of its potential, limitations, and broader implications in not only socio-economic landscape of the country but also for the southern Caucasus region, is crucial.

However, Azerbaijan has, since long, played a significant role in the production and consumption of fossil fuel, thereby transforming its economy and becoming a upper-middle-income economy has helped safeguard its sovereignty and territorial integrity. As weak states cannot safeguard their sovereignty and territorial integrity, Azerbaijan's role in concentrating on fossil fuel is justified. But its high time, Azerbaijan to look for sustainable energy transformation and green energy transition from fossil fuel.

According to the World Bank, since economic prospects will largely rely on rising gas exports, the projected acceleration in growth in the medium term will be temporary. "The country needs reforms to boost private sector investment, reduce the state footprint, tackle issues of competitiveness, and develop human capital," it further details. Low economic diversification and need for more investment – domestic and foreign investment - on renewal energy through public and private sector is also a herculean task.

However, Azerbaijan has been involved in the development of its green energy resources including wind, solar, biomass and hydropower. Additionally, Azerbaijan is also involved in using the renewal energy in household consumption and mobility like transportation to lessen the fossil fuel usage.

But the fossil fuel's contributions to national economy also through export and its transition to green energy, will bring multifaceted challenges as transition is always a difficult and complicated process. Developing new policies and implementing them, and creating new institutions, building their capacity, and equip them with human capital to cope up with the transition is cumbersome. The economic transformation through the transformation of traditional resources of energy to the greener ones could have impact on economy and largely to the development process of a country.

Policy formation is one of the easiest parts but the implementation without hurting and offsetting the economy and larger mass is difficult. Without affecting various developmental and humanitarian activities, Azerbaijan has to become an integral part of the greener initiatives for sustainable economic growth. Considering the complicated matrix of the issue not only in industrial development, but also in daily lives of the people Azerbaijan also need to set a sectoral calendar for the transformation.

In this context, it is pertinent to examine the perspective roles of the public and private sector players, along with the export destination's plans and policies. Azerbaijan playing a major role in reviving the natural resources, can be a role model for the region. But at the same time, it could not only hit the national economy but also the regional economy too, thereby making it a weaker and vulnerable state.

From historically dependent on oil and gas exports, Azerbaijan has been trying to shift its focus on diversifying its energy portfolio and transitioning to more sustainable, greener energy resources. The country is working towards integrating renewable energy sources into the national grid, focusing on sustainability, energy security, and meeting international climate commitments. The government has prepared the Strategy and Policy Framework to go on. Recognizing the importance of renewable energy in ensuring long-term energy security and economic stability, the Azerbaijani government has taken several steps in recent years to promote green energy.

Azerbaijan has prepared Energy Strategy that includes a significant emphasis on renewable energy, focusing specially on solar and wind power, and targets substantial increases in renewable energy capacity by 2030. The government has developed policies to support country's objectives, including a law on renewable energy, mechanisms for

power purchase agreements, and incentives for investment in green energy. Azerbaijan has, as part of its climate goals, committed to reducing carbon emissions by 40% by 2050, and it is making efforts to incorporate renewable energy sources into its energy mix. The government aims to generate 30% of its electricity from renewables by 2030, signaling a clear shift toward sustainability.

According to Renewal Energy Agency, Azerbaijan, the potential renewal energy sources and installed capacity:

•**Solar Energy:** Azerbaijan has huge solar energy potential in its central and southern regions, where the climate offers favorable conditions for photovoltaic (PV) technology. The government has been promoting large-scale solar projects, with several initiatives underway to build solar plants. Garadagh solar power plant in Azerbaijan has already producing 230 MW of solar energy and signed agreements to develop a further 1GW of clean energy projects in the country. It is the largest solar power plants in the region. According to Azerbaijan Renewal Energy Agency by 2023, Azerbaijan has already 281 MW of installed capacity of the Solar power.

The currently operational solar power plants are as follows:
230 MW Garadagh Solar Power Plant
2.8 MW Gobustan Hybrid Power Plant
1.5 MW Surakhani Solar Power Plant
1.1 MW Pirallahi Solar Power Plant
1.9 MW Sahil Solar Power Plant
2.8 MW Samukh Solar Power Plant
22 MW Babek Solar Power Plant in Nakhchivan Autonomous Republic
5 MW Kangarli Solar Power Plant in Nakhchivan Autonomous Republic
5 MW Sharur (Zeyva) Solar Power Plant in Nakhchivan Autonomous Republic

The following solar power plant projects are currently being implemented:
240 MW Shafag Solar Power Plant project in Jabrayil region implemented by bp
445 MW Solar Power Plant project in Bilasuvar region implemented by Masdar
315 MW Solar Power Plant project in Banka settlement of Neftchala region implemented by Masdar

According to the U.S. Department of Energy, a typical residential solar system (around 6 kW) can save about 100,000 pounds (45,000 kg) of CO_2 over its 25-year lifespan. This translates to roughly 4,000 pounds (1,800 kg) of CO_2 saved per year.

Likewise, on a larger scale, the International Energy Agency (IEA) estimates that solar energy could avoid 4.7 gigatons of CO2 emissions annually by 2030, if deployed widely.

While, producing the Solar Energy the carbon footprint is significantly lower. Over its lifetime, solar panels generate electricity with a CO2 footprint of about 20 to 60 grams per kWh, depending on the manufacturing process and location. Thus, the development of solar energy is considered crucial for Azerbaijan's green transition, given its high number of sunny days per year. Solar energy not only decreases carbon footprint but also creates sustainable jobs.

•**Wind Energy:** The total technical potential of wind energy in the Azerbaijani part of the Caspian Sea is estimated at 157 GW (35 GW in shallow water basins and 122 GW in deep water basins). Azerbaijan's Caspian Sea coastline, particularly in the Absheron Peninsula, offers significant wind energy potential. Several wind farms are in planning or development stages, and there is increasing interest from international investors. Wind energy is seen as an important part of the mix for achieving Azerbaijan's renewable energy targets. According to Azerbaijan Renewal Energy Agency by 2023, Azerbaijan has already 66.4 MW installed capacity of wind power.

The currently operational wind power plants are as follows:
50 MW "Yeni Yashma" Wind Power Plant
8 MW Hokmali Wind Power Plant
3.6 MW "Yasma Baghlari" Wind Power Plant
2.7 MW Gobustan Hybrid Power Plant
1.7 MW Shurabad Wind Power Plant in Nakhchivan Autonomous Republic
0.11 MW Julfa Wind Power Plant in Nakhchivan Autonomous Republic

The following wind power plant projects are currently being implemented:
240 MW Khizi-Absheron Wind Power Plant project implemented by ACWA Power

One MWh of wind energy avoids some 75 tonnes, or 1,500 pounds, of CO2 emissions on average. A typical 2 MW wind turbine avoids around 4,000-4,500 tonnes of carbon emissions annually, equivalent to the annual carbon emissions of more than 700 cars.

•**Hydropower:** Azerbaijan already generates a portion of its energy from hydroelectric power, albeit through small hydel plants. However, there is potential for expanding hydroelectric capacity, though environmental and social considerations

surrounding large hydropower plants require careful attention. According to Azerbaijan Renewal Energy Agency by 2023, Azerbaijan already has 1158.5 MW of installed capacity of hydropower plants and 143.3 MW of installed capacity of small hydropower plants.

Apart from the Solar, Wind and Hydropower plants, Azerbaijan also has, by 2023, some 35.5 MW of installed capacity of bio energy plants. With its huge potential, the country is on its way to reduce carbon emission, though Azerbaijan's economy is completely dependent on fossil fuel.

Likewise, Azerbaijan is also exploring the potential for producing green hydrogen from renewable energy sources. Hydrogen can be an important clean energy carrier for transport and heavy industry, which are harder to electrify.

Azerbaijan has its Green Growth Strategy 2030, a strategic plan developed by the government to guide the country's green transition with more sustainable, environmentally-friendly economy without unbalancing the economic growth. The strategy aligns with Azerbaijan's broader national and international environmental goals and commitments, particularly its international climate pledges under the Paris Agreement and the 2030 Agenda for Sustainable Development.

To steer the country's sustainable development efforts over the next decade and beyond, the Green Growth Strategy was officially adopted to achieve Sustainable Economic Development through diversification of economy, and promotion of green business and innovation; Environmental Sustainability and Resource Efficiency through water and waste management and circular economy; Renewable Energy Development by generating at least 30% of its electricity from renewal energy sources by 2030 -- to increase the share of renewable energy sources in its national energy mix -- by attracting green energy investment; Climate Change Mitigation and Adaptation in key sectors such as transport, industry, and agriculture, and adaptation; Biodiversity Conservation and Land Management by Protection of Forests and Wildlife and Sustainable Land Use; Green Financing and Investment through Public-Private Partnership (PPP) and International Cooperation; Social Inclusion and Education by creating more jobs, education and awareness; and Institutional Strengthening and Governance through Policy Coordination, Monitoring and Reporting.

Azerbaijan has forged cooperation with foreign Renewal Energy Companies (RES companies). The country signed several important agreements with companies such as

Masdar, ADNOC, ACWA Power, TEPSCO, Bp, and China Gezhouba Group Overseas Investment aimed at developing renewable energy sources in Azerbaijan.

Before the COP29, Azerbaijan has also prepared green energy zones concept and green energy corridors. The Green energy zones is expected to act as centralized hubs, where sustainable energy generation is maximized by combining high-quality variable renewable energy resources, renewable energy infrastructure and storage. It is expected to Promote efficient use of natural resources, Stimulate investment and economic viability, Help sustainable economic growth and job creation, and Develop infrastructure and enhanced energy efficiency applications.

Likewise, Green energy corridors are expected to serve as a tool to enable energy transition and sustainable development. While there is no strict definition of green energy corridors, many existing and planned connectivity projects have been conceived of with the explicit goal of increasing the share of renewable energy power in the electricity network.

Azerbaijan has prepared these initiatives in partnership with UNIDO, UNECE and UNESCAP to smoothen the transition to green energy, apart from Apart from smart cities and villages.

Azerbaijan not only supports green transition in national level, it also supports green transition in the regional level too like Black Sea Submarine Cable. A 1,155-kilometer-long Black Sea submarine cable (BSSC) that will link the power grids of Azerbaijan, Georgia, and later Central Asia with Europe, creates a strong basis for the 'Green Energy Corridor' in the South Caucasus as well as supports the EU’s climate goals. Azerbaijan signed documents with Kazakhstan and Uzbekistan to connect power grids which supports export of green energy from Central Asia to Azerbaijan.

III. THE GENERAL OVERVIEW: STUDYING THE ENERGY DYNAMICS

Facets of Global Energy Transformation vis-a-vis Azerbaijan

According to International Renewal Agency (IRENA) by 2050, global energy consumption will need to drop by 6% from 2020 levels through substantial improvements in energy efficiency, while the share of renewables in the global energy mix will have to rise to 77% by 2050, up from 16% in 2020.

According to Global Energy Outlook (WEO) 2023 published by International Energy Agency (IEA), there are set to be almost 10 times as many electric cars on the road, with renewables nearing half of the global power mix, but much stronger policies needed for 1.5 °C. Though, the phenomenal rise of clean energy technologies like solar, wind, electric cars and heat pumps is reshaping how to power everything from factories and vehicles to home appliances and heating systems, it is up to the governments around the world to deliver on their national energy and climate pledges on time and in full to expedite the clean energy progress. Thus, even stronger measures would still be needed to keep alive the goal of limiting global warming to 1.5 °C.

The combination of growing momentum behind clean energy technologies and structural economic shifts around the world has major implications for fossil fuels, with peaks in global demand for coal, oil and natural gas all visible this decade – the first time this has happened in a WEO scenario based on today's policy settings, the report states. "In this scenario, the share of fossil fuels in global energy supply, which has been stuck for decades at around 80%, declines to 73% by 2030, with global energy-related carbon dioxide (CO2) emissions peaking by 2025."

"As things stand, demand for fossil fuels is set to remain far too high to keep within reach the Paris Agreement goal of limiting the rise in average global temperatures to 1.5 °C. This risks not only worsening climate impacts after a year of record-breaking heat, but also undermining the security of the energy system, which was built for a cooler world with less extreme weather events. Bending the emissions curve onto a path consistent with 1.5 °C remains possible but very difficult. The costs of inaction could be enormous: despite the impressive clean energy growth based on today's policy settings, global emissions would remain high enough to push up global average temperatures by around 2.4 °C this century, well above the key threshold set out in the Paris Agreement," according to the WEO 2023.

The WEO-2023 has also proposed a global strategy for getting the world on track by 2030 that consists of five key pillars, which can also provide the basis for a successful COP28 climate change conference. They are: tripling global renewable capacity; doubling the rate of energy efficiency improvements; slashing methane emissions from fossil fuel operations by 75%; innovative, large-scale financing mechanisms to triple clean energy investments in emerging and developing economies; and measures to ensure an orderly decline in the use of fossil fuels, including an end to new approvals of unabated coal-fired power plants.

To achieve the goal, every country including Azerbaijan needs to find its own pathway in international cooperation without failing to address better infrastructure needs for its people to excel in livelihood.

And at the time of Russia-Ukraine war that has led to supplies cut by the Russia to Europe, Azerbaijan on one hand has role to balance supply and price and on the other, needs to push for its growth in clean energy putting the country's fossil fuel demand and emissions into decline.

As the WEO states, renewables are set to contribute 80% of new power generation capacity to 2030 under current policy settings, with solar alone accounting for more than half of this expansion. However, this scenario takes into account only a fraction of solar's potential. By the end of the decade, the world is set to have manufacturing capacity for more than 1 200 gigawatts (GW) of solar panels per year, but it is projected to actually deploy only 500 GW in 2030. If the world were to reach deployment of 800 GW of new solar PV capacity by the end of the decade, it would lead to a further 20% reduction in coal-fired power generation in China in 2030 compared with a scenario based on today's policy settings. Electricity generation from coal and natural gas across Latin America, Africa, Southeast Asia and the Middle East would be a quarter lower.

Likewise, Azerbaijan in its strides towards green energy transition has many challenges to face as it is highly dependent on fossil fuels. Of the total $75 billion economy, some 41% that is around $30.75 billion is contributed by the oil sector, according to Center for Analysis of Economic Reforms and Communication (CAERC). This high dependency on oil and gas may complicate efforts to transition to green energy. The fossil fuel industry of Azerbaijan still generates significant revenue that is around 90% from exports, and employment, making the shift to renewables difficult without restructuring the energy sector. Apart from the regular expenses, Azerbaijan has a huge capital demand for reconstruction of its liberated territories from Armenian occupation,

which calls for more revenue generation pressure for the government. The country has pledged to spend AZN 29 billion (approximately 17.05 USD) on restoration of Karabakh until 2027.

With energy sector reform, Azerbaijan's existing power grid also needs to be upgraded as it is traditionally designed to accommodate large, centralized power plants (primarily fueled by oil and gas), while renewable sources are often decentralized and intermittent, according to the Renewal Energy Agency. The technological Innovation and digitalization including Smart Grids to optimize the integration of renewable energy sources into the power grid and also to improve energy efficiency, reduce costs, and enhance grid resilience; and Energy Storage systems, including batteries and pumped-storage hydropower, are critical for balancing supply and demand from intermittent renewable energy sources like wind and solar.

Similarly, large-scale renewable energy projects require significant investment, Azerbaijan has a challenge to create an attractive environment for foreign direct investment (FDI). Dependency on the government's fund is not a futuristic approach thus overcoming the challenge to make enough room for private sector and public-private partnership (PPP) is key. The domestic and foreign investment in the renewal energy sector, that can be attracted with tax breaks and other attractions, is key to achieve the goal set by the Azerbaijani government.

Raising public awareness of the importance of green energy, and building technical and institutional capacity in renewable energy technologies, is also a must for Azerbaijan in the green transition.

Expanding international cooperation including Europe and market integration is also key to Azerbaijan's green transition, thus, more engagement with regional actors, including neighboring countries such as Georgia, Turkiye, and Iran to develop regional renewable energy markets, which could facilitate cross-border electricity trade, particularly in solar and wind energy, where Azerbaijan can become a net exporter in the future, is also a must.

With recent organizing of COP29, Azerbaijan is also part of the global effort to combat climate change and has signed the Paris Agreement. Though, this aligns its energy policy with global sustainability objectives, more pressure is needed to expand renewable energy and reduce carbon emissions. COP29 in Baku will foster a green transition and renewable energy sources. The international event may also serve as a catalyst for capacity building and knowledge sharing necessary to tackle the dramatic

environmental challenges that Azerbaijan, like many other developing countries, are faced with.

IV. WAY FORWARD

Conclusion and recommendations

Azerbaijan has the capacity and willpower to undertake the transition sustainable energy transformation. With its clear strategy and policy frameworks to facilitate the transformation in the transition of greener energy resources, the involvement of Azerbaijan in exploiting greener resources for sustainable energy transformation is serious. However, the transition could hit the huge need for development of the liberated lands of Karabakh region, economic growth and above all national development as it might upset the macroeconomic stability, if the process got derailed and/or in unexpected external situations.

The implementation of strategy and pace of the transition is a key challenge. The opportunities are more than the challenges, as Azerbaijan could not be only the regional leader but also global leader in the transition of greener energy exploitation, if it succeeds in its strategy. But the government must be strict in implementation, with institutions in place with manpower, attract foreign as well as domestic private investments to expedite the transition process.

According to McKinsey & Company (informally McKinsey), an American multinational strategy and management consulting firm, while significant progress has been made in the nine years since the landmark Paris Agreement, the global energy transition is entering a new phase, marked by rising costs, complexity, and increased technology challenges. There is a global call for urgent action and accelerated pace of change for successfully navigating the next phase and meet the Paris Agreement goals. The green transition will also need to be balanced with affordability, energy system resiliency, and energy security in an increasingly uncertain macroeconomic environment.

The Global Energy Perspective 2024 claims that successfully navigating the transition away from fossil fuels will require focusing beyond a single solution or technology. "There are no silver bullets—the future calls for a holistic transformation of the global energy system by incorporating a range of proven and emerging levers," it states, adding that considerations beyond technological feasibility will need to be addressed, spanning capital deployment, improving business cases, ensuring economic

returns, adjusting regulation, and establishing continued political and public support in the face of competing economic and societal priorities.

The Global Energy Perspective 2024 also warns that global emissions to 2050 remaining above a 1.5º pathway—even if all countries deliver on current commitments. "Increased energy demand and the continued role of fossil fuels in the energy system mean emissions could continue rising through 2025–35," it claims, "Emissions have not yet peaked, and global CO2 emissions from combustion and industrial processes are projected to increase until around 2025 under all our bottom-up scenarios. The scenarios begin to diverge toward 2030, with all showing a decline in emissions by 2050. Despite this projected decline, 2050 emissions are still meaningfully above net-zero targets across all scenarios.

In all scenarios, rising emissions would lead to global temperature increases above 1.5°C by 2050, from around 1.8°C in the Sustainable Transformation scenario, through around 2.2°C in Continued Momentum, to around 2.6°C in Slow Evolution, it warns.

In this scenario, Azerbaijan also feels the heat, though the Green Growth Strategy 2030 reflects Azerbaijan's commitment in addressing environmental challenges, transitioning to a more sustainable economy, and reducing its carbon footprint. Gliding through the high emissions in 2025-2035 decade, as mentioned by the Global Energy Perspective 2024 could be a rollercoaster ride for every nation including Azerbaijan.

However, Azerbaijan aims to create a greener, more resilient economy that can thrive in the face of global environmental challenges by focusing on renewable energy, resource efficiency, climate change mitigation, and sustainable development. The strategy's success depends on effective policy implementation, the development of green technologies, and significant investment from both the public and private sectors.

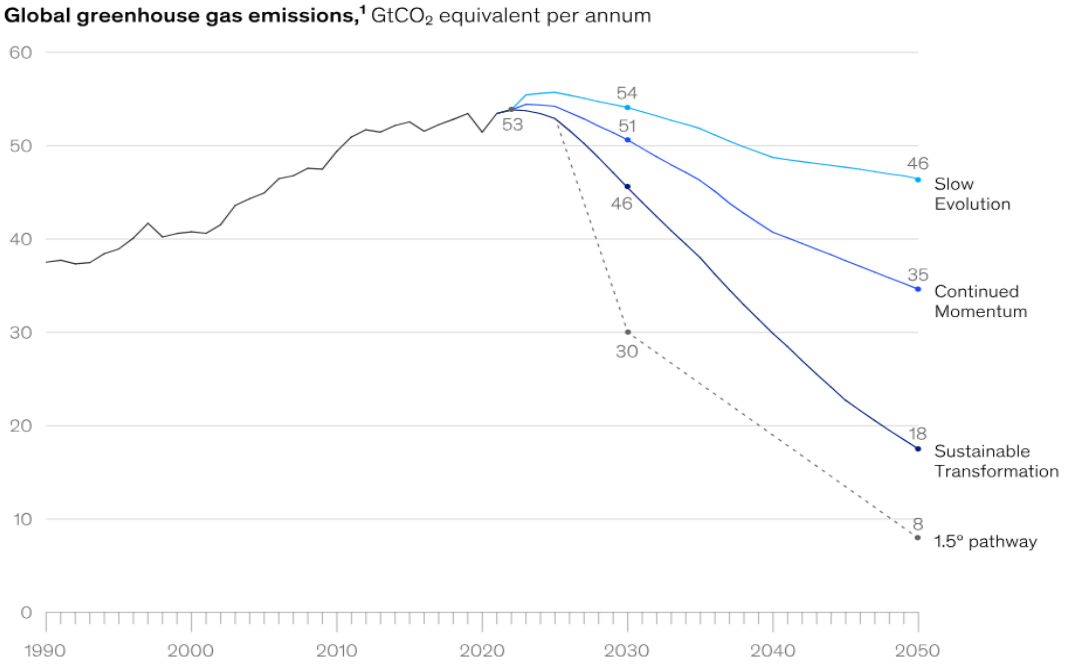
Though, Azerbaijan’s transition to sustainable energy is a complex but promising process, it calls for structural reform of not only energy sector but also the economy as a whole. Structural reengineering of the economy will help overcome challenges related to fossil fuel dependency without disturbing microeconomic stability, whereas energy sector reform will help grid modernization, and encourage innovation-friendly environment to green transition.

The country has abundant renewable energy resources, a growing policy framework supporting the green transition, and a strong interest in international

cooperation and investment. According to the Renewal Energy Agency, by 2027, it is planned to build and connect 8 industrial-scale solar and wind power plants with a capacity of around 2 GW to the grid, with foreign and local investment of approximately 2.8 billion US dollars.

Thus, a strict policy implementation and active private sector participation will help achieve Azerbaijan its goal in green transition. Thus, the government must be strict in policy implementation and be more private sector investment -- both local and foreign -- friendly in renewal energy sector. If successful, Azerbaijan's green energy transition could transform not only its energy sector but also contribute to climate goals, and position the country as a regional leader in sustainable energy.

Global emissions are projected to peak between 2025 and 2035 before beginning to decline.



Note: Warming estimate is an indication of global rise in temperature by 2100 versus pre-industrial levels, based on MAGICCv7.5.3 as used in IPCC AR6 given the respective energy and non-energy (eg, agriculture, deforestation) emission levels and assuming continuation of trends after 2050 but no net-negative emissions. The remaining emissions in 2050 (ie, ~4Gt) are compensated by negative emissions from direct air carbon capture and sequestration (DACCS), bioenergy with carbon capture and storage (BECCS), and reforestation.
[1]Includes process emissions from cement production, chemical production and refining, and negative emissions from applying carbon capture, utilization, and storage (CCUS).
Source: IEA Global Energy Review 2022; IEA World Energy Balances

McKinsey & Company

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