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AFTER THE WAR

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CHAPTER 04

CONCEPTUAL

Towards a Zero-Carbon Economy: Formal and Informal Efforts of Sudan – A Post-War Strategy

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ABSTRACT

Sudan's natural resources (fertile land, sun, wind, and water) offer strong potential for renewable energy and sustainable development. Transitioning to renewable energy can reduce fossil fuel dependence, create jobs, and alleviate poverty, particularly in rural areas. Since 2015, Sudan has implemented reforms aimed at economic stability, social protection, and environmental sustainability, focusing on a shift to a zero-carbon economy by reducing emissions, improving efficiency, and promoting clean energy.

PURPOSE: This study examines how Sudan can meet international emission reduction targets and transition to a zero-carbon economy, despite financial and technical challenges. It explores strategies for aligning with global agreements such as the Paris Agreement, integrating environmental concerns into economic planning, and fostering cultural change to support the transition.

METHODOLOGY: The research is based on qualitative secondary data, focusing on social and economic transformations. It highlights both formal and informal efforts to promote a zero-carbon economy and addresses barriers to full implementation.

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FINDINGS: Sudan has made significant efforts, both formal and informal, to transition to a zero-carbon economy. However, the lack of co-ordination and the absence of a unified platform to organise these efforts have weakened their impact, preventing the anticipated economic and social transformation from being achieved.

ORIGINALITY: This study contributes new insights into Sudan's unique challenges, including conflict, instability, and limited data, while highlighting the role of social and economic factors in achieving a zero-carbon economy.

LIMITATIONS: Data access, especially in rural areas with active projects such as the Mukhrebish Forest Regeneration and Acacia Gum Belt, and the political environment, limit data collection and policy implementation.

The study urges socio-economic reform and provides practical guidance for policy-makers and development partners to support Sudan's green transition by 2030.

KEYWORDS: *Zero-Carbon Economy; Renewable Energy; Sustainable Development; Socio-Economic Transformation.*

INTRODUCTION

As part of the 2015-2030 Sustainable Development Agenda, Sudan has launched strategic initiatives focusing on macro-economic reforms, enhanced social protection, and comprehensive environmental reforms, with a key emphasis on transitioning to a carbon-neutral economy. This shift targets reduced greenhouse gas emissions through renewable energy, resource efficiency, and innovation in clean energy technologies.

Addressing climate change requires deep structural changes towards a zero-carbon economy, including emission cuts in key sectors. In energy, this involves reducing fossil fuel use and investing in sustainable alternatives. Enhancing energy efficiency and lowering building emissions are also critical. In agriculture, climate-smart practices and improved carbon sequestration are vital. Higher education institutions play an essential role in supporting this transition through research and innovation.

This chapter reviews Sudan's emerging experience in moving towards a zero-carbon economy by examining the policy framework, economic and social indicators, influencing factors, and overall impacts. It also explores the challenges and opportunities facing Sudan in achieving a zero-carbon economy.

The study aims to investigate Sudan's path to a zero-carbon economy, focusing on key issues such as:

- Sudan's capacity to implement environmental programmes aligned with the Paris Agreement and the United Nations' Sustainable Development Goals (SDGs);
- integration of environmental concerns into macro-economic planning for sustainability;
- financial and investment challenges in supporting the transition;
- the role of education and private sector engagement in promoting environmental awareness.

SIGNIFICANCE OF THE STUDY

This study is important for several reasons:

First, Sudan is among the top ten developing countries most harmed by climate change, despite its minimal contribution to global emissions. This makes it more of a victim than a contributor, yet offers an opportunity to lead through its rich renewable resources such as solar, wind, and hydropower.

Second, Sudan has begun key investments towards a zero-carbon economy, including projects such as the Makharebish and Acacia Belt reforestation efforts, and the "NIM" gas project that utilises associated gas for power.

Third, the country is advancing energy efficiency and renewable technologies (including solar, wind, and exploring green hydrogen), efforts that need to be documented and integrated into a unified macro-economic framework.

Fourth, this study adds value to global discussions by positioning Sudan as a model for other Global South countries, highlighting strategies to overcome financial and structural barriers for a sustainable, equitable energy future.

LITERATURE REVIEW

Sudan has strong potential to shift to a zero-carbon economy by using its rich renewable energy resources. However, it faces key challenges such as financial limits, political instability, and weak institutions. To move forward, Sudan needs a broad strategy that blends environmental policy with macro-economic planning, drives societal change, and brings in global investment. Tackling these issues can help Sudan lead in renewable energy in the Global South and serve as a model for other developing countries seeking sustainable growth.

Sudan is among the countries most vulnerable to the effects of climate change, ranking among the top ten developing nations most negatively impacted by global warming. Research by the Intergovernmental Panel on Climate Change (IPCC, 2022) highlights the country's susceptibility to severe droughts, desertification, and erratic rainfall patterns, all of which threaten agriculture,

water resources, and public health. The agricultural sector, a cornerstone of Sudan's economy, has experienced declining productivity due to climate variability. These challenges are further exacerbated by political instability that undermines effective adaptation efforts (ElHassan and Alhassan, 2021).

Despite its vulnerability, Sudan has a relatively low carbon footprint, positioning it as an environmentally innocent nation in global climate discourse (Zakieldeen and Elhassan, 2015). This status provides Sudan with a unique opportunity to advocate for a renewable energy transition without the historical burden of high emissions. The country's vast renewable energy potential, especially in solar, wind, and hydropower, offers a viable pathway to mitigate environmental degradation and support sustainable development.

Several studies emphasise Sudan's substantial renewable energy potential. For instance, Elhassan and Hamid's (2020) report that Sudan receives 5-7 kWh/m^2/day of solar radiation, ranking it among the most suitable regions globally for solar energy generation.

The transition to a zero-carbon economy in Sudan presents both significant challenges and promising opportunities. While the current reliance on fossil fuels and inefficient energy infrastructure poses major obstacles, Ali and Mohamed (2019) argue that the development of green energy industries, particularly solar and wind power, can provide notable economic benefits, including job creation, economic diversification, and enhanced energy security. In addition, renewable energy can support key sectors such as agriculture by powering irrigation systems and processing facilities.

Hassan and Elhassan (2021) stress the importance of integrating renewable energy and environmental sustainability into Sudan's national development plans. They contend that achieving a green economy will require a strategic shift from short-term fossil fuel dependence to long-term investments in sustainable development. The successful adoption of renewable energy hinges on strong governmental leadership, international co-operation, and alignment with global climate agreements, such as the Paris Agreement.

A successful transition also depends on societal readiness and cultural acceptance of renewable energy. Research by Kiplagat *et al.* (2011) underscores the necessity of public education and awareness programmes to encourage sustainable practices, including energy conservation and the adoption of renewable technologies. One major challenge is the widespread reliance on traditional energy sources such as wood, charcoal, and imported fuels (Abdel-Azim, 2017). Overcoming these entrenched practices requires not only the promotion of modern energy solutions but also behavioural change, driven by school-based education, media campaigns, and community-level renewable energy projects; integrating environmental education into the formal curriculum is essential for equipping future generations with the knowledge and skills needed to lead the transition towards a green economy (Yousif, 2018).

International co-operation and investment are also critical to supporting Sudan's transition, given the country's financial and institutional limitations. Multiple studies emphasise the role of partnerships with international organisations, donor agencies, and the private sector in securing both funding and technical expertise for renewable energy initiatives. Alnour (2021) highlights successful collaborations, such as the World Bank's role in financing renewable energy projects and regional partnerships with entities such as the Arab Petroleum Investments Corporation (APICORP). In addition, international climate finance mechanisms, such as the Green Climate Fund (GCF), can provide essential support for renewable energy infrastructure in Sudan. As Kiplagat *et al.* (2011) argue, Sudan's participation in these global climate finance platforms not only boosts its renewable energy capacity but also enhances its standing as a responsible actor in international climate negotiations.

LIMITATIONS OF THE STUDY

This study has several limitations worth noting.

First, there is a lack of comprehensive, disaggregated data to support accurate analysis and strong policy recommendations for transitioning to a zero or low-carbon economy, likely due to the absence of prior studies.

Second, there is no macro-economic development and planning framework with clear goals for this transition.

Third, policy-makers and development practitioners have a limited understanding of the benefits of a carbon-neutral economy, which the study cannot fully address. Nonetheless, the study offers valuable insights and aims to encourage a deeper examination of climate change impacts on the Sudanese economy and the role of a zero-carbon transition in fostering resilience during post-war recovery.

CHAPTER STRUCTURE

This chapter begins with an overview of Sudan's zero-carbon potential, then analyses both formal and informal efforts towards transitioning to a zero-carbon economy. It concludes with our proposed strategy for a zero-carbon social and economic transition in Sudan.

Formal and Informal Efforts of Sudan towards Achieving a Zero-Carbon Economy

Sudan, despite facing severe economic, political, social, environmental, and institutional challenges, has actively engaged in the 2015 Paris Climate Agreement. In response, the government developed comprehensive strategies to reduce carbon emissions and promote sustainable development, demonstrating a strong commitment to mitigating climate change and achieving long-term ecological and economic sustainability.

Central to these strategies is the shift towards renewable energy, especially solar and wind power, to replace traditional, carbon-intensive sources. Forest conservation and natural resource protection are also key to carbon reduction due to the critical role forests play in carbon sequestration. Sudan has adopted energy efficiency measures, improved technology use, and promoted public environmental awareness to support both environmental and economic transformation.

Initiatives such as the Sudan Solar Energy Project and solar-powered irrigation systems aim to expand access to clean energy, especially in rural areas. According to the Poverty Reduction Strategy Chapter (PRSP), Sudan 2021-2023, wind energy is set to grow from zero in 2020 to 200MW by 2023 in regions such as the Red Sea, South Darfur, and Northern states. A Renewable Energy Act and policies will be formulated to attract private sector investment, particularly in decentralised electricity distribution.

The Dongola Wind Energy Project harnesses wind power in northern Sudan, contributing to energy diversification. Hydropower is another strategic pillar, with the Roseires and Merowe dams providing both energy and water management infrastructure. Additional wind stations are planned in the Red Sea and Suakin areas.

The Rural Solar Electrification Initiative promotes clean energy in agricultural communities, reducing diesel dependency. Sudanese universities are integrating climate change topics into curricula and promoting renewable energy research, supported by government scholarships and research grants.

Since 2014, Sudan has implemented a restoration initiative aligned with AFR100 and the Great Green Wall (GGW), restoring over 250,000 hectares and involving more than 10,000 community members. The project aims to scale up to 1 million hectares, enhancing food security, livelihoods, and ecosystem resilience.

Sudanese universities collaborate with global partners on climate research, organising events such as the 2022 conference at Sudan International University with the World Association for Sustainable Development (WASD).

Environmental efforts include protecting marine sites such as Sanganeb and Dungonab Bay, now UNESCO World Heritage Sites, and expanding forest conservation through afforestation, national parks, and empowering the High Council for Environment and Natural Resources.

Since 2013, non-governmental organisations (NGOs) have been crucial in building climate resilience. The Wadi Ko Watershed Management Project in North Darfur improves water management and agriculture through community-based approaches. The Ministry of Agriculture leads the transition to a zero-carbon economy with projects such as the Pan-Africa Great Green Wall and the Reducing Emissions from Deforestation and Forest Degradation (REDD+) programme. The UK-supported adaptation project builds local capacity, improves infrastructure, and strengthens

disaster preparedness. The Sawa Sudan Organization's REDD+ programme targets several regions to reduce emissions through forest conservation. Emphasising community participation, it creates sustainable livelihoods and job opportunities while contributing to national development goals by improving living standards and resilience.

Sudan and the Pan-African Great Green Wall Initiative

In 2011, Sudan ratified the legal framework to implement the Pan-African Great Green Wall (GGW) initiative, co-ordinated by the Ministry of Agriculture and Forestry in collaboration with the Ministry of Finance and Economic Planning. This continent-wide project spans the Sahel from Senegal to Ethiopia and Djibouti, involving countries such as Burkina Faso, Mali, Niger, Cameroon, Chad, and Sudan, aligning their national strategies with the regional goals.

The GGW aims to:

- restore 100,000 hectares of arable land;
- create 10 million green jobs;
- sequester 250 million tonnes of carbon dioxide;
- improve water resource mobilisation and build capacity at local, regional, and national levels;
- establish 3,000 integrated agricultural farms.

The GGW in Sudan covers about 22,800 square kilometres and stretches 1,520 kilometres across North Darfur, North Kordofan, Khartoum, Kassala, River Nile, and Northern State. This diverse region, rich in natural resources and water bodies, supports approximately 17.5 million people with various socio-economic activities and livelihoods. Baseline assessments highlight the GGW as a transformative project with strong potential to benefit both local communities and Sudan's macro-economic development. Agriculture in the region includes irrigated farming, semi-mechanised rain-fed agriculture, and traditional rain-fed agriculture. Key outputs are fruit (bananas, mangoes, oranges), cereals (sorghum, millet), and cash crops (oilseeds), together with vegetables, spices, legumes, and gum arabic (GA). The region also houses about 26% of Sudan's total livestock.

The GGW area faces significant challenges from climate change, such as food insecurity, disrupted livelihoods, and frequent losses from erratic floods. To improve livelihoods, promote economic development, and restore the ecosystem, reforestation and modern agricultural and livestock practices are essential. These interventions are central to the GGW project.

In light of these priorities, the Sudanese government has committed to scaling up investment in the GGW initiative over the next decade. The aim is to strengthen mechanisms for mobilising resources and to enhance Sudan's contribution to achieving the Sustainable Development Goals (SDGs). The overarching objectives include:

- sustainable management and development of natural resources;
- conservation and restoration of degraded land and biodiversity;

- mitigation of climate change risks through climate action and the expansion of green financing;
- formulation of resilient economic development policies.

Following the devastating impacts of the ongoing conflict in Sudan, which has disrupted nearly all aspects of life, the GGW initiative should be considered a high priority for recovery, reconstruction, and long-term sustainability. A project of this scale is essential to Sudan's economic revival and its transition towards a carbon-neutral future. Strengthening the GGW will be instrumental in achieving meaningful socio-economic transformation in the years to come.

The REDD+ Activities

This project is being implemented across three states: Blue Nile, Sennar, and Gedaref. It spans an area of 134,918 square kilometres, accounting for approximately 7.2% of Sudan's total land area and encompassing around 11% of the country's total forested land. Despite its significance, these forests have been severely affected by deforestation and land degradation driven by multiple factors. The primary causes include unsustainable biomass harvesting and extensive mechanised agriculture. Additional contributors to forest decline are wildfires, overgrazing, and the increasing demand for construction materials.

The project's core interventions, which align with Sudan's transition towards a low-carbon economy, focus on reducing emissions resulting from deforestation and enhancing forest carbon reserves.

REDD+ Strategies for Reducing Emissions from Deforestation and Promoting Sustainable Development

- **Reducing Emissions from Deforestation:** Achieving emission reductions requires enhancing agricultural productivity and diversifying income sources for rural communities, alongside institutional reforms and the promotion of research-based agricultural practices.
- **Adopting Sustainable Energy Strategies:** Expanding the use of renewable energy sources and improving energy efficiency in industrial and domestic production are essential for environmentally friendly energy practices.
- **Encouraging Private Sector Investment:** Promoting investment in the manufacturing of solar technologies, ethanol-based fuels, and biogas cooking systems will support the green transition and reduce reliance on traditional biomass.
- **Promoting Sustainable Firewood and Charcoal Production:** Developing and managing forest plantations for sustainable firewood and charcoal production will ensure long-term resource availability and reduce pressure on natural forests.
- **Responsible Fuelwood Consumption:** Promoting responsible production and consumption of fuelwood is critical to alleviating pressure on natural forests and maintaining ecological balance.

- **Improving Refugee Policies:** Addressing the environmental impact of displacement, particularly deforestation and land degradation, alongside meeting humanitarian needs, is crucial for sustainable management.
- **Enhancing Forest Carbon Stocks:** Restoring degraded ecosystems, including forests, rangelands, and agricultural lands, contributes to carbon capture and biodiversity preservation through ecosystem restoration, deforestation prevention, and land safeguarding.

- Mukhrebish Forest Rehabilitation Project: A Model for Ecological Restoration in Sudan

As part of Sudan's broader strategy to transition towards a green and zero-carbon economy, the Mukhrebish Forest Rehabilitation Project represents a critical environmental and socio-economic initiative. Implemented in the Kordofan and Darfur regions, this project is a collaborative effort between the Sudanese government, local communities, and international partners. Its primary objectives include combatting desertification, enhancing carbon sequestration, and restoring ecological balance by replanting native tree species such as acacia, Hashab, and Talh. In addition to its environmental benefits, the project promotes rural development by creating green jobs and supporting sustainable livelihoods through the cultivation of seedlings, and harvesting of non-timber products such as gum Arabic and honey. It also incorporates community awareness and capacity-building programmes focused on sustainable forest management. However, the project faces key challenges including limited and inconsistent funding, security concerns in conflict-prone areas, and the accelerating impacts of climate change. Despite these obstacles, the Mukhrebish initiative stands out as a scalable model for climate resilience and ecological restoration in arid regions of Sudan, aligning environmental regeneration with socio-economic development goals.

- Sudan's Bioenergy Strategy: The Case of Jatropha-Based Green Oil Production

Sudan has embarked on an ambitious strategy to establish itself as a leader in bioenergy production through the large-scale cultivation of the Jatropha plant, under the national initiative titled *Planting Petroleum* in Sudan. This programme involves the planting of approximately one billion Jatropha trees over one million feddans (1.038 acres) of arid and marginal agricultural land, previously considered unsuitable for food production. The core objective is to produce Green Oil, a biodiesel derived from the Jatropha fruit; this can yield up to 100 litres of biofuel per tonne of fruit, making it a highly efficient and viable alternative to traditional fossil fuels.

The Sudanese government's approach aligns with principles of sustainable development, particularly in its utilisation of non-arable lands and alternative water sources such as treated wastewater and desalinated seawater. This not only optimises under-utilised resources but also avoids competition with food crops. From an environmental perspective, Green Oil is characterised

by its low carbon footprint, as it does not emit carbon dioxide, one of the major contributors to climate change. Furthermore, it extends the lifespan of machinery due to its clean-burning properties.

In terms of economic viability, the cost of producing Green Oil is significantly lower than that of conventional or shale oil extraction, or refinery operations. The low input costs, combined with the plant's adaptability to harsh climates, position Jatropha cultivation as both cost-effective and environmentally sustainable. Strategically, Sudan aims to achieve energy self-sufficiency and position itself as an exporter to European markets, which are increasingly demanding eco-friendly fuel alternatives.

In conclusion, the Sudanese biofuel initiative presents a replicable model for countries facing similar climatic and economic constraints. It demonstrates how bioenergy innovation can contribute to national energy strategies and global climate goals when aligned with environmental stewardship and resource optimisation.

- Ethanol Plants in Sudan

Kenana Sugar Company's initiative to establish ethanol plants represents a strategic move to address both environmental and economic challenges. By converting molasses, an otherwise harmful by-product, into ethanol, the company not only mitigates environmental impact but also generates valuable economic returns. The first plant's ability to operate at full capacity, despite a shortfall in molasses supply, highlights the company's innovative approach in introducing "bamby", a fast-growing crop that offers a viable alternative for ethanol production. This crop's versatility in being processed into various products further enhances its economic value.

The expansion of Kenana's ethanol production through the second plant, in partnership with Inter-Union, underscores the scalability of this model. Ethanol's potential for export, blending with gasoline, and medical uses makes it a highly beneficial product for Sudan's national economy. Additionally, the relatively low cost of setting up an ethanol plant, US$30 million compared to a sugar plant's US$1 billion, makes the ethanol project a cost-effective and profitable investment. Once completed, the planned third plant will raise the company's total annual ethanol production to 180 million litres, substantially contributing to Sudan's economic growth by generating foreign currency, reducing fuel imports, and fostering sustainable agricultural practices.

This model demonstrates how leveraging local resources and innovation can drive sustainable economic development while addressing environmental concerns, providing a framework for other industries facing similar challenges.

- War has Destroyed all Efforts towards Zero-Carbon Economy: Sudan after 2023 War

The ongoing armed conflict in Sudan has had devastating effects on the country's environmental resources and scientific infrastructure. Industrial zones in Khartoum, including Bahri, Omdurman, Giad, and Al-Bagir, have sustained significant destruction, particularly in areas containing strategic facilities located near residential neighbourhoods. Fires and the destruction of chemical stocks and raw materials have led to hazardous leaks into soil and water sources, resulting in cases of poisoning among civilians, some of which have been fatal. The environmental consequences of destroyed military factories remain difficult to assess but are expected to be long-lasting.

Critical wetland environments, particularly sewage treatment centres in Bahri and Soba, are under severe threat due to fire damage and drought stemming from ongoing water shortages. These wetlands serve as essential habitats for various species, including two bird species that are now at risk of extinction or forced migration, thereby threatening biodiversity and ecological stability.

Forest ecosystems, such as the Sunut (Acacia) Forest and the Elephant Forest, have experienced extensive degradation due to widespread fires and unsustainable deforestation, exacerbated by the absence of alternative energy sources. The unchecked cross-border charcoal trade, particularly in western Sudan, has accelerated the loss of vegetation cover. This degradation has disrupted local ecosystems, leading to unusual ecological phenomena such as the increased presence of snakes in residential zones.

Sudan's scientific and cultural heritage has also suffered significant setbacks. The Sudan Natural History Museum was nearly destroyed (approximately 90% damage), primarily due to its proximity to key military sites. The museum contained thousands of rare environmental specimens dating back to the 19th century, collected from various regions of Sudan and South Sudan. According to the museum's director, Dr Sara Abdullah Khidr, the loss includes not only physical specimens but also critical digital data and research outputs. The destruction also impacted the University of Khartoum's Center for Venomous Creatures Research, which had been hosted within the museum. These losses represent a profound disruption to national biodiversity research and the preservation of environmental knowledge.

Overall, the conflict has imposed irreversible damage on Sudan's natural heritage, scientific assets, and ecological balance, raising urgent concerns about long-term environmental recovery and sustainable development.

CONCLUSIONS

Sudan's transition towards a zero-carbon economy is impeded by a series of intricate challenges that are deeply embedded in the structural characteristics of its economy. These challenges encompass the fragility of legislative institutions and patterns of unsustainable consumer behaviour. Furthermore,

the country's inadequate physical infrastructure represents a substantial obstacle to the successful implementation of sustainable environmental policies. These issues are intrinsically linked to the broader social and economic context, and overcoming them requires the formulation and execution of comprehensive strategies that focus on fortifying both environmental and economic institutions. Additionally, there is a pressing need to raise public awareness regarding sustainable consumption practices to foster long-term behavioural change.

Sudan shows clear signs of vulnerability to climate change. According to the Global Adaptation Initiative Matrix (GAIN-ND) by the University of Notre Dame, it ranks 8th in terms of climate vulnerability out of 185 countries and 175th in terms of readiness, positioning it in the upper-left quadrant of the matrix. This indicates significant challenges and an urgent need for action. Indeed, Sudan scores high on the vulnerability index and low on readiness.

Sudan is also facing a problem with solid waste, especially municipal solid waste: solid waste management practices throughout Sudan are uniformly poor. In 2016 Khartoum generated about 6,600 tonnes of waste per day, although the city only can collect 4,200 tonnes per day. Waste management in Sudan is limited to organised collection from the more affluent urban areas and dumping in open landfills or open ground. Most of the industrial facilities dispose of their waste without any treatment. In many places, garbage of all types accumulates until it is burnt in residential areas. Sudan has a large volume of obsolete pesticides that creates environmental hazards due to storage and dumping. Khartoum also has the challenge of dealing with toxic materials. Management of medical waste in Sudan is inefficient as a result of infrastructure for treatment and lack of awareness. Its disposal is very limited and much ends up in landfill sites.

In Sudan, smallholder farmers lose up to a third of the food they produce because of inadequate storage systems. Post-harvest losses reduce incomes for farmers, exacerbate food insecurity, and have negative impacts on the environment. Land, water, farm inputs and energy are all used to produce food that is not consumed.

Additionally, it is essential to align the economic recovery efforts with the broader goal of transitioning towards a zero or low-carbon economy. In parallel, significant attention should be given to the development of a comprehensive national statistical plan; this would enhance the quality and scope of statistical work at the national level, providing a solid foundation for informed decision-making and policy formulation.

Scientific research on climate change and the zero-carbon economy in Sudan is currently hindered by the lack of accurate and reliable data, with most studies relying heavily on estimates. To enhance the quality and credibility of climate-related research, there is an urgent need for technical support to establish specialised laboratories equipped to monitor and measure key environmental indicators and hazards. It is also essential to foster partnerships and formal agreements with renowned research institutions, ensuring that their work is directly aligned with the study of climate change impacts.

- The Proposed Strategy for Sudan's Transition to a Zero-Carbon Economy

Through the development of this conceptual paper, we conclude by recommending a proposed strategy aimed at supporting Sudan's sustainable economic recovery and facilitating its transition to a zero-carbon economy. This proposed strategy involves several key components:

- **Unified National Platform:** A co-ordinated platform to align Sudan's strategies with the Paris Agreement, set emission targets, and secure sustainable financing.
- **Legislative Reforms:** Enacting policies to attract green investments and promote sustainable economic development.
- **Grid Modernisation:** Upgrading the electricity grid to integrate renewable energy and ensure equitable access, supported by public-private partnerships in renewable projects.
- **National Climate Finance Facility:** Establishing a facility to mobilise climate funds, carbon credits, and green bonds, with incentives for small and medium-sized enterprises (SMEs) and youth-driven green initiatives.
- **Inclusive Planning:** Ensuring the participation of women, youth, and marginalised groups in community-driven projects focused on climate resilience and local energy solutions.

- Steps Forward

This study emphasises the urgent need for Sudan to develop a comprehensive and adaptable macro-economic framework that supports long-term recovery and sustainable development. As the country focuses on rebuilding, it is crucial to prioritise a transition towards a zero-carbon economy, ensuring that environmental sustainability is central to Sudan's economic recovery strategy. This will require a multi-dimensional approach, integrating decarbonisation policies across key sectors while promoting economic growth, job creation, and environmental preservation. The establishment of such a framework will not only facilitate Sudan's recovery but also position the country as a key player in the global transition to sustainable development.

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