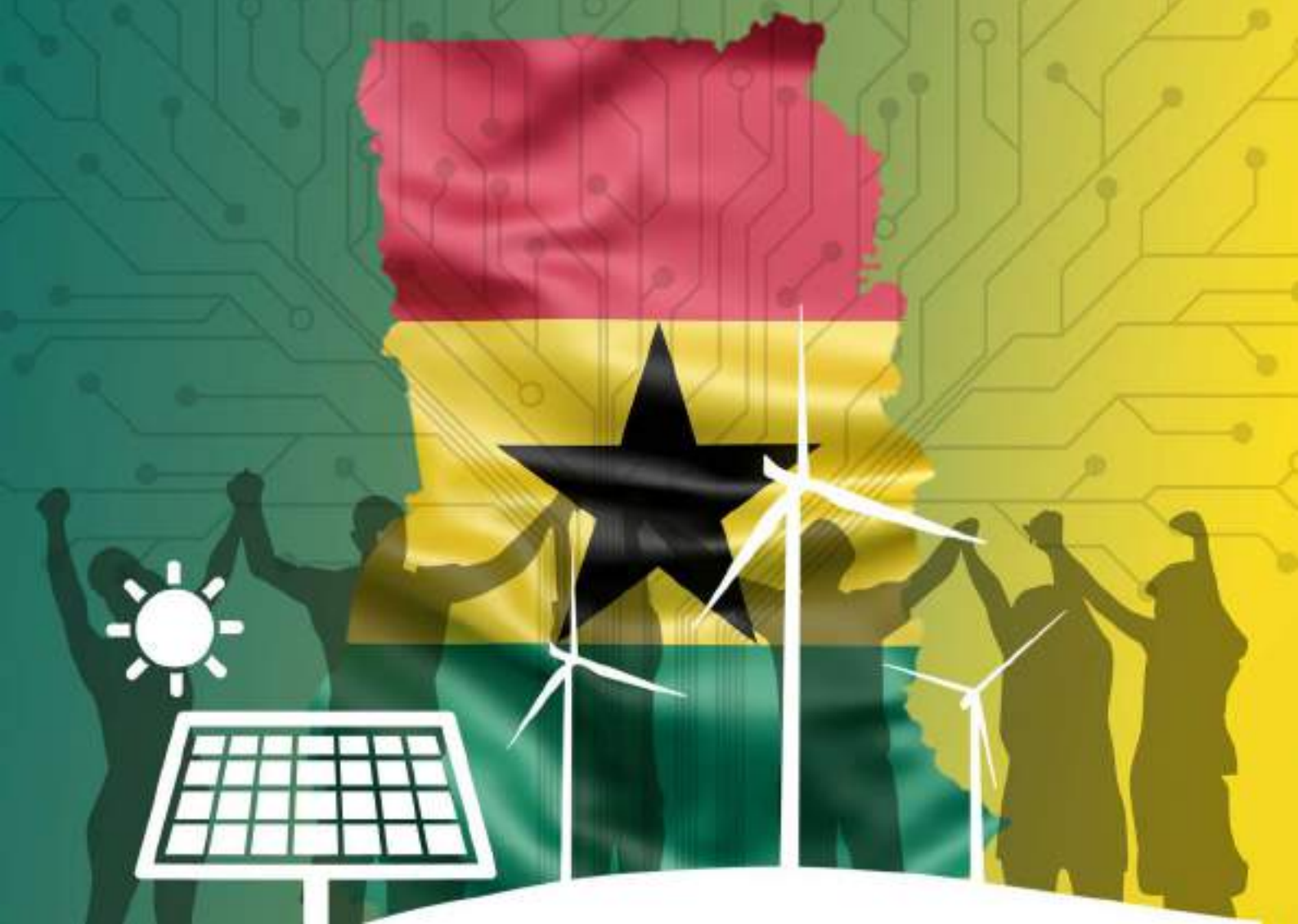
STRATEGIC YOUTH NETWORK FOR DEVELOPMENT

YOUTH-NREG

YOUTH ENGAGEMENT

IN GHANA'S ENERGY TRANSITION AGENDA



ANALYTICAL REVIEW
YOUTH ENGAGEMENT IN GHANA'S ENERGY TRANSITION AGENDA

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FOR
Strategic Youth Network for Development (SYND)

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LIST OF ACRONYMS AND ABBREVIATIONS

AMI	ADVANCED METERING INFRASTRUCTURE
ASM	Artisanal and Small Scale Mining
AU	African Union
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
BAU	Business As Usual
BCA	Building and Construction Authority
BECCS	Bioenergy with Carbon Capture and Storage
BOST	Bulk Oil Storage and Transportation Company
BRT	Bus Rapid Transit
CAT	Climate Action Tracker
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CEDA	Centre for Extractives and Development Africa
CNG	Compressed Natural Gas
CSO	Civil Society Organization
DRC	Democratic Republic of Congo
DRI	Direct Reduced Iron
DVLA	Driver and Vehicle Licensing Authority
ECG	Electricity Company of Ghana
ECOWAS	Economic Community of West African States
EIAs	Environmental Impact Assessments
EPA	Environmental Protection Agency
ETF	Energy Transition Framework
ETIP	Energy Transition and Investment Plan
ETM	Energy Transition Model
ETP	Energy Transition Plan

EU	European Union
EV	Electric Vehicle
GCF	Green Climate Fund
GGSA	Ghana Geological Survey Authority
GHEITI	Ghana Extractive Industry Transparency Initiative
GHG	Greenhouse Gas
GIADEC	Ghana Integrated Aluminium Development Corporation
GIISDEC	Ghana Integrated Iron and Steel Development Corporation
GIPC	Ghana Investment and Promotion Centre
GNPC	Ghana National Petroleum Corporation
ICE	Internal Combustion Engine
IEA	International Energy Agency
IMF	International Monetary Fund
IPPU	Industrial Processes and Product Use
IPSMP	Integrated Power Sector Master Plan
IRENA	International Renewable Energy Agency
JETP	Just Energy Transition Partnership
LDAR	Leak Detection and Repair
LRT	Light Rail Transit
LULUCF	Land Use, Land-use Change and Forestry
Li2O	Lithium Oxide
MDBs	Multilateral development banks
MEE	Ministry of Environment and Ecology
MESTI	Ministry of Environment Science Technology and Innovation
MOFA	Ministry of Food and Agriculture
MW	Megawatts
NDC(s)	Nationally Determined Contributions
NEDCo	Northern Electricity Distribution Company
NRSA	National Road Safety Authority
PCFV	Partnership for Clean Fuels and Vehicles
PLI	Production Linked Indicators
PPPs	Public-Private Partnerships
PV	Photovoltaics
R&D	Research and Development
RSDG(s)	Sustainable Development Goals
SGN	Sankofa Gye Nyame
SNEP	Strategic National Energy Plan
STEM	Science Technology Engineering and Mathematics

TOR	Tema Oil Refinery
UN	United Nations
UNEP	United Nations Environment Programme
US	United States
USD	United States Dollar
VRA	Volta River Authority
VRUs	Vapour Recovery Units
WAGP	West African Gas Pipeline

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EXECUTIVE SUMMARY

Energy systems worldwide have undergone significant evolution, driven by **socio-economic factors and technological advancements**.

While fossil fuels have powered industrialization and economic growth, they have also escalated greenhouse gas (GHG) emissions, exacerbating climate change. To address this, nations, including Ghana, are shifting towards environmentally responsible energy sources. This global transition from fossil fuels to renewable energy is motivated by the imperative to reduce GHG emissions and bolster energy security. Countries are setting ambitious targets, aligned with international agreements such as the Paris Agreement and the Sustainable Development Goals (SDGs). Investments in renewable energy technologies are increasing as these technologies become more cost-effective. Ghana's National Energy Transition Framework aims to achieve a low-carbon, climate-resilient energy sector by 2070.

Ghana's Energy Transition and Investment Plan (ETIP) outlines an ambitious pathway to achieve net-zero CO2 emissions by 2060. The plan projects a need for approximately USD 550 billion in cumulative capital investment by 2060, with power and transport sectors accounting for about 90% of this investment. This represents an additional USD 140 billion over business-as-usual scenarios. The transition is expected to avoid about 2 GtCO2 of emissions compared to BAU over the next 40 years, with emissions peaking around mid-2030s before rapidly declining. Key strategies include massive expansion of renewable energy, full electrification of passenger vehicles, and innovative decarbonization technologies in industry. The plan anticipates significant economic benefits, potentially supporting an additional 400,000 jobs by 2060, primarily in renewable energy construction and clean transportation infrastructure. Success will hinge on policy consistency, rapid technology adoption, innovative financing mechanisms, workforce development, and international cooperation.

Below are the study's key findings

Ghana's Energy Transition and Investment Plan Sets Ambitious Targets, but Implementation Challenges Exist

Ghana's National Energy and Investment Plan aims for net-zero emissions by 2060, but faces challenges including technological readiness, financial constraints, and institutional frameworks. Early-stage clean energy technologies, like carbon capture and hydrogen fuel cells, require cost-effectiveness evaluation. Securing funding and enhancing institutional capacity and stakeholder coordination are crucial for success.

Significant Investment Required, with the Power and Transport Sectors Dominating

The Ghana Energy Transition and Investment Plan requires USD 561.8 billion by 2070, with 90% needed for the power and transport

and transport sectors. The transport sector will require about 70% of the total due to rising private vehicle ownership, while the power sector, including renewables and hydrogen, will need 20%. Funding will need to come from public and private sources, as well as international climate finance.

Renewable Energy and Energy Efficiency are Key Drivers of Decarbonization

Ghana's energy transition plan targets a renewable energy capacity of 1,363.63 MW by 2030, focusing on solar, wind, and hydropower. The plan also emphasizes energy efficiency measures, including standards, energy-efficient appliances, and behavioral changes, to optimize resource use and reduce consumption, aiding decarbonization goals.

Transport Sector Electrification and Clean Fuels Offer Significant Emission Reduction Potential

Ghana's energy transition framework focuses on the transport sector, promoting electric vehicles, charging infrastructure, and cleaner fuels like CNG and biofuels. Transport electrification is expected to contribute 40% of emission reductions by 2060, with a goal for all road and rail mobility to be powered by electricity and hydrogen by 2070, significantly reducing greenhouse gas emissions and improving urban air quality.

Critical Minerals Present Economic Opportunities, but Sustainable Exploitation is Crucial

Ghana's recent lithium and graphite discoveries present opportunities for economic diversification and clean energy industry development. The energy transition framework advocates value addition and positioning Ghana as a hub for electric vehicle and battery technology production. Sustainable development of these resources, with transparent licensing, robust safeguards, and local value addition, is essential to maximize economic benefits and minimize environmental and social impacts.

Socioeconomic Impacts and Stakeholder Engagement are Essential for a Just Transition

The energy transition could create 400,000 jobs by 2060, alleviate poverty, and improve energy access. However, equitable distribution of benefits is crucial to avoid leaving vulnerable communities and workers in carbon-intensive sectors behind. Stakeholder engagement, impact assessments, targeted support programs, and investments in education and skills development are essential for a just and inclusive transition.

Institutional Capacity Building and Access to International Climate Finance are Key Challenges

To successfully implement Ghana's energy transition plan, strong institutional readiness and capacity building are essential. Key challenges include technical, capacity, and infrastructural issues in power, transport, oil and gas, environmental oversight, and infrastructure development. Strengthening institutions, providing training, and creating dedicated coordination units are crucial. Additionally, improving the ability to prepare high-quality proposals is vital for accessing international climate finance. Enhancing institutional capacity and streamlining processes are critical for securing necessary financial support.

The study makes the following recommendations:

Recommendations to Optimise Ghana's Energy Transition Plans:

Prioritize Realistic and Achievable Targets: Ghana must reassess its energy transition plan, prioritizing realistic short- and medium-term goals that align with economic constraints. While aiming for net-zero emissions by 2060 remains vital, the government should phase large-scale renewable projects like solar and wind farms based on financial capacity and investment climate. Emphasizing the rehabilitation and upgrade of existing power infrastructure will improve efficiency and reliability, proving more cost-effective than new infrastructure projects.

Focus on Low-Hanging Fruits and Cost-Effective Measures: To achieve an optimized energy transition, prioritize energy efficiency initiatives like promoting energy-efficient appliances, implementing building energy codes, and optimizing industrial processes. These measures offer significant energy savings with short payback periods and minimal investment. Additionally, accelerate the deployment of small-scale, distributed renewable energy solutions, such as solar home systems, mini-grids, and solar water pumps in off-grid and underserved areas, to provide immediate community benefits

Ensure Efficient Exploitation of Critical Minerals: Ghana's recent critical mineral discoveries present an opportunity to support the energy transition and economic growth; the government should conduct geological assessments, establish a transparent licensing process, implement environmental and social safeguards, and prioritize value addition and local processing capabilities to position the country as a key player in the global clean energy supply chain.

Engage Stakeholders and Address Social Impacts: To ensure a just and inclusive energy transition, the government should engage directly affected stakeholders through meaningful consultation and participation. This includes conducting impact assessments to identify risks, developing support programs for workers in carbon-intensive sectors, and promoting alternative livelihoods. Prioritizing investments in education, skills development, and social protection will mitigate adverse impacts on vulnerable populations, build public support, and ensure a more equitable and sustainable transition in Ghana.

Enhance Institutional Capacity for Accessing International Climate Funds: Ghana lacks the institutional capacity to effectively access international climate funds for its energy transition. To overcome this, the government should invest in training and resources to enhance the technical expertise of relevant staff and establish dedicated units to coordinate fund access. Strengthening institutional capacity will improve Ghana's ability to secure financial support for its energy transition initiatives.

Strengthen the Legal and Regulatory Framework: Ghana should review and update its legal and regulatory framework to support the energy transition. This includes introducing renewable energy policies, energy efficiency standards, and clean technology incentives. Additionally, clear guidelines for sustainable mineral resource development

are needed. Strengthening these frameworks will attract investment, encourage private sector participation, and aid in implementing energy transition initiatives.

Develop a Comprehensive Technology Advancement Plan: Ghana should create a comprehensive technology advancement plan to support the energy transition and drive innovation. This plan should focus on promoting R&D in renewable energy, energy storage, electric vehicles, and clean cooking solutions. Key strategies include establishing research centers, fostering academia-industry collaborations, and providing incentives for private sector R&D. Additionally, the plan should emphasize technology transfer, capacity building, and localization of clean energy technologies to boost technological capabilities and create economic opportunities.

Foster Regional Cooperation and Knowledge Sharing: Ghana should engage in regional cooperation and knowledge-sharing to accelerate its energy transition. By collaborating with neighboring countries and organizations, Ghana can benefit from joint projects, technology transfer, and capacity building. Regional integration of energy systems, such as cross-border electricity trade and renewable energy corridors, is essential. Participation in regional and international platforms will allow Ghana to share best practices and innovative solutions. Leveraging these partnerships will provide collective expertise, resources, and economies of scale, advancing Ghana's energy transition agenda.

Establish a Dedicated Energy Transition Fund: Ghana should establish an Energy Transition Fund to finance energy transition initiatives. This fund would mobilize resources from domestic budgets, international climate finance, and private sector contributions. It should feature clear governance, transparent allocation criteria, and strong monitoring and evaluation to ensure effective resource use. This fund will offer stable, predictable financing for Ghana's energy transition efforts.

Recommendations to Increase Youth Participation in Ghana's Energy Transition Implementation

Establish a Comprehensive Clean Energy Skills Development Program

92% of the survey's respondents identified technical skills as most valuable for clean energy careers highlighting the need for a comprehensive skills development program that benefits existing and upcoming professionals. The program can be implemented by partnering with educational institutions to develop specialized curricula, creating industry-aligned vocational training programs, and offering online courses in renewable energy technologies and energy efficiency. Hands-on training modules, internship programs, and innovation-type competitions can also be implemented with clean energy companies to provide practical experience and engender interest.

Launch a Youth Clean Energy Entrepreneurship Fund

With 93% of respondents expressing high interest in youth-led renewable energy startups, and 86% citing lack of funding as a major barrier, there is a need for a dedicated Youth Clean Energy Entrepreneurship Fund to precipitate an influx of

financing to the burgeoning sector through youth-led initiatives. This includes establishing a grant program for innovative clean energy ideas, creating a low-interest loan scheme for youth-led startups, and setting up a mentorship network connecting young entrepreneurs with industry veterans. Collaboration opportunities can be explored with international development partners and private sector entities to expand the fund's capacity.

Develop a Digital Platform for Energy Transition Awareness and Engagement

To boost awareness of Ghana's Energy Transition Plans and the impact on youth and communities this study highlights the need for a comprehensive and strategic information campaign tailored specifically to Ghana's youth demographic. For example, a user-friendly digital platform for information dissemination and engagement that features interactive learning modules about the energy transition, a job board for clean energy opportunities, and a forum for youth to share ideas and collaborate on projects. Also important, social media campaigns and gamification elements can be integrated to increase engagement. The recommendation is to leverage digital tools popular among Ghanaian youth to build a community of young energy transition advocates.

Implement a "Youth Energy Transition Leaders" Program

Recognizing that 71.43% of respondents rated their interest in participating in youth-led initiatives at the highest level, we recommend the establishment of a "Youth Energy Transition Leaders" program. This includes selecting and training youth representatives from each region to act as energy transition ambassadors, organizing youth-led community workshops and awareness campaigns, and involving these leaders in national energy policy discussions. This program can empower youth to drive grassroots change and ensure their voices are heard in national energy planning.

Create Industry-Academia Partnerships for Applied Research and Innovation

A popular misconception is that Ghana lacks sufficient educated capacity or technical knowledge to develop renewable energy solutions. To highlight that the nation does not need "renewable energy engineers" but rather all engineers and educational backgrounds to apply their skills towards providing services applicable in the space, partnerships must be forged between universities, research institutions, and clean energy companies to drive innovation. This includes establishing joint research programs focusing on localized clean energy solutions, creating innovation hubs or living labs on university campuses, and offering research grants for projects that promote interdisciplinary collaboration, bringing together expertise from fields such as engineering, economics, environmental science, and social sciences to address the multifaceted challenges of energy transition. By bridging academia and industry, Ghana can cultivate a culture of innovation and position its youth at the forefront of clean energy technological advancements.

1 INTRO DUCTION

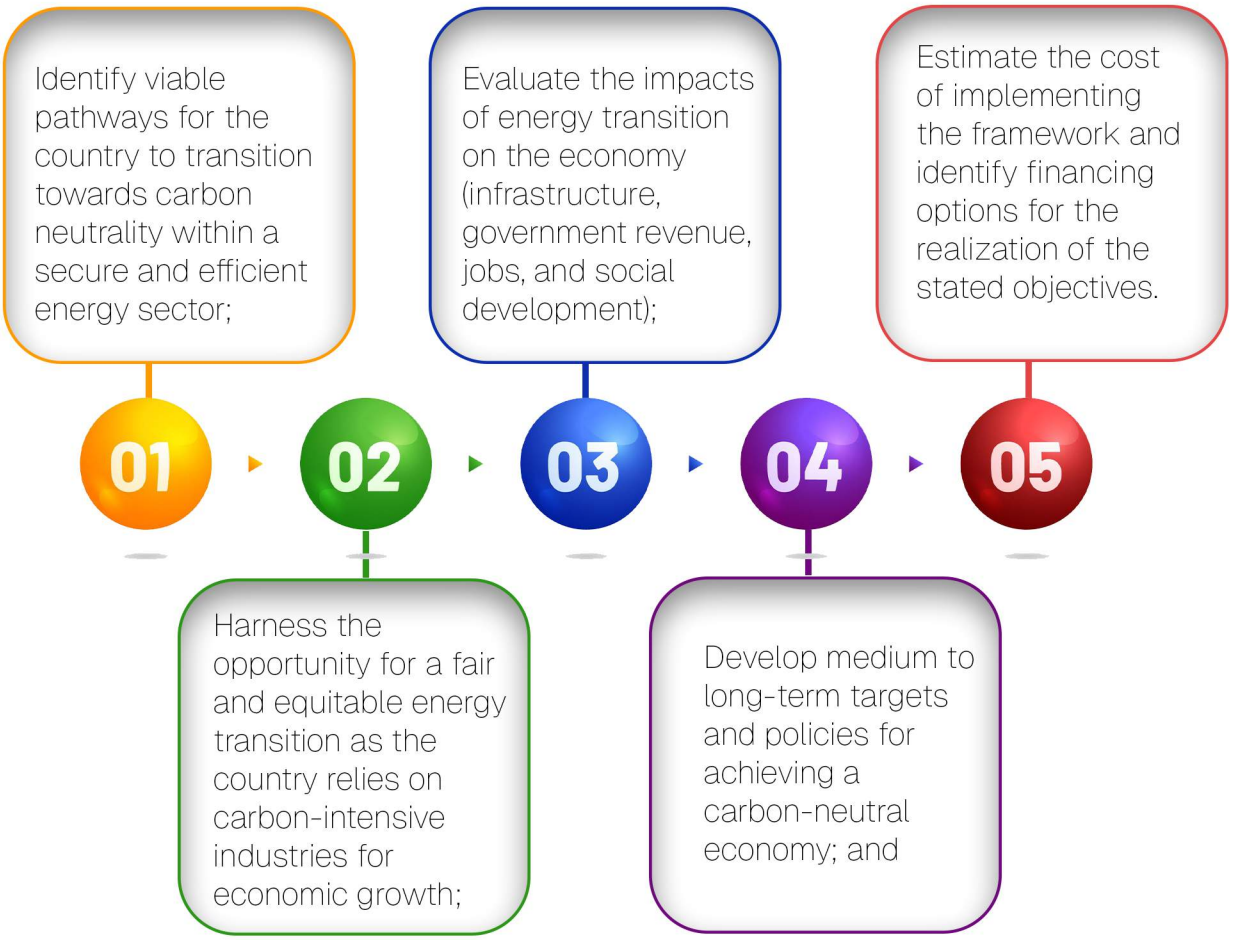
Globally, energy systems, influenced by **socio-economic factors and technological advancement,** have constantly evolved.

Coal oil and gas (fossil fuels) have powered industrialization and accelerated rapid socio-economic growth and development of countries since the 17th century. However, the combustion of these fossil fuels to generate the vital energy needed to power global economies has increased greenhouse gases (GHGs), resulting in extreme weather conditions such as rising sea levels, drought, desertification, higher temperatures, and erratic rainfall. **For instance, average surface temperatures have increased by 2 degrees Fahrenheit (1 degree Celsius) due to an increase in GHGs since the 1880s.**[1]
Also, fossil fuels contributed to about 92% of global CO2 emissions in 2019 alone.[2]

In response to the pressing need for a global energy transition, nations worldwide are forging pathways to replace unsustainable energy sources with more environmentally responsible alternatives. Ghana, much like many nations across the globe, has affirmed its dedication to a gradual transition towards achieving net-zero greenhouse gas (GHG) emissions. This commitment is driven by the need to safeguard energy security and ensure the nation's readiness in a future characterized by diminished investments in fossil-related products and projects. Unpreparedness in the face of this global shift carries pronounced risks, including stranded national assets, substantial revenue and employment downturns in the oil and gas sector, and a potential threat to the nation's access to the global green market.

Ghana's commitment to achieving a low-carbon and climate-resilient future is further reflected in its national policies and plans, as well as its international obligations and initiatives, such as the Paris Agreement, the Sustainable Development Goals, and the Africa Renewable Energy Initiative, The National Energy Policy, the Renewable Energy Act, the National Climate Change Policy and the Sustainable Energy for All Action Plan.
Significantly, **Ghana has developed and adopted the National Energy Transition Framework as the overarching document to guide its shift from fossil fuel dependency to a cleaner,** low-carbon, and climate-resilient energy sector by 2070. Specifically, the framework seeks to;

[1]https://www.c2es.org/content/international-emissions/
[2]https://www.climatewatchdata.org/ghg-emissions?breakBy=sector&chartType=area&end_year=2019&gases=co2&start_year=1990]



The framework is complemented by the Energy Transition and Investment Plan, which sets out the financing and resource requirements for Ghana's transition. Projections made by the ETM indicate that energy infrastructure, policy reforms and supporting government implements need to be put in place within the window from 2022 to 2070. This period represents the epicentre of the transition, with a peak expected around 2045-2055 as the pivotal years during which government and other leaders will be required to navigate the complexities of a rapidly changing energy landscape, shifting from fossil fuels to renewable sources, enhancing energy efficiency, and adopting sustainable practices to meet international climate commitments. Concurrently, the age demographic distribution indicates that, during this very peak period, the majority of Ghana's youth population, between the ages of 15 and 35, will be actively participating in the workforce and, by extension, shaping national policy. This juxtaposition of energy transition requirements and youth's prime working years underscores the undeniable necessity of engaging the youth in crafting and implementing the energy transition framework.

By conducting a comprehensive analysis of Ghana's energy transition plans, this study aims to provide valuable insights and recommendations to inform policy decisions, guide implementation strategies, and ensure that the transition towards a low-carbon and sustainable energy future is achieved in a manner that maximizes socioeconomic benefits while minimizing potential risks and challenges.

1.1 Objectives of the Study

The study aims to provide an analytical review of Ghana's energy transition plans, focusing on their alignment with the country's development objectives, the feasibility of the proposed measures, and the potential socio-economic impacts. The study also seeks to engage youth and other relevant stakeholders in the energy transition discourse, ensuring that their perspectives and concerns are considered in the implementation process.

Specifically, the project aimed to:

1.2. Scope and Methodology

The chart below depicts the scope of this study

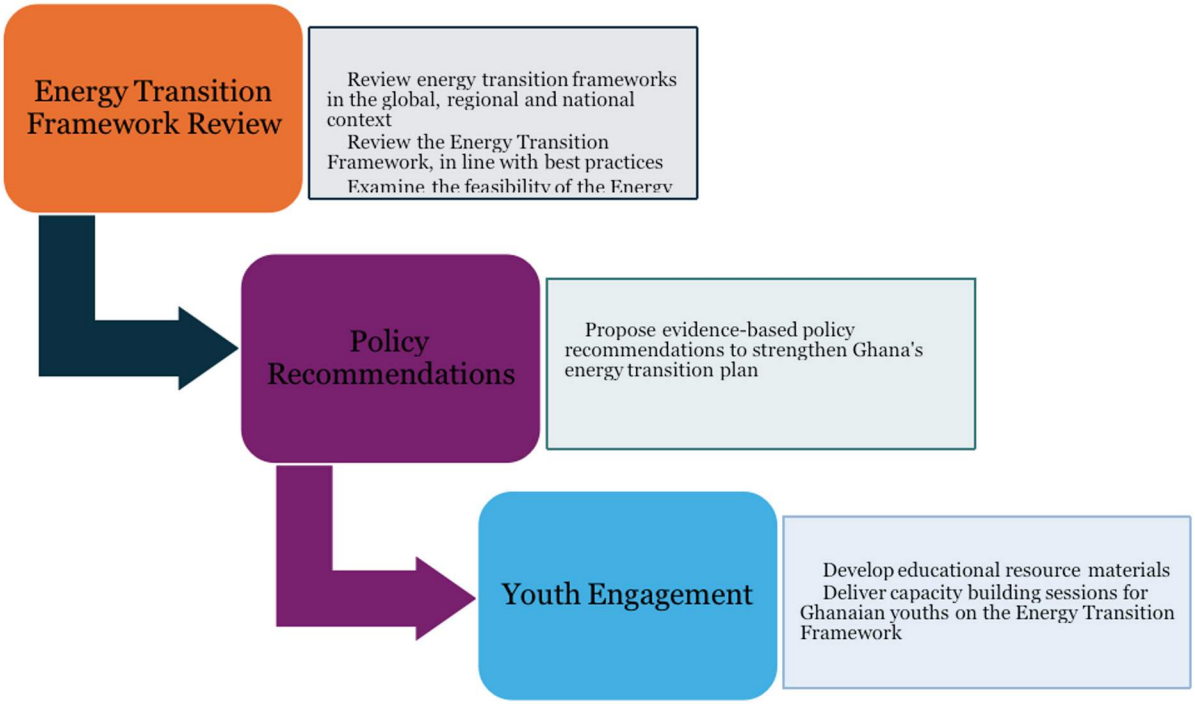


Figure 1: Scope of Study

The study employed a mixed-methods approach, combining desktop research, stakeholder consultations, and quantitative analysis as detailed below. .

Document Review

The desktop research involved a thorough review of relevant policy documents, reports, and scientific literature to establish the context and identify best practices in energy transition planning and implementation.

Stakeholder Consultation

Stakeholder consultations, including focus group discussions and key informant interviews, were conducted to gather diverse perspectives and insights from youth, civil society organizations, academia, private sector actors, and government officials. Consultations with key institutions identified from the sectors relevant to Ghana's transition were also engaged to assess the institutional readiness of the country for implementing its transition plans.

Youth Engagement

Following the analytical review of Ghana's energy transition plans, the consultants delivered a capacity-building session for youth representatives in Ghana at Crystal Palm Hotel, Tesano at 10:30 am. The objective of the engagement is to expose Ghanaian youth to Ghana's energy transition framework and targets.

Quantitative analysis

Quantitative analysis, using energy system modelling tools and economic assessment techniques, is employed to evaluate the feasibility and impact of the proposed measures and targets.

2 GLOBAL ENERGY TRANSITION

2.1 Drivers of the Global Energy Transition

The strategic shift of global economies and populations from dependence on fossil fuels to **clean and renewable energy sources** is primarily driven by the urgent need to reduce greenhouse gas emissions to combat climate change.

Across the world, countries are setting ambitious targets to decrease their reliance on fossil fuels and increase the adoption of more ecologically sound, efficient, reliable, and cost-competitive energy systems through rapid improvements in renewable energy technologies and energy storage systems. The gradual change to clean energy sources will go a long way to mitigate Greenhouse gas (GHG) emissions, improve air quality, conserve natural resources, and increase resilience to climate change.

Furthermore, declining exploration and discovery of commercial petroleum resources means that diversifying energy sources through the adoption of renewables can enhance energy security by reducing dependence on imported fossil fuels and minimizing exposure to price volatility. Many governments are implementing policies and incentives to encourage the adoption and development of clean energy solutions and with the sharply rising market demand for "green" products, countries at the forefront of the transition gain a competitive advantage which further spurs the trend of energy transition. The costs of renewable energy technologies have fallen significantly in recent years, making them increasingly attractive to investors and energy providers. In some cases, renewable energy is now cheaper than fossil fuels. Costs for electricity from utility-scale solar photovoltaics (PV) fell 85% between 2010 and 2020 while onshore and offshore wind also saw significant cost declines during the same period, with the global weighted-average falling by 56% and 48%, respectively[3]

Furthermore, declining exploration and discovery of commercial petroleum resources means that diversifying energy sources through the adoption of renewables can enhance energy security by reducing dependence on imported fossil fuels and minimizing exposure to price volatility. The economic factors driving the transition extend to job creation and other profitable opportunities for governments and the private sector.

According to the United Nations Sustainable Energy Hub, the global investment needed to reach net-zero emissions by 2050 is USD 4 trillion which will be accompanied by the creation of 30 million jobs[4]

[3] International Renewable Energy Agency (IRENA). (2021). Renewable Power Generation Costs in 2020. Retrieved from https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020].
[4] https://www.undp.org/energy/our-work-areas/energy-transition

Investment in the sector is expected to further boost local economies both in the short term and long term by driving down energy costs, attracting private investors, and fostering innovation and entrepreneurship.
Resource-rich countries with critical minerals are also uniquely poised to benefit from the transition through the production and exportation or processing of the minerals relevant to the transition; it is estimated that over 3 billion tons of critical minerals and metals will be required to meet net zero by 2050.[5]

2.2 Policy Frameworks and International Agreements

The Paris Agreement and the Sustainable Development Goals (SDG) are the two major international agreements that obligate countries to transition to sustainable energy. The SDG mandates signatories to call an end to poverty and inequality into action, protect the planet, and ensure all enjoy health, justice and prosperity.[6]

Goal 7 of the SDGs focuses on the energy sector and targets three core areas, aiming "to Ensure access to affordable, reliable, sustainable and modern energy for all". Specifically, the Goal sets out to proliferate efforts to increase the share of renewable energy in the global energy mix and double the global rate of improvement in energy efficiency. Transitioning from fossil-fueled energy is the best way to combat climate change, biodiversity loss, and pollution.[7]

The Paris Agreement became the landmark agreement to tackle climate change and increase investment into a sustainable low-carbon future. The primary goal of the Paris Agreement is to fortify international efforts to combat climate change by limiting this century's global temperature rise to well below 2 degrees Celsius over pre-industrial levels and by pursuing measures to further restrict temperature increases to 1.5 degrees Celsius.[8]

The emissions gap in 2030 between the 1.5°C Paris Agreement compatible pathway and the pathway under current policies is projected to be 24-27 GtCO2e/year. Closing this gap requires ambitious climate action and the implementation of more stringent emissions reduction targets.

[5] https://www.igfmining.org/three-emerging-policy-trends-for-critical-minerals-in-latin-america/
[6] https://www.who.int/europe/about-us/our-work/sustainable-development-goals
[7] https://sdgpulse.unctad.org/sdg-costing/ .
[8] https://unfccc.int/most-requested/key-aspects-of-the-paris-agreement

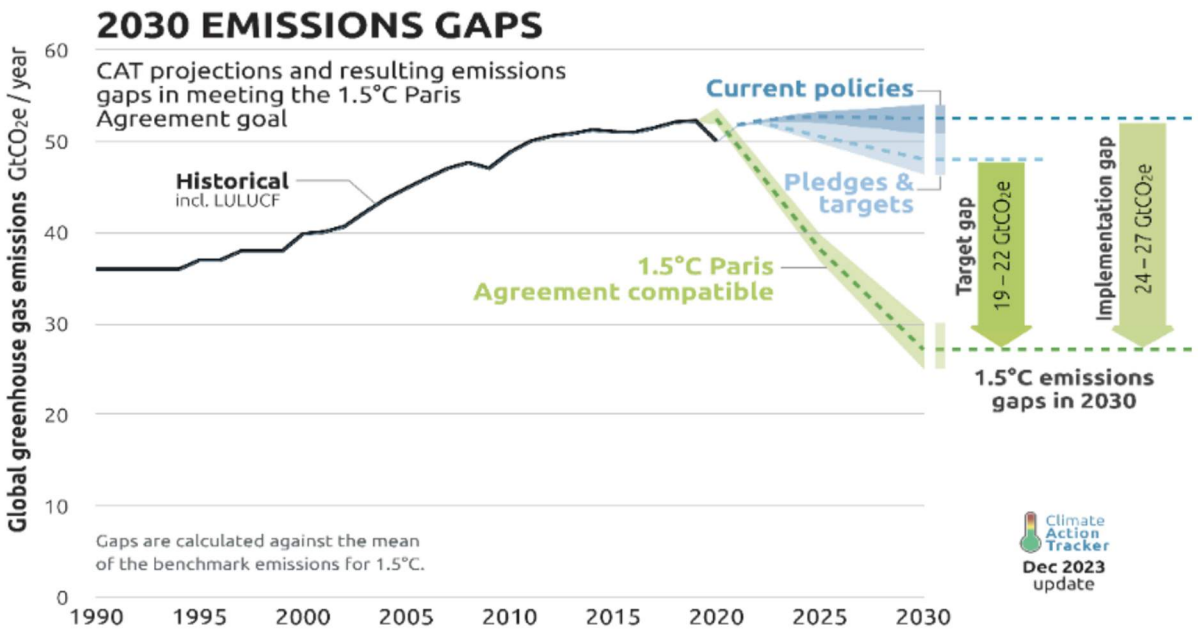


Figure 2: Historical and projected global GHG emissions gaps between the 1.5°C Paris Agreement goal and current policies, pledges, and targets. Source: CAT Emissions Gap | Climate Action Tracker

The Paris Agreement addresses various areas necessary to combat climate change and this includes mitigation through Nationally Determined Contributions (NDC). These NDCs constitute climate actions aimed at curtailing emissions and fortifying resilience against climate impacts. Mandated by the Paris Agreement, signatories are required to submit their NDCs every five years, commencing in 2020, with subsequent submissions due in 2025 and 2030. Fossil-based energy stands as the primary contributor to carbon emissions, accounting for approximately 73% of greenhouse gas emissions globally. Mitigation strategies within the energy sector, aimed at reducing greenhouse gas emissions, are pivotal for transitioning away from fossil fuels toward renewable energy sources. NDCs therefore elucidate countries' plans to phase out fossil fuels and transition towards renewables, delineating national renewable

energy plans and investments as key components of this transition. Ghana submitted its first NDC in 2015, targeting a 45% reduction in greenhouse gas emissions by 2030 compared to business-as-usual scenarios. In 2021, Ghana updated its NDC, increasing its ambition to a 47% reduction by 2030.[9]

Post the Paris Agreement, there have been some exemplary policies introduced in some selected countries and regions (Table 1).

[9] Republic of Ghana (2021) Ghana's Updated Nationally Determined Contribution under the Paris Agreement (2020-2030). https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Ghana%20First/Ghana%27s%20Updated%20Nationally%20Determined%20Contribution%20to%20the%20UNFCCC_2021.pdf

Region/ Country	Policies
United States	▬ Approval of the Inflation Reduction Act o Tax credit extensions for solar PV and wind: production credit (per unit of energy) and investment credit (capital costs) o Investment tax credit is also available for battery storage and zero-emission nuclear o Financial support for grids and manufacturing clean power equipment
China	▬ 14th Five-Year Plan raises renewable target to 33% of power consumption by 2025 (and 18% for non-hydro renewables)
Europe	▬ Announcements by the European Commission: REPowerEU Plan, Net-Zero Industry Act proposal, and other potential reforms o Increase EU 2030 renewables target to 45% by 2030 (whole energy matrix not just power) o Fast-tracking permitting process plus ~EUR 225 billion in loans for grids o Proposed reform of market design and technology-specific targets for EU manufacturing capacity ▬ Nine European countries committed to boost offshore wind capacity to over 120 GW by 2030 and over 300 GW by 2050
Indonesia and Southeast Asia	▬ Indonesia introduced its JETP o Renewable energy target up to at least 34% of power generation by 2030, accelerate coal power plant retirement and achieve net zero emissions in the power sector by 2050 o USD 20 billion of initial funding ▬ Thailand introduced new regulation for renewable power procurement, establishing the feed-in tariffs payable by distribution companies and capacity targets (additional 5 GW of biogas, solar, solar with storage, and wind) ▬ Philippines set out a 35% renewable electricity generation target by 2030 (from about 20% in 2021) and 50% by 2040
India	▬ Continues to expand the Production-Linked Incentive (PLI) scheme o 50 GWh of battery manufacturing capacity o 40 GW of solar PV manufacturing capacity to be added in next three years
Japan	▬ Government is studying extension to lifetime of nuclear power plants (beyond 60 years)
Korea	▬ Plan to increase nuclear power to 35% of total generation and renewables to 31% from 10% in 2021 by 2036 ▬ Coal-fired power to reduce to 15%
South Africa	▬ Government concluded sixth renewable auction
Brazil	▬ Planning two major transmission auctions in 2023, including the largest ever held in Brazil (in investment terms)

Table 1: Key Policies Which Aim to Reduce Emissions (IEA World Energy Investment 2023[10]

[10] https://iea.blob.core.windows.net/assets/8834d3af-af60-4df0-9643-72e2684f7221/WorldEnergyInvestment2023.pdf
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2.3 Global Energy Investment Landscape

Current trends of Global Energy Investment show significant investment flows into the renewable energy space; a report from the International Monetary Fund shows that investment in renewable sources of energy has nearly tripled post the Paris Agreement. Global investment in renewable energy was estimated to have increased from 1074 billion USD in 2015 to 1740 billion USD in 2023, while investment in fossil fuels decreased from 1319 billion USD to 1050 billion USD in 2023.[11]

The renewable energy investment is led by technological advancement in Renewable Power, EV, Battery Storage, Nuclear, and Low Emission Fuels and Carbon Capture Utilization and Storage with investment in renewable power leading reaching 659 billion USD in 2023.[12]

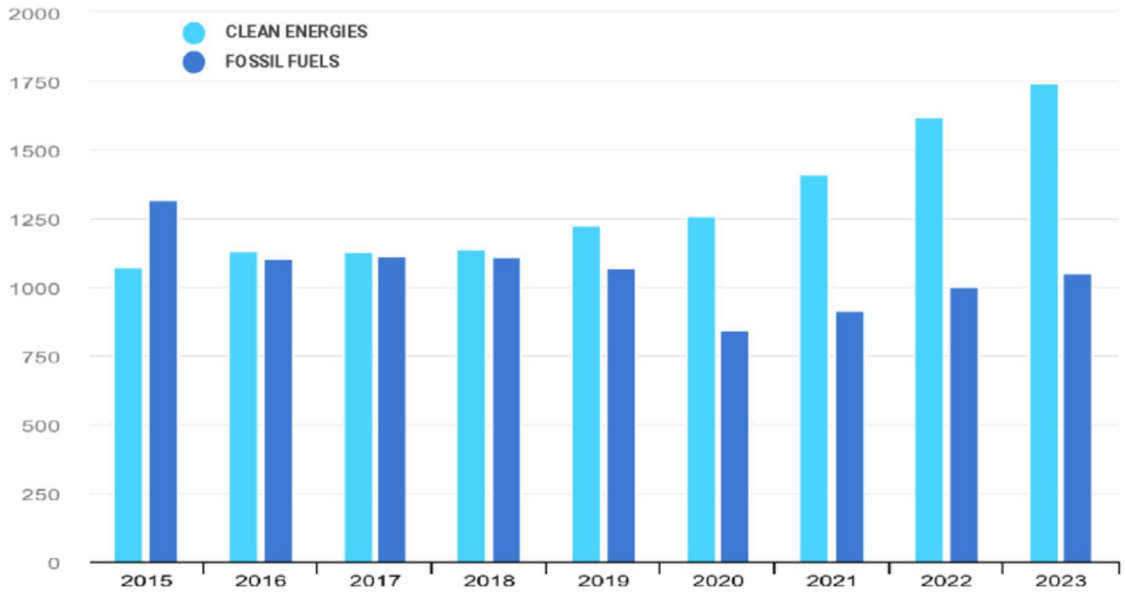


Figure 3: Global Energy Investment in Clean Energy and in Fossil Fuels, 2015-2023
Source: IEA, 2023

However, the investment patterns are unbalanced with more renewable investments going to developed countries than developing countries.[13] Even though developing countries require about 1.7 trillion each year to invest in sustainable energy, only 544 billion USD was brought in 2022.[14] Due to political and regulatory risk, economic volatility, and insufficient grid and transmission, private investors are reluctant to engage in renewable projects in developing countries.[15]

Multilateral development banks (MDBs) play a crucial role in financing renewable energy infrastructure in developing countries by providing long-term financing, technical assistance, policy advice, and capacity-building support. [16]

[11] EA, Global energy investment in clean energy and in fossil fuels, 2015-2023, IEA, Paris https://www.iea.org/data-and-statistics/charts/global-energy-investment-in-clean-energy-and-in-fossil-fuels-2015-2023, IEA. Licence: CC BY 4.0

[12] EA, Global energy investment in clean energy and in fossil fuels, 2015-2023, IEA, Paris https://www.iea.org/data-and-statistics/charts/annual-clean-energy-investment-2015-2023.

[13] https://www.imf.org/external/pubs/ft/bop/2023/pdf/42/23-21.pdf

[14] https://unctad.org/publication/world-investment-report-2023

[15] https://www.mdpi.com/1996-1073/14/9/2648

[16] https://www.researchgate.net/publication/374631119_The_support_of_Multilateral_Development_Banks_to_renewable_energy_projects_in_developing_countries

The Global Capacity Building Initiative, launched at COP28 with the support of the UN, World Bank, other MDBs, and donor partners, aims to streamline climate finance technical assistance programs and make them more accessible to financial institutions and stakeholders in underdeveloped and emerging markets.[17] Climate finance serves as a key funding source for developing countries' energy transitions, offering financial resources and instruments to support climate change action. Developing nations can access climate financing through various channels, including the Global Environment Facility and the Green Climate Fund, in the form of grants, sovereign bonds, carbon trading, and carbon taxes. As of 2019, approximately $450 billion in climate finance had been deployed in developing countries, representing an estimated 20% of the investment required by 2030.[18]

2.4 Challenges and Opportunities

There has been significant progress made by countries globally to transition, however, there have been noted challenges that could delay the implementation of the global energy transition. The global energy transition is being faced with the challenge of energy security. The concern about energy security does not stop at the availability of energy but also the affordability; The transition is hobbled by a high cost of capital.[19] Developing countries are unable to afford the high cost of clean energy sources, and for them to reach targeted goals, renewable sources of energy should be cheaper than fossil-fuel-based energy.[20] Also, the renewable sector faces a shortage of skilled workers in the space. For instance, Germany currently faces a shortage of around 216,000 skilled workers needed to expand the sector.[21]

Despite the challenges, the energy transition presents significant opportunities globally. Energy transition will be a catalyst for employment, the development of renewable energy has been given top priority by many governments, both to achieve global climate targets and cut emissions as well as to pursue wider socioeconomic advantages.[22] In 2021, 12.7 million people were employed in the renewable energy sector worldwide.[23]

It is estimated that 500 million people lack access to energy, marking a stark 52% electrification deficit compared to the global average; however, the energy transition targets to increase electrification by 63 million people each year by 2030, thereby bridging this gap.[24]

[17] https://www.bloomberg.org/press/un-agencies-multilateral-development-banks-private-sector-finance-and-philanthropy-leaders-unite-to-scale-climate-finance-capacity-building/]
[18] https://www.mckinsey.com/capabilities/sustainability/our-insights/solving-the-climate-finance-equation-for-developing-countries
[19] https://www.imf.org/en/Publications/fandd/issues/2022/12/bumps-in-the-energy-transition-yergin
[20] https://findevlab.org/financing-costs-of-green-transition-in-developing-countries/
[21] https://www.reuters.com/business/energy/learn-by-doing-german-renewables-companies-bid-beat-labour-shortage-2023-04-20/].
[22] https://www.irena.org/Energy-Transition/Socio-economic-impact/Energy-and-Jobs
[23] https://link.springer.com/article/10.1007/s11625-023-01440-y
[24] https://www.un.org/ohrlls/news/opportunities-achieving-universal-energy-access-through-energy-transition-least-developed

Furthermore, nations endowed with critical minerals stand poised to leverage their natural resources, bolstering their economies through mineral exploration ventures. Concurrently, the transition towards cleaner energy sources holds the promise of mitigating health hazards associated with pollution, presenting a proactive avenue for averting adverse health outcomes. Moreover, at its core, the energy transition endeavors to attenuate the pernicious impacts of climate change, fostering sustainability and resilience on a global scale.

3

OVERVIEW OF GHANA'S ENERGY TRANSITION PLANS AND POLICIES

3.1 Current Energy Landscape and Transition Targets

3.1.1.Ghana's Energy Mix

Based on the National Energy Transition Framework, the country's current energy mix is analyzed in the sub-sections below:

3.1.1.1.Electricity Generation

Ghana's installed electricity generation capacity as of 2021 was 5,492.8 MW, comprising 68.4% thermal, 28.8% hydro, and 2.8% renewable energy sources (solar, hydro, and waste). The country's electricity generation mix has been predominantly from hydro and thermal sources, with hydro contributing 92% in 2000 and thermal accounting for 31.2% in 2010. However, the share of hydro has been decreasing over the years due to variability in hydrology, while thermal generation has been increasing. In 2021, thermal sources accounted for 65.3%, hydro for 34.1%, and other renewable sources for 0.6% of the total electricity generated.

3.1.1.2.Petroleum Sector

Ghana's petroleum sector consists of upstream (exploration, development, and production) and downstream (refining, storage, and distribution) activities. The country began commercial oil production in 2010 from the Jubilee field, followed by the TEN and SGN fields. In the downstream sector, Ghana imports and refines crude oil and distributes petroleum products through bulk distribution companies and oil marketing companies.

3.1.1.3.Natural Gas

Natural gas has become an increasingly important part of Ghana's energy mix since the commencement of commercial production in 2014. The country produces natural gas from the Jubilee, TEN, and SGN fields, and imports natural gas from Nigeria through the West African Gas Pipeline (WAGP). Natural gas is primarily used for power generation and non-power applications in the industrial sector.

3.1.1.4.Renewable Energy

Renewable energy sources, such as solar, hydro, and biomass, currently contribute a small share to Ghana's energy mix. As of 2021, the installed capacity of grid-connected renewable energy was 155.8 MW, representing 2.8% of the total installed capacity. The government has set targets to increase the share of renewable energy in the national energy mix through the Renewable Energy Master Plan (REMP), which aims to achieve 1,363.63 MW of installed renewable energy capacity by 2030.

3.1.1.5.Challenges and Opportunities

Ghana's energy mix heavily relies on fossil fuels, particularly thermal power generation and petroleum products. This dependence exposes the country to price volatility, energy security risks, and environmental concerns. In addition, the decreasing share of hydropower in the electricity generation mix can be attributed to the variability in hydrology, which poses challenges to the reliability of power supply.

Ghana has significant potential for renewable energy development, particularly in solar, wind, and biomass resources. The government's efforts to increase the share of renewable energy through policies and initiatives such as the Renewable Energy Act

and the REMP present opportunities for diversifying the energy mix and reducing greenhouse gas emissions. The expansion of natural gas infrastructure, including the development of domestic gas fields and the WAGP, has enhanced Ghana's energy security and provided cleaner fuel for power generation and industrial use.

3.1.2 Ghana National Energy Transition Framework

Ghana's National Energy Transition Framework (ETF) lays out a roadmap for the country's ambitious transition to a sustainable, low-carbon energy system. The framework sets targets for 2030, 2050, and 2070, aligning with Ghana's commitments under the Paris Agreement and the United Nations' Sustainable Development Goals.

The 2030 targets focus on diversifying the energy mix, aiming to increase the share of renewable energy to 10%, up from the current level of approximately 1%. This is to be achieved through investments in solar, wind, and hydropower projects, with a projected installed capacity of 1,363 MW of solar, 800 MW of wind, and 150 MW of small hydro. By 2050, the framework aims to increase the share of renewable energy to 30%, with a further increase to 50% by 2070. The long-term target will require sustained investments in renewable energy infrastructure and the development of a robust local supply chain.

Energy efficiency is another key focus area of the ETF, with the aim of reducing overall energy demand by 20% relative to business-as-usual (BAU) levels by 2030. The framework sets a target of a 40% reduction in energy intensity by 2050 and a 60% reduction by 2070. To achieve these goals, Ghana will need to implement stringent energy efficiency standards, promote the adoption of best practices and technologies across sectors, and encourage behavioural changes among consumers.

In the transport sector, Ghana aims to reduce greenhouse gas emissions by 10% relative to BAU levels by 2030, 30% by 2050, and 50% by 2070. The framework outlines a gradual transition to electric vehicles, with targets of 10% of new vehicle sales being electric by 2030, 50% by 2050, and 100% by 2070. This will require significant investments in charging infrastructure, as well as incentives to encourage the adoption of electric vehicles.

By the halfway point of 2050, the ETF asserts that Ghana should have made substantial progress in its energy transition. The share of renewable energy in the energy mix should have reached at least 20%, with a significant portion of the targeted installed capacity already in place. Energy efficiency measures should have resulted in a reduction in energy intensity of around 30%, with widespread adoption of energy-efficient technologies and practices across sectors. In the transport sector, electric vehicles should account for a significant portion of new vehicle sales, supported by a growing network of charging infrastructure.

According to the ETF, Ghana aims to reduce its greenhouse gas emissions by 64 million tonnes of CO2 equivalent (31% below BAU) by 2030, achieve a 70% reduction by 2050, and reach net-zero emissions by 2070.

3.1.3 Ghana Energy Transition and Investment Plan

The Energy Transition and Investment Plan was published in 2024 and adjusts the target to achieve net-zero CO2 emissions by 2060. This framework builds on the ETF and aims to balance economic growth with environmental stewardship, positioning Ghana as a leader in sustainable development among African nations. The plan outlines the substantial investment and technological transformation required for the country's transition across key sectors, with a focus on renewable energy, electrification, and innovative carbon reduction strategies.

The ETIP places the power sector at the forefront of Ghana's energy transition, with a dramatic shift towards renewable sources. Solar PV is projected to dominate the energy mix, with capacity expected to reach over 150 GW by 2060. This exponential growth in renewable capacity is illustrated in Figure 3 which shows the projected power generation mix from 2020 to 2060.

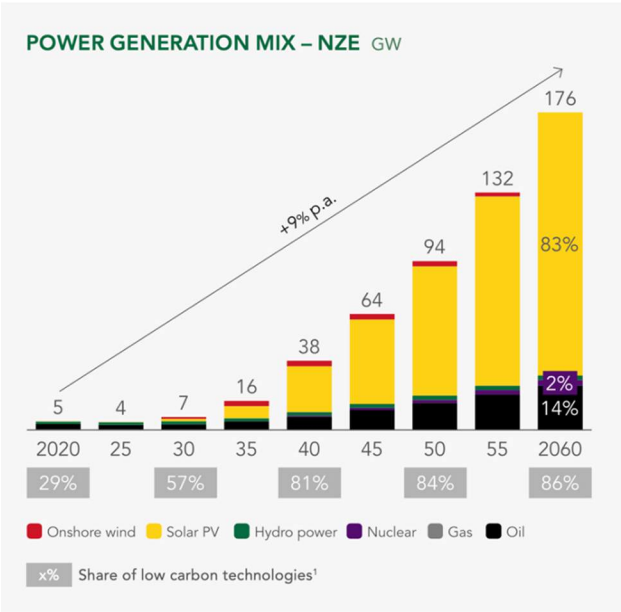


Figure 4: Projected Power Generation Mix from 2020 -2060
(Source: Energy Transition and Investment Plan (2024))

The plan also envisions the phase-out of unabated fossil fuels in power generation by 2060, complemented by the introduction of nuclear power (reaching about 3 GW) and the deployment of energy storage solutions. Notably, the power sector is expected to achieve negative emissions through technologies like bioenergy with carbon capture and storage (BECCS), offsetting residual emissions from hard-to-abate sectors.

The ETIP sets up Ghana's transport sector for a radical transformation, with a clear pathway towards full electrification of passenger vehicles by 2060. The plan outlines a shift to a mix of battery electric and hydrogen fuel cell vehicles for heavy-duty transport, addressing the unique challenges of long-distance and high-load transportation. Figure 4 illustrates the projected transition in the passenger vehicle fleet, showing a rapid increase in electric vehicles from the 2030s onwards. This transition is not only crucial for emissions reduction but also presents significant opportunities for industrial development and job creation in the electric vehicle value chain.

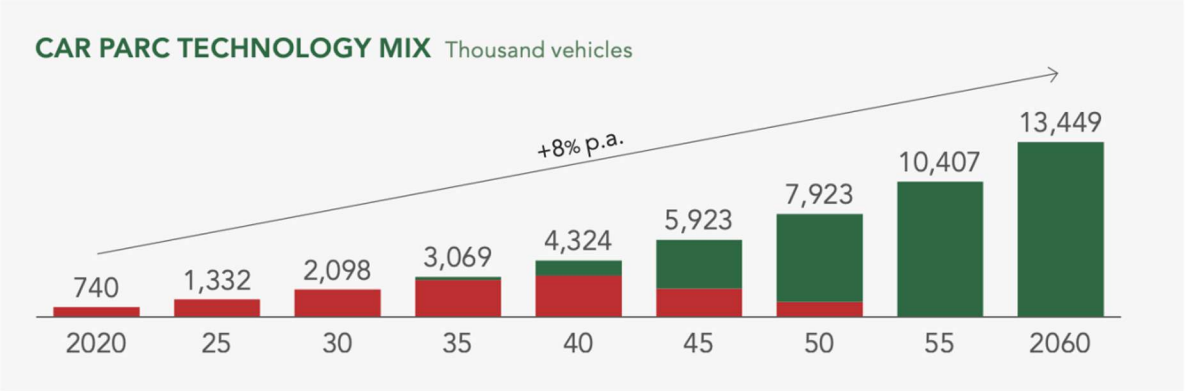


Figure 5: Car Parc Technology Mix from 2020 -2060
* red – non-electric vehicles; green – electric vehicles
Source: Energy Transition and Investment Plan (2024)

The industrial sector's decarbonization strategy focuses on innovative technologies and fuel switching. The strategy is underpinned by measures designed to address the challenging emissions from energy-intensive industries, balancing the need for continued industrial growth with emissions reduction targets. Key initiatives include:

- Transitioning steel production to hydrogen-based direct reduced iron (DRI) processes, targeting 80% of production by 2060.
- Implementing carbon capture and storage (CCS) in cement production.
- Electrifying low and medium-temperature heat processes through industrial heat pumps.
- Utilizing hydrogen and CCS for high-temperature heat processes.

Overall, the ETIP estimates a total cumulative capital investment need of approximately USD 550 billion by 2060, with the power and transport sectors accounting for about 90% of this investment. This represents an additional investment of USD 140 billion over the business-as-usual scenario.

This level of investment presents both challenges and opportunities for Ghana's economy, potentially stimulating new industries and creating an estimated 400,000 additional jobs by 2060, primarily in renewable energy construction and EV/hydrogen infrastructure.
By implementing the measures outlined in the National Energy Transition Framework and Investment Plan, Ghana aims to reduce its greenhouse gas emissions by 2 gigatonnes of CO2 equivalent (2 Gt CO2e) by 2060, representing a 200% reduction relative to BAU levels. This target will require sustained efforts over the coming decades, as well as the development of a robust monitoring, reporting, and verification system to track progress and ensure accountability.

3.2 Policy Frameworks and Regulations

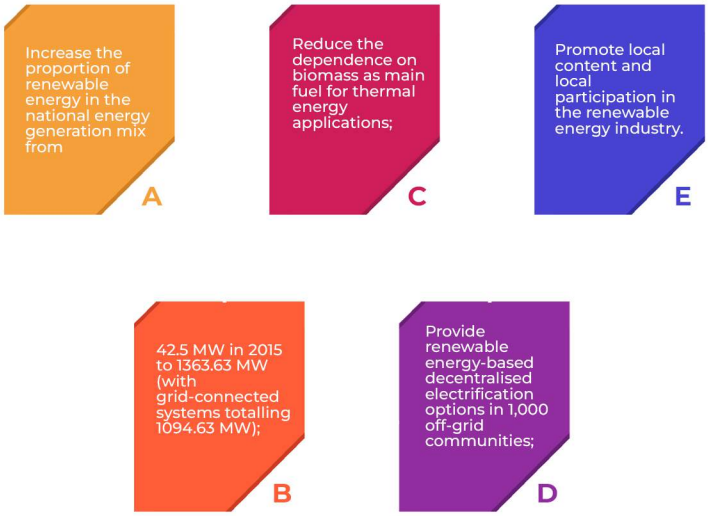
The Government of Ghana has adopted and enacted some primary policy frameworks and regulations pre and post the Paris Agreement to govern the transition process. The primary supporting policy frameworks and regulations include the Renewable Energy (Amendment) Act, 2020 (Act 1045), the Renewable Energy Master Plan, the Ghana Integrated Power Sector Master Plan, the Ghana National Energy Policy, and the National Climate Change Policy.

3.2.1 Renewable Energy (Amendment) Act, 2020 (Act 1045)

The act was enacted in 2011 and amended in 2020. The Renewable Energy Act of Ghana seeks to advance the nation's development, administration, and application of renewable energy resources. It creates a legislative framework for the advancement of renewable energy and names the Renewable Energy Authority to supervise its execution. In order to promote investment and industry expansion, the legislation offers incentives for renewable energy projects, including tariff guarantees and tax deductions. Additionally, it mandates the inclusion of renewable energy technology in the country's energy mix and establishes adoption objectives for renewable energy.

3.2.2 Renewable Energy Master Plan

The Renewable Energy Master Plan aims to create an investment-focused framework to foster the utilization and growth of Ghana's abundant renewable energy resources. Its objective is to drive sustainable economic development, enhance societal well-being, and mitigate the negative impacts of climate change. The REMP aims to achieve the following by 2030:



3.2.3.Ghana Integrated Power Sector Master Plan

The Ghana Integrated Power Sector Master Plan (IPSMP) is a subset of the Strategic National Energy Plan (SNEP) and is intended to guide the development of Ghana's future power sector. The primary objective of the IPSMP is to identify a long-term Least-Regrets power sector resource plan that will meet Ghana's future electricity demand, through the optimisation of existing and future power plants and other energy systems, as well as transmission capability. The Least-Regrets resource plan is based on an evaluation of the resilience of the Ghana power system to potential risks, including fuel prices and availability, hydrological changes, economic growth, policy and regulatory changes, and climate change.

3.2.4.Ghana National Energy Policy

The Ghana National Energy Policy is a strategic plan aimed at ensuring reliable, affordable, and sustainable energy for economic growth. The policy document puts emphasis on diversifying energy sources, promoting renewable energy, energy efficiency and conservation, infrastructure development, establishing regulatory frameworks, and stakeholder engagement and capacity building. The policy document aims to guide Ghana's energy sector to achieve socio-economic advancement while addressing the multifaced challenges in the current energy sector of Ghana.

3.2.5.The National Climate Change Policy

The National Climate Change Policy is a comprehensive response to climate change. The policy is based on three main goals i.e. mitigation, social development, and successful adaptation. The policy however seeks to revolutionalize four sectors that can address adaptation including energy and infrastructure, natural resources management, agriculture and food security, and disaster preparedness and response.

3.3. Key Stakeholders and Actors

Main Stakeholders	Role
Government	
Ministry of Energy	The general policy direction for Ghana's energy industry is established by this ministry. It is responsible for supervising the development and execution of energy policies, plans, and guidelines that encourage the use of renewable energy sources and energy-saving techniques. The ministry works in tandem with other relevant parties to guarantee the efficient implementation of renewable energy technology[25]
Environmental Protection Agency	In Ghana, the execution of policies and projects pertaining to renewable energy is closely monitored by the EPA. The EPA guarantees that renewable energy projects are produced and run in an ecologically sustainable way through the completion of environmental impact assessments (EIAs), the issuance of licenses, and the monitoring of compliance with environmental legislation[26]
Ministry of Food and Agriculture	As the principal organization and focal point of the Ghanaian government, the Ministry of Food and Agriculture (MOFA) is in charge of creating and carrying out agricultural sector policies and plans within the framework of a coordinated national socioeconomic growth and development agenda. The goal of MOFA is to help farmers, processors, and merchants achieve better livelihoods by conducting research and developing technologies, providing efficient extension services, and other means of support. MOFA plays a crucial role by encouraging sustainable farming (stop bush burning and use renewable sources of energy).[27]

[25] https://energymin.gov.gh/
[26] http://www.epa.gov.gh/epa/
[27] https://mofa.gov.gh/site/about-us/about-the-ministry

Energy Commission	In Ghana, the Energy Commission is in charge of overseeing and encouraging the exploitation of renewable energy sources. It issues permits for renewable energy projects, offers advice and technical assistance, and keeps track of how well renewable energy installations are doing throughout the nation. Additionally, the commission works on research and development projects to enhance technology related to renewable energy[28]
Electricity Company of Ghana (ECG)	The Electricity Company of Ghana is the sole provider of electricity for the southern and middle parts of Ghana. The role of ECG is to integrate renewable energy into the nation's energy grid[29]
Northern Electricity Distribution Company (NEDCo)	Just like ECG, NEDCo focuses on power distributions in the 5 northern regions of the country[30]
Ghana Investment and Promotion Centre (GIPC)	GIPC is the principal organization that promotes and facilitates investments in the country and this includes investments in renewable energy[31]
Non-Governmental Organizations	
Academic Institutions	The role of academic institutions is crucial in the phase of energy transition. They provide evidence-based research to support the implementation of the framework. Also, provide academic programs in the renewable energy sector[32]
Financial Institutions	Financial institutions will have to play a significant role in energy transition. Investment needed for the transition will sum up to US$ 561.8 billion. Ghana intends to fund transition plans with the collaboration of financial institutions making investments in the sector[33]
Civil Society Organization	The role of civil society is crucial in the implementation of the energy framework. Civil Society Organization's role in advocating for a just energy transition across the world and Africa. Also, it helps mobilize investment for developing countries as they give solutions tailored to address unique circumstances during the transition period[34]
Youth Networks	For an energy transition framework like that of Ghana, taking 50 years to transition, young people have the potential to contribute significantly to energy transition. Such as global decisions in the energy sector, serving as skilled labour to support more sustainable energy sources[35], and in the case of Ghana and other African countries, the youth will have to implement the decisions on the energy transition made today.

[28] https://www.energycom.gov.gh/newsite/
[29] https://ecg.com.gh/index.php/fr/
[30] http://www.nedcogh.com/
[31] https://www.gipc.gov.gh/
[32] https://www.uiin.org/2023/03/09/role-of-universities-in-sustainability/
[33] Ghana Energy Transition Framework
[34] https://www.weforum.org/agenda/2023/09/3-ways-civil-society-crucial-equitable-energy-transition/
[35] https://www.gfse.at/fileadmin/4_gfse/services___policy_briefs/youth_gfse_policy_brief_v2_01.pdf

4

ASSESSMENT OF GHANA'S ENERGY TRANSITION INITIATIVES

4.1.Policy Considerations in the ETP

Renewable energy in the form of solar and wind would contribute **20%** of the country's installed generation capacity by 2070 **growing from an electricity generation mix comprised of 68.4% thermal, 28.8% hydro, and 2.8% renewable energy sources** as at 2021.

This subsection provides an analysis of the Renewable Energy Deployment Policies embedded within the energy transition framework, aiming to elucidate their significance, efficacy, and implications for Ghana's energy landscape.

4.1.1.Renewable Energy Deployment Policies

According to the Energy Transition Framework (ETF), renewable energy in the form of solar and wind would contribute 20% of the country's installed generation capacity by 2070 growing from an electricity generation mix comprised of 68.4% thermal, 28.8% hydro, and 2.8% renewable energy sources as at 2021. With thermal sources dominating electricity generation and petroleum accounting for a substantial portion of the energy matrix, there arises a pressing need to recalibrate the trajectory towards a more sustainable paradigm. Deployment of renewable energy therefore stands as a pivotal component, crucial for steering the nation towards its envisioned sustainable future and is accompanied by an equally pivotal requirement for robust legal and regulatory frameworks, alongside innovative tools, to effectively address the evolving challenges and associated opportunities.

The ETF cites the Renewable Energy Act, 2011 (Act 832) and its amendment in 2020 (Act 1045) as the primary legislative tools for the development and utilization of renewable energy resources in Ghana. While Section 53 of Act 832 establishes the Renewable Energy Authority to oversee the implementation of renewable energy policies, the amendment (Act 1045) introduces transitional provisions, stating that until the Renewable Energy Authority is established, the Renewable Energy Directorate under the Ministry of Energy shall oversee the implementation of renewable energy activities. This suggests the sluggish implementation of legal provisions and directives, which could potentially impede effective governance of the sector in the short term, especially when contrasted with the rapidly evolving global trend of energy transition.

Act 1045 introduces a Competitive Procurement Scheme, consisting of a tendering process and an auction scheme, to attract competitive market rates for electricity generated from renewable energy sources. This is a robust measure to promote cost-effective renewable energy development and ensure fair market prices for renewable electricity. Similarly, Section 4 of the amendment (Act 1045) establishes a net-metering scheme to encourage self-generation of electricity from renewable energy sources for power cost reduction or climate change mitigation purposes.

This is structured to incentivize the adoption of small-scale renewable energy generation by consumers, promoting distributed generation and reducing reliance on fossil fuel-based electricity, however, without effective operational structures such as standardised eligibility criteria for scheme participants and insufficient transparency safeguards in place to prevent abuse or manipulation of the scheme, it could undermine its credibility and effectiveness in achieving its intended goals of promoting small-scale generation.

The ETF additionally outlines plans to establish a Renewable Energy Purchase Obligation Scheme, mandating electricity distribution companies and bulk customers to procure a designated portion of their electricity from renewable sources. This policy seeks to establish a secured market for renewable energy and foster investments in the sector and is realised in Section 2 of the Renewable Energy (Amendment) Act, 2020 (Act 1045). The amendment mandates electricity distribution utilities to procure electricity from renewable energy sources from consumer generators under a net-metering scheme as a measure to encourage the uptake of renewable energy and support the integration of small-scale renewable energy generators into the grid. Moreover, it will be reinforced by additional strategies to offer fiscal incentives aimed at advancing renewable energy deployment. These incentives encompass tax incentives, import duty waivers, and concessional loans for renewable energy ventures. The Renewable Energy Fund, established pursuant to Section 31 of Act 832, aims to allocate financial resources for the promotion, development, and utilization of renewable energy sources. With its enhanced scope following the amendment (Section 5 of Act 1045), which now encompasses financial incentives, capital subsidies, production-based subsidies, and equity participation for diverse renewable energy activities, it offers a comprehensive financial mechanism to bolster the development and deployment of renewable energy projects and technologies.

The Renewable Energy Master Plan (REMP) is Ghana's comprehensive framework for promoting and developing the country's renewable energy resources to achieve sustainable economic growth, improve social life, and mitigate climate change effects. The plan, spanning from 2019 to 2030, sets specific targets for various renewable energy technologies and prescribes action plans for their implementation. It proposes strategies such as boosting local assembly and manufacturing, providing support to existing companies, guaranteeing the local market through local content and participation, offering concessional financing, institutionalizing competitive procurement, upgrading transmission infrastructure, incorporating land requirements in spatial planning, and supporting research and development.
The REMP is a well-structured and ambitious plan that recognizes the potential of renewable energy in Ghana's socio-economic development and environmental sustainability and demonstrates a strategic approach to promoting various renewable energy technologies. However, the successful implementation of the REMP will depend on sustained political commitment to secure continuity across governments and the ability to mobilize the necessary financial, technical, and human resources. The REMP is a significant investment plan, with an estimated US$ 5.6 billion required over 12 years. While the plan emphasizes private sector involvement, it is crucial to ensure that the necessary financing mechanisms, incentives, and enabling environment are in place to attract and sustain private investments.

Furthermore, the effective implementation of the REMP will require sufficient investment into Research and Development and strong institutional capacity, including the establishment of the Renewable Energy Authority, the REMP Coordinating Unit, and the National Steering Committee. In addition to being adequately resourced and empowered to effectively carry out their roles, these institutions must set up structures to guarantee that the necessary capacity building, technology transfer, and support mechanisms are in place to enable local companies and stakeholders to effectively participate in the renewable energy value chain.
It is evident that close collaboration between the government, private sector, development partners, and other stakeholders will be crucial in realizing the plan's objectives and contributing to Ghana's sustainable development. Therefore comprehensive stakeholder awareness building and private sector mapping are required at fundamental stages of the plan's implementation to secure commitments and resources.

The accessibility of renewable energy sources and their corresponding management policies and frameworks is particularly pivotal for the advancement of sectors heavily reliant on energy sources, wherein sustainable resource management is essential for long-term viability. While the ETF outlines these policies and measures to promote renewable energy deployment and adoption in the industry, it is essential to note that the effectiveness of these policies will depend on their proper implementation, enforcement, and monitoring. The framework does not provide a detailed roadmap or timeline for the implementation of these policies, nor does it specify the financial resources allocated for their execution. Additionally, the framework lacks specific and quantifiable targets for energy efficiency improvements across different sectors. Best practice for a comprehensive and implementable transition framework outlines a plan for capacity building, public awareness campaigns, and technical assistance programs to support the adoption of energy-efficient practices and renewable energy technologies.

4.1.2 Energy Efficiency Standards

Energy efficiency measures represent cost-effective reduction of energy consumption and emissions to complement investments in new energy infrastructure over the long term. Introducing energy efficiency standards is therefore critical to ensure the optimal use of available resources, maximizing energy output while minimizing waste and environmental impacts. They are also essential considerations for alignment with national and international sustainability goals, including the United Nations Sustainable Development Goals (SDGs) and commitments under the Paris Agreement.
Ghana's Energy Transition Framework (ETF) emphasizes the importance of promoting energy efficiency and conservation in various sectors, including homes and industries. The framework mentions the introduction of minimum energy efficiency requirements and standards for appliances and equipment such as air conditioners, refrigerators, and lighting, ensuring that only energy-efficient models are available on the Ghanaian market. To raise adequate awareness of the need for improved domestic energy efficiency and encourage the uptake of more efficient home appliances, the scheme includes the adoption of energy efficiency labels to provide consumers with information about the energy performance of everyday appliances. This aligns with global best practices as many countries have successfully implemented such policies, leading to significant energy savings. Globally, countries have adopted various energy

efficiency standards for appliances; for example, the U.S. Energy Star Program[36] and EU's Ecodesign and Energy Labelling Directives have resulted in substantial energy savings and reduced greenhouse gas emissions.[37] The implementation of these standards is expected to reduce energy consumption and promote the subsequent adoption of more energy-efficient technologies. A key initiative in this direction is the ECOWAS Refrigerators and Air Conditioners Initiative, a regional effort to harmonize energy efficiency standards between Senegal and Ghana. However, the success of this initiative will depend on the level of cooperation and implementation across ECOWAS member states.

Encouraging the adoption of electric vehicles through incentives like tax credits, low-emission zones, and vehicle trade-in programs represents another globally recognized initiative. Nevertheless, the feasibility of widespread electric vehicle adoption in Ghana hinges on various factors, including the availability and accessibility of maintenance technology and infrastructure, charging utilities, grid stability, and the affordability of electric vehicles. The global shift toward electric mobility is unmistakable, with numerous countries establishing targets to phase out internal combustion engine vehicles.[38] Therefore, Ghana's strategy to devise and execute a delivery plan for electric vehicle charging infrastructure holds pivotal importance for the success of this initiative.

4.1.3. Carbon Pricing Mechanisms

Globally, carbon pricing mechanisms, such as carbon taxes and emissions trading schemes, have been implemented to incentivize the adoption of clean technologies.[39] Carbon pricing mechanisms play a crucial role in driving the transition to a low-carbon economy by aligning economic incentives with environmental goals and promoting sustainable development. Carbon pricing ensures that the costs associated with carbon emissions are accounted for in the price of goods and services. By internalizing these external costs, carbon pricing encourages businesses and individuals to consider the environmental impact of their activities and make more sustainable choices. Economic incentives for investments in low-carbon technologies and practices are created when carbon emissions are priced, as businesses and consumers are then motivated to reduce their carbon footprint by adopting cleaner energy sources, improving energy efficiency, and implementing carbon capture and storage technologies. Furthermore, carbon pricing initiatives level the playing field for businesses by ensuring that the costs of carbon emissions are borne by those responsible for them. This prevents carbon-intensive industries from gaining a competitive advantage over cleaner alternatives and promotes fair competition in the market.

Ghana's Energy Transition Framework and Investment Plan recognizes the importance of carbon pricing mechanisms in achieving the country's net-zero emissions target by 2070. The documents outline several carbon pricing initiatives including the introduction of an annual carbon levy on all fossil-fuelled internal combustion engine

[36] IEA (2020) Appliances and Equipment. https://www.iea.org/reports/appliances-and-equipment

[37] European Commission (2021) Ecodesign and Energy Labelling https://energy-efficient-products.ec.europa.eu/ecodesign-and-energy-label_en

[38] IEA. (2021). Global EV Outlook 2021. https://www.iea.org/reports/global-ev-outlook-2021

[39] World Bank. (2021). Carbon Pricing Dashboard. https://carbonpricingdashboard.worldbank.org/

(ICE) vehicles and the establishment of the Ghana Carbon Registry to serve as a database for collecting and tracking transactions from mitigation activities under the Environmental Protection Agency (EPA). The investment plan also proposes developing a Green Premium Capture Framework to enable green premium capture in the industrial sector, such as mandating transparency and certification in production processes.

Effective implementation of these pricing mechanisms requires strong institutional capacity, including skilled personnel, robust data management systems to track emissions, and efficient monitoring and verification processes to ensure compliance. This highlights the need for a clear assessment of Ghana's current institutional readiness to implement these mechanisms. Public awareness campaigns, stakeholder workshops, and capacity-building programs are also necessary to promote understanding and participation. While many countries have rolled out carbon pricing mechanisms domestically, there is a lack of harmonization and coordination at the global level. A more unified approach to carbon pricing could help create a level playing field for businesses operating across borders and facilitate greater emissions reductions on a global scale. The ETF however could explore innovative approaches to carbon pricing, such as border carbon adjustments or carbon pricing mechanisms specifically tailored to sectors with unique challenges, such as agriculture and aviation.

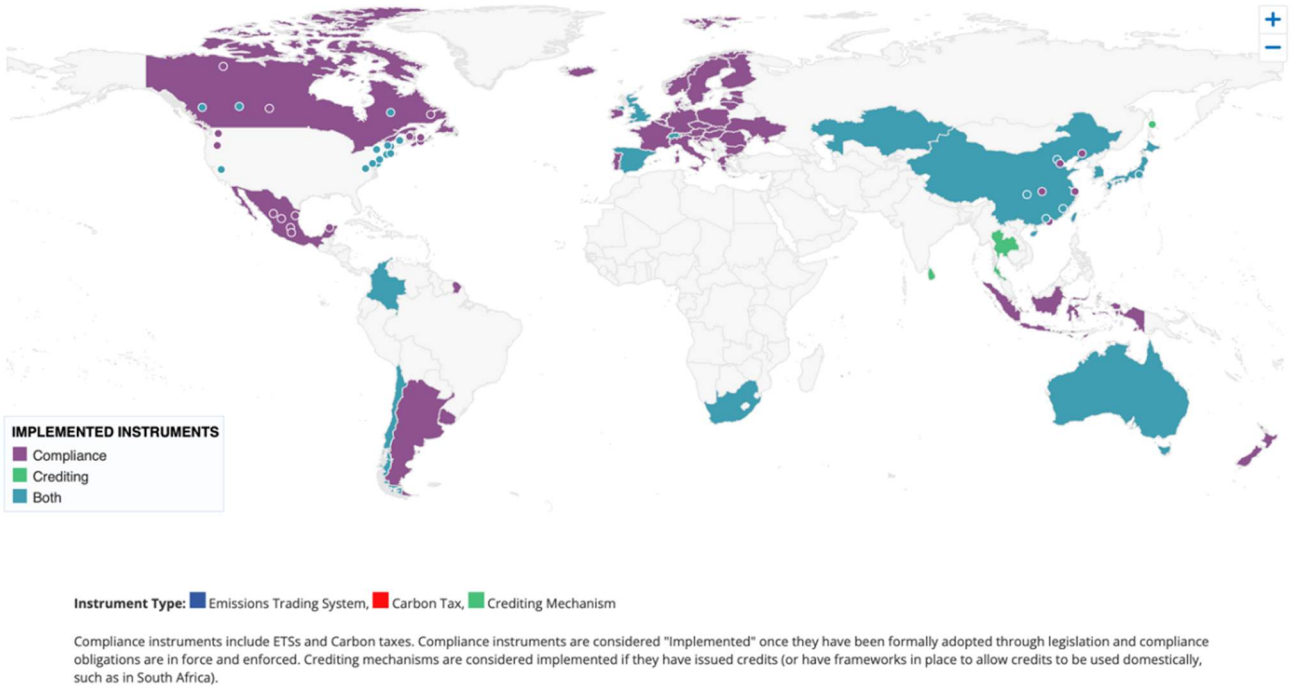


Figure 6: Regional Adoption of Carbon Pricing Mechanisms Across the World
Source: World Bank, 2021[39]

4.1.4 Gaps in Regulatory Framework

The regulatory framework in Ghana for renewable energy lacks specificity regarding financial incentives and subsidies, such as tax breaks and feed-in tariffs, necessary to attract private sector investment. Moreover, additional support mechanisms like technical assistance and public awareness programs are needed to facilitate the

widespread adoption of renewable energy technologies.
Furthermore, the integration of renewable energy into the national grid requires more detailed provisions, including grid codes, interconnection standards, and transmission infrastructure development. Addressing these grid integration challenges and ensuring sufficient infrastructure is crucial for the successful deployment of renewable energy projects.

Additionally, the framework lacks adequate provisions for monitoring, reporting, and enforcement mechanisms to ensure compliance with renewable energy regulations and standards. Strengthening these aspects would help uphold the integrity and effectiveness of governance in the renewable energy sector.
Regarding carbon pricing initiatives, such as the carbon levy on fossil-fueled vehicles and the green premium capture framework, the current scope is relatively narrow and may not sufficiently drive economy-wide decarbonization. Expanding carbon pricing coverage to sectors like power generation and industry could enhance its effectiveness.

Compared to global practices, Ghana's carbon pricing initiatives are still in their infancy. While promising, the carbon levy and green premium capture framework remain limited in scale and scope compared to comprehensive systems seen in other countries. For instance, countries like South Africa, Chile, and Mexico have implemented carbon taxes, while emissions trading systems (ETS) and carbon offset mechanisms have been established in various jurisdictions worldwide.
Additionally, implementing effective carbon pricing mechanisms in Ghana requires significant institutional capacity and stakeholder engagement. There is a need for investment in technical expertise, data management systems, and stakeholder outreach to ensure the successful implementation of these initiatives. Therefore, capacity building and robust stakeholder engagement will be essential elements

4.2.Emissions Reduction Plans and Targets

Ghana's total national greenhouse gas (GHG) emissions have been steadily increasing over the years. In 2019, the total national GHG emissions, including Land Use, Land-Use Change, and Forestry (LULUCF), reached 59.8 MtCO2e.[40] The energy sector has emerged as the leading source of GHG emissions in the country, accounting for 45.7% of total national emissions in 2019, followed by the agricultural sector (including LULUCF) at 44.6%, and the Industrial Processes and Product Use (IPPU) sector at 2.8%.

[40] Environmental Protection Agency (EPA) (2022) Ghana's Fourth National Greenhouse Gas Inventory Report https://unfccc.int/sites/default/files/resource/gh_nir4-1.pdf

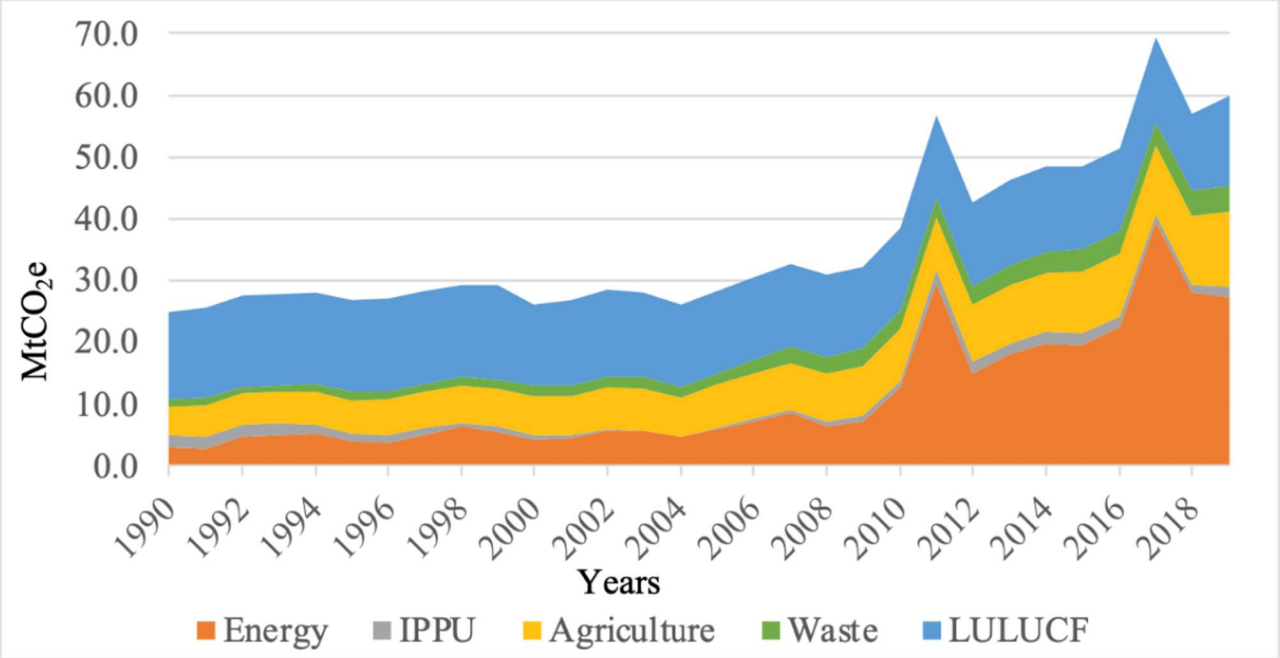


Figure 7: Total Emissions Trends by Sectors
Source: Ghana National Energy Transition Framework

The primary contributors to energy sector emissions are transportation (33.8%), oil and gas production (29.5%), and energy industries (27.2%). The sector has experienced significant emissions growth, notably in CO2 emissions, which have surged elevenfold from 2.5 Mt in 1990 to 26.4 Mt in 2019, representing an annual growth rate of 8.9%. This uptick can be chiefly attributed to the rising share of thermal electricity generation, increased gas flaring, and greater reliance on fossil fuels within the transport industry.

At the local level, emissions from the energy sector contribute to air pollution, which has adverse impacts on human health, agriculture, and ecosystems; and on a global scale, Ghana's GHG emissions contribute to climate change, which has far-reaching consequences for the country and the world at large. The ETF establishes the urgent need to reduce GHG emissions and mitigate the environmental impacts of the energy sector and sets targets for emission reductions in the energy sector, aiming for net-zero emissions by 2070 through a combination of strategies and measures across different sectors, focusing on the adoption of clean energy technologies, energy efficiency improvements, and the promotion of sustainable practices.

The specific measures outlined in the ETF to mitigate emissions from the transport sector include the promotion of electric vehicles, improving public transportation systems, encouraging non-motorized transport, and introducing cleaner fuels such as compressed natural gas (CNG) and biofuels. In addition, the ETF plans to implement regulations to prohibit flaring and venting, promote the utilization of associated gas, and invest in infrastructure for gas monetization to minimize emissions from the oil and gas sector. These measures require not only robust regulatory bodies but also adeptly skilled capacity to develop standards and efficiently conduct monitoring and conformance assessments.

Furthermore, ETF strategizes to achieve net-zero emissions by 2070 by supporting the development and deployment of innovative clean energy technologies, such as energy storage systems, hydrogen fuel cells, and carbon capture and storage. Although these are efficient emission reduction technologies, carbon capture and storage and hydrogen fuel cell technologies are still in the early stages of development and deployment. The plans therefore need to consider the technological readiness and corresponding cost-effectiveness of these technologies in the Ghanaian context and provide a realistic roadmap for their adoption and scaling up.

4.3 Technological, Research, and Development Requirements

Ghana's National Energy Transition Framework and Energy Transition and Investment Plan underscore the pivotal role of technological innovation and research and development in facilitating the transition to cleaner and more sustainable energy systems. The proposed strategies and measures, spanning renewable energy development, energy efficiency, and other emission reduction measures necessitate collaboration between government, research institutions, academia, and the private sector to drive innovation and knowledge sharing. Specifically, the plans highlight the importance of enhancing renewable energy technologies like solar, wind, and hydropower to improve efficiency and cost-effectiveness and also place emphasis on developing energy storage solutions, CCUS, smart grid technologies, and hydrogen and fuel cell applications to optimize grid stability and flexibility; where investment and innovation are needed.

Investing in research and development requires significant financial resources, and mobilizing these resources may be challenging, particularly in the context of competing development priorities. This highlights the need for clearer mechanisms for attracting investment from both public and private sources, as well as leveraging international partnerships and collaborations to support technological innovation.

While the plans emphasize the need to adopt global best practices and technologies, it is equally important to consider the local context and the specific needs and challenges of Ghana's energy system. The research and development efforts need to focus on adapting and localizing technologies to suit Ghana's socio-economic, environmental, and cultural realities. This includes considering factors such as affordability, scalability, and social acceptance of new technologies.

Advancing technological capabilities requires a skilled workforce and a robust research and innovation ecosystem. The absence of this consideration and prioritization of capacity building and skills development programs to ensure that Ghana has the necessary human capital to drive technological advancements in the energy sector is a gap in the ETF. This includes investing in science, technology, engineering, and mathematics (STEM) education, as well as fostering partnerships between academia and industry to promote applied research and technology transfer.

4.4 Socio-Economic Impact of the ETP

The Energy Transition Framework and the Energy Transition and Investment Plan acknowledge the potential for leveraging Ghana's energy transition to achieve multiple development objectives. The transition to a low-carbon economy has social and economic implications, for the general Ghanaian public but also for communities and workers in carbon-intensive sectors. Ensuring a fair and equitable transition requires the integration of specific measures within the energy transition plans that encompass initiatives aimed at fostering job creation while mitigating job erasure, enhancing skills development, and providing awareness campaigns and social protection to communities adversely affected by the transition.

4.4.1.Job Creation and Job Erasure

One of the key socio-economic impacts of the ETP is the potential for job creation. The Energy Transition and Investment Plan estimates that the implementation of the ETP could support around 400,000 additional jobs by 2060 across various sectors, including renewable energy, energy efficiency, and sustainable transportation. The growth of the renewable energy sector, particularly in solar and wind power, is expected to create new employment opportunities in areas such as manufacturing, installation, operation, and maintenance. Achieving these projections, particularly with maximized Ghanaian participation in the workforce, necessitates a strategic focus on investing in education, training, and capacity-building initiatives to develop the necessary skills and expertise in renewable energy, energy efficiency, and sustainable technologies.

The ETF recognizes the potential for stimulating economic growth by creating new business opportunities for small and medium enterprises through the development of a local renewable energy industry. By attempting to create an enabling regulatory environment for small-scale renewable energy generation by consumers, the plan seeks to encourage more individuals and businesses to invest in small-scale renewable energy projects, thereby fostering the growth of the local industry.

4.4.2.Poverty Alleviation and Energy Access

The transition also presents opportunities for poverty alleviation and improving energy access. The ETF highlights the importance of providing affordable and reliable energy access to all Ghanaians, particularly in rural and underserved communities. The plan aims to achieve universal access to electricity by 2025, promote the adoption of clean cooking solutions, and reduce reliance on traditional biomass. Improving energy access can have significant socio-economic benefits, including increased productivity, improved health outcomes, and enhanced educational opportunities, thereby contributing to poverty reduction and social development.

Energy transition frameworks often emphasize the concept of a "just transition," which focuses on ensuring that the transition to a low-carbon economy is fair and equitable, ensuring that the benefits of the transition are shared widely and equally. This includes providing targeted support and incentives for vulnerable and marginalized communities to access clean energy solutions and participate in the renewable energy value chain. The incorporation of measures to address energy poverty is necessary to ensure that the transition does not exacerbate existing social and economic inequalities.

While Ghana's plan emphasizes the need for developing local content and promoting local participation in the renewable energy value chain, the integration of renewable energy into agricultural and industrial processes should be considered to boost rural development, increase income generation, and promote sustainable livelihoods. Furthermore, opportunities for promoting circular economy principles and resource efficiency are also presented by energy transition. Although "waste" is presented as one of the sectors considered in the overall energy transition plan, specific strategies for this sector are not elaborated. Leveraging the shift to develop and promote strategies for managing and minimizing waste, promoting recycling and reuse, and optimizing resource consumption across the energy value chain will result in a more comprehensive sustainable economy.

4.4.3.Community and Inclusion

Achieving the socio-economic benefits of the energy transition requires public awareness, understanding, and acceptance of the proposed changes. Extensive public engagement and awareness campaigns to educate and sensitize the public about the benefits and opportunities of the energy transition should therefore be a foundation upon which the Framework is built and implemented. Engaging communities, civil society organizations, and other stakeholders in the planning and implementation processes can help build trust, address concerns, and ensure social acceptance of the transition measures.

Gender is an important aspect of energy transition frameworks, as women often face unique challenges and opportunities in accessing and benefiting from energy services. Although the ETF mentions the importance of gender equality, elaborate strategies for promoting gender equality, empowering women in the energy sector, and addressing gender-specific energy needs are missing.

Energy transition frameworks often incorporate social protection measures and safety nets to support communities and individuals adversely affected by the transition. This can include provisions for income support, social security, and access to essential services. Ghana's plan lacks specific social protection mechanisms to mitigate the potential negative impacts of the energy transition on vulnerable populations.

4.5 Relevance of Youth Participation in the Transition

Projections made by the ETF indicate that energy infrastructure, policy reforms, and supporting government implements need to be put in place within the window from 2022 to 2070. This period represents the epicentre of the transition, with a peak expected around 2045-2055 as the pivotal years during which government and other leaders will be required to navigate the complexities of a rapidly changing energy landscape, shifting from fossil fuels to renewable sources, enhancing energy efficiency, and adopting sustainable practices to meet international climate commitments. Ghana's age demographics are characterized by a substantial youth population, with 73.5% of the Ghanaian population being younger than 36 years. 35.3%% of the population is aged 0-14 years while the demographic poised to be in early and prime working ages during core implementation (15-35 years) of the energy

transition plan makes up 38.2% of early and prime working ages during core implementation (15-35 years) of the energy transition plan makes up 38.2% of the population.[41]

Concurrently, the age demographic distribution indicates that, during this very peak period, the majority of Ghana's youth population, between the ages of 15 and 35, will be actively participating in the workforce and, by extension, shaping national policy. This juxtaposition of energy transition requirements and youth's prime working years underscores the undeniable necessity of engaging the youth in crafting and implementing the energy transition framework. The youth's emergence as leaders during the critical phase of the transition can be transformed from a mere happenstance into a calculated strategy that harnesses emerging technologies

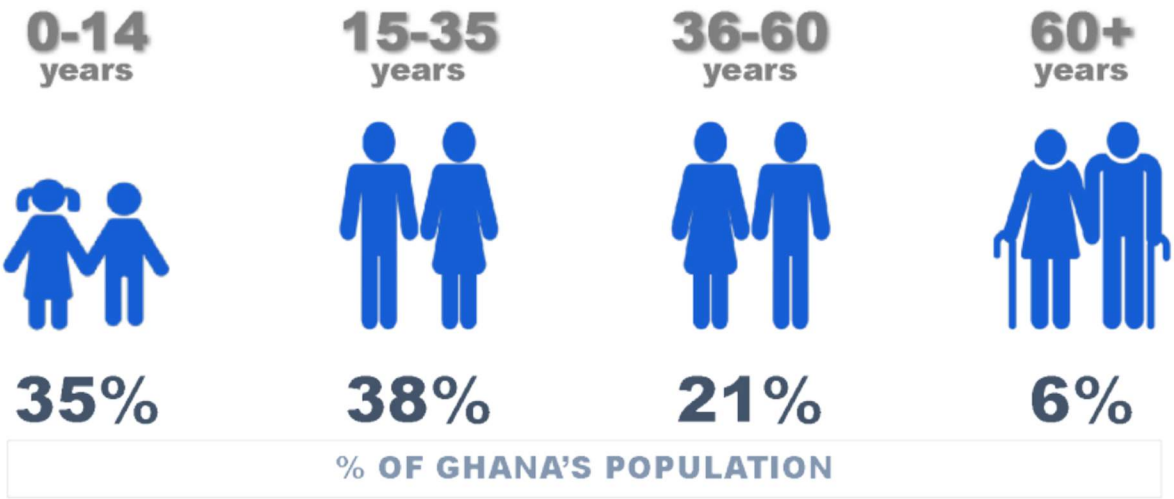


Figure 8: Age Demographic Distribution of Ghana

and engenders an infusion of fresh perspectives into the governance structures and policy frameworks that will underpin this transition. This can be achieved through knowledge-sharing engagements and increasing youth involvement at this stage as a deliberate imperative to ensure that future leaders are not only well-prepared but also deeply committed to the cause.

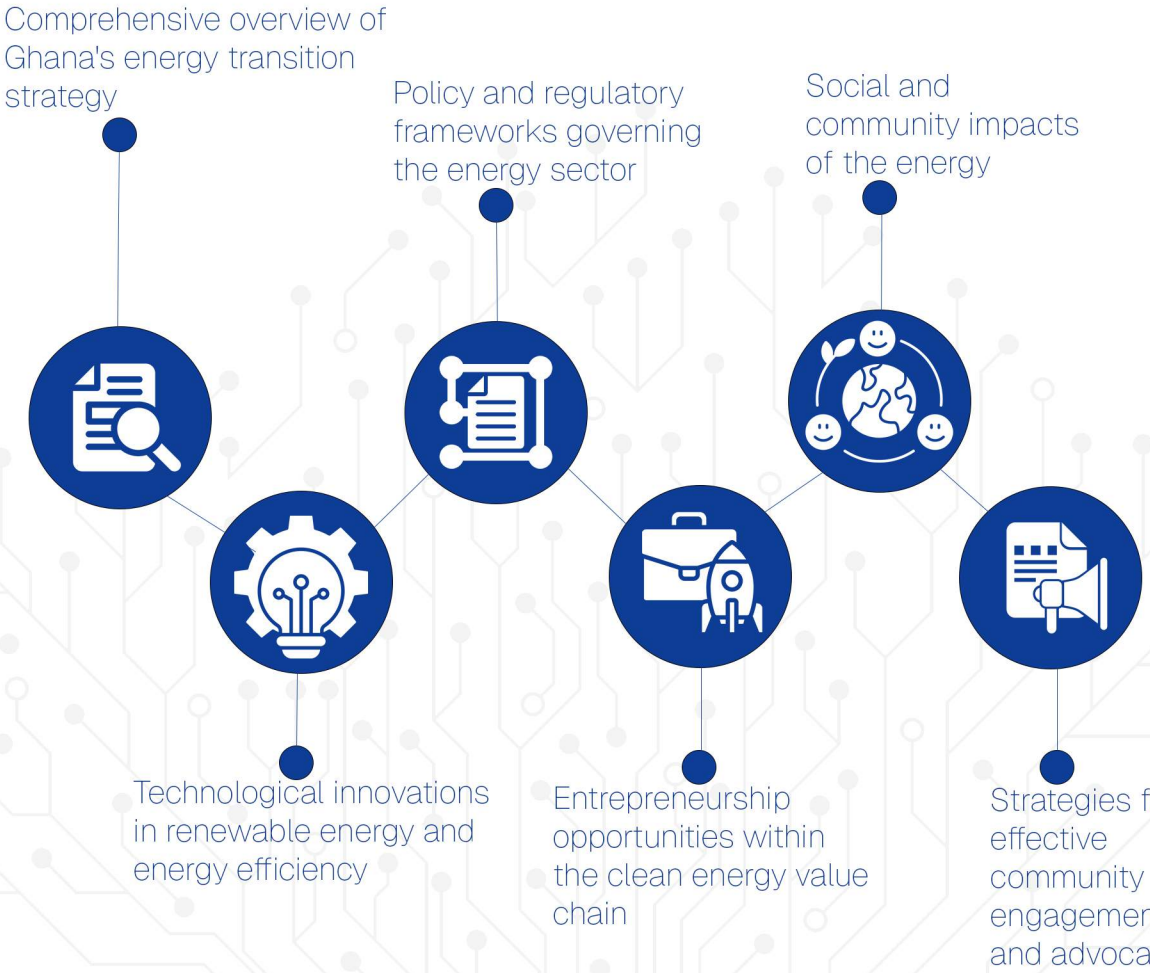
Building upon the recognition of youth as key stakeholders in Ghana's energy transition, a comprehensive youth engagement and capacity-building initiative was included as a core part of the study. This initiative was designed to jumpstart the address of the critical need for informed and empowered youth participation in the energy transition process.

The primary objective of this training program was to cultivate a deep understanding among youth representatives about Ghana's energy transition plans, targets, and associated financial commitments. Given their pivotal role as future leaders and primary implementers of the transition, the training encompassed a multi-faceted

[41] Ghana Statistical Service (2021) Ghana 2021 Population And Housing Census General Report Volume 3B https://census2021.statsghana.gov.gh/subreport.php?readreport=MjYzOTE0MjAuMzc2NQ==&Ghana-2021-Population-and-Housing-Census-General-Report-Volume-3B]

approach, providing in-depth knowledge on the technical aspects of renewable energy technologies, policy frameworks, and the intricate socio-economic implications of the transition.

The training program was strategically structured to cover the following key areas:



As part of the training, a brief survey was conducted among the participants to identify specific interests of Ghanaian youth and explore how these could be aligned with the transition's objectives. Recognizing the financial limitations on the youth and the reduced access to capital, the study placed a significant focus on identifying and exploring entrepreneurial pathways within the sector. This aimed to ultimately uncover viable entry points for youth in the burgeoning clean energy economy of Ghana and ensured that this study's recommendations are well-grounded and reflective of youth perspectives.

The survey (see full report in Annex 1) revealed the lack of awareness about the transition and the opportunities it presents as the primary barrier to the youth's active and profitable participation in Ghana's energy transition, cited by 77% of the 30 respondents (Figure 9). This suggests that there's a substantial information gap when it comes to actual participation opportunities. Following closely, 71.43% identified lack of resources or support as a major obstacle, indicating that even if aware, many young people feel ill-equipped to engage effectively.

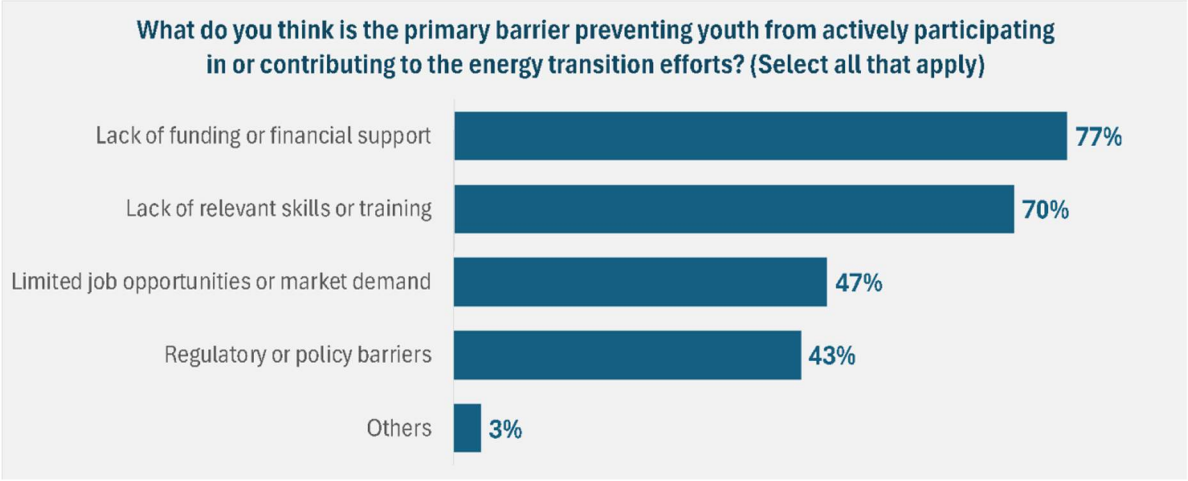


Figure 9: Survey Responses on Barriers to Youth Participation in the Energy Transition (% of respondents)

On a more positive note, 92.86% of respondents expressed high interest in participating in or supporting youth-led renewable energy startups. This extraordinary level of enthusiasm indicates a huge untapped potential for youth-driven initiatives in the clean energy sector. To harness this enthusiasm and overcome the identified barriers, respondents suggested several strategies. These include extending outreach efforts, involving youth in decision-making processes, creating job opportunities, simplifying sensitization processes, and utilizing engaging media formats. These suggestions point towards a desire for more direct, accessible, and meaningful ways for youth to participate in the energy transition.

The survey highlights a strong perception of nature of the clean energy field as technical, with 87% of respondents identifying technical skills as the most valuable for pursuing careers in this sector. Interestingly, business and entrepreneurship skills, as well as digital and technology skills, were equally valued by 83% of respondents (Figure 10). This suggests an understanding that the clean energy transition is not just about technical know-how, but also about creating viable business models and leveraging digital technologies.

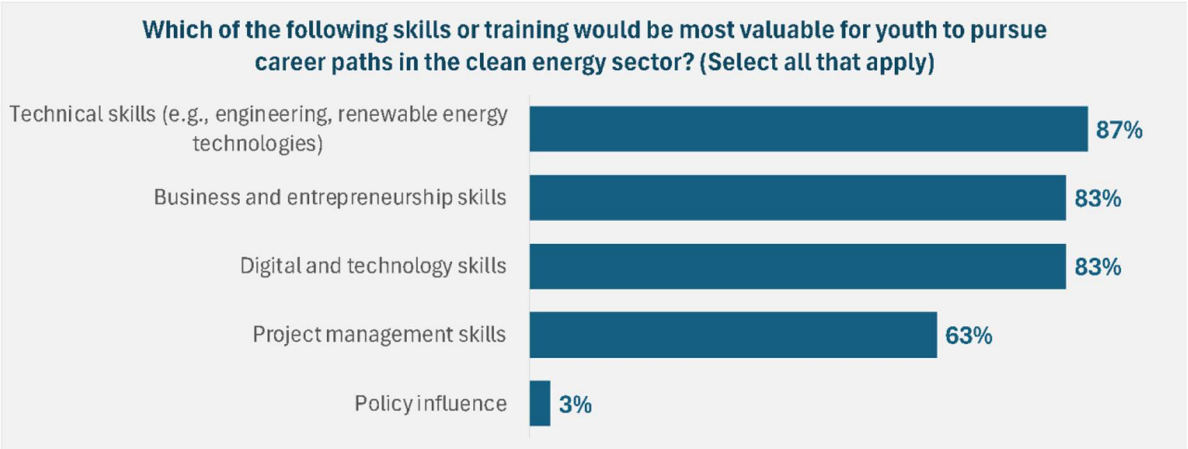


Figure 10: Skills and Training Interests of Survey Respondents (% of respondents)

When it comes to nurturing youth talent, incubation programs emerged as the most popular strategy, with 87% of respondents supporting this approach. This indicates a strong desire for structured, supportive environments where young professionals can develop their ideas and skills. Partnerships with technology companies were also highly favoured (77%), highlighting the importance of industry involvement in skill development, particularly in emerging industries like renewable energy.

Despite these challenges, respondents expressed high interest in various investment opportunities within the clean energy sector. Clean energy technology manufacturing garnered the most interest (86%), closely followed by renewable energy project development and construction (82%) and energy storage solutions (82%). This enthusiasm spans across different aspects of the clean energy value chain, from manufacturing to project development and innovative technologies.

Given these findings, it might be beneficial to consider developing targeted programs or initiatives that directly address the identified barriers. For instance, a comprehensive awareness campaign using engaging media formats could help bridge the information gap. Additionally, creating structured opportunities for youth involvement in energy-related projects or policy discussions could provide the direct engagement many seem to be seeking.

Leveraging the participants' roles as members of the community, the survey also gathered insights on the perceived impacts of the energy transition on local communities. This community-level perspective is crucial for developing inclusive and socially responsible transition strategies. Interestingly, the findings point towards a strong enthusiasm among youth for community involvement in the energy transition process. As depicted in Figure 11, 87% of respondents identified volunteering or supporting local initiatives as an effective approach for youth to contribute to community engagement, while 80% recognized the value of organizing community events or workshops and developing educational materials or campaigns.

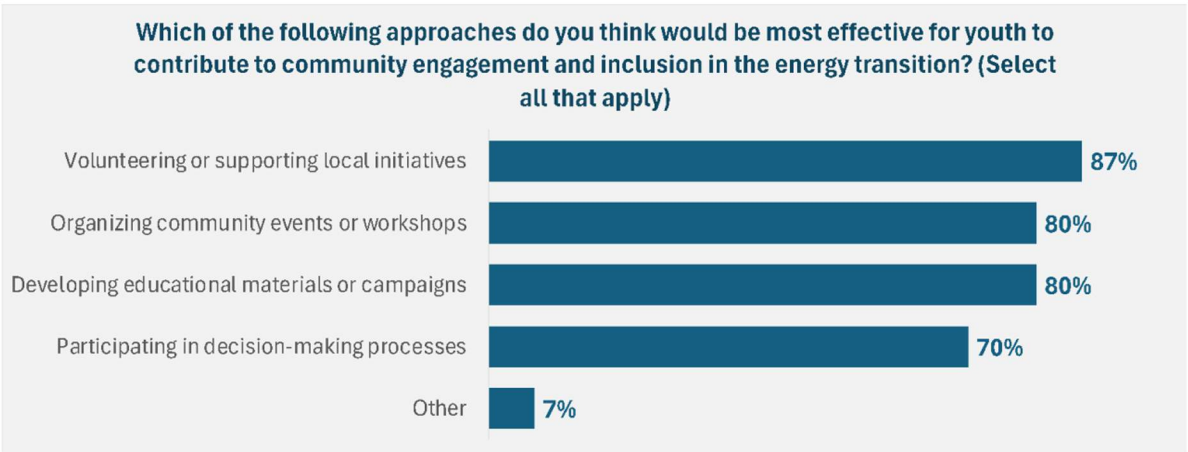


Figure 11: Survey Respondents' take on Effective Ways for Youth Participation in Community Inclusion Efforts (% of respondents)

Turning to the impact on local communities, the survey reveals a nuanced understanding of both the benefits and challenges of the energy transition. Access to reliable and affordable energy was seen as the primary benefit by 77% of respondents, underlining the fundamental importance of energy access for community development.

Job creation and economic development opportunities were equally valued, each cited by 70% of respondents.

At the same time, job losses in traditional energy sectors were identified as the most significant concern by 50% of respondents, emphasising the need for a just transition that considers the livelihoods of those currently employed in conventional energy industries. To address these challenges and support communities during the transition, respondents emphasized the importance Job training and reskilling programs, as well as access to information and resources, which were both seen as "very important" by 90% of respondents in response to the query "Rate the importance of the following types of support or assistance for communities and individuals affected by the energy transition."

The survey indicates that thee Ghanaian youth see themselves as potential educators and facilitators in the energy transition process and can therefore be trained as such to serve as change agents in communities.

5 FINANCIAL AND INVESTMENT LANDSCAPE

5.1.Financial Implications of the ETP

5.1.1 Financing Requirements

The Ghana Energy Transition and Investment Plan addresses the financial needs for achieving a net-zero emissions economy by 2060. The plan emphasises the importance of significant capital expenditure to meet such lofty goals. According to the plan, nearly USD 550 billion in cumulative capital investment (USD 140 billion more than under BAU) is required, with the power and transport sectors accounting for around 90% of the total. Coordination between government agencies, businesses, financial institutions, and foreign partners is necessary to meet the multifaceted financial requirements of Ghana's Energy Transition Plan.[42]

Ghana's energy transition offers a plethora of opportunities, both economically and in terms of sustainable development. A number of sources, including carbon pricing mechanisms, renewable energy projects, and other transition-related activities, are expected to generate significant amounts of revenue. The expansion of renewable energy projects is one of the main forces behind Ghana's energy transition in terms of revenue production. The plan calls for raising the proportion of renewable energy to 10% of the nation's energy mix by 2030. There will likely be major economic benefits from this change to renewable energy, especially solar and wind power. Estimates indicate that by 2030, total investment in renewable energy projects might reach around $4.5 billion, creating large revenue streams through project development, operations, and maintenance.

Furthermore, carbon pricing mechanisms will play a crucial role in incentivizing low-carbon investments and activities. Ghana's commitment to reducing greenhouse gas emissions aligns with global efforts to mitigate climate change. The implementation of carbon pricing, such as carbon taxes or emissions trading schemes, not only encourages industries to adopt cleaner technologies but also creates new revenue streams for the government. The plan suggests that carbon pricing mechanisms could contribute up to $200 million annually to Ghana's economy by 2030.

The primary factors influencing costs and investment priorities in the transition plan are centered on the progression of fundamental decarbonization technologies like Renewable Energy Infrastructure, Grid Modernization, Transportation Electrification, and Energy Efficiency. Additional drivers include the implementation of supportive policies and incentives, along with fostering collaboration among stakeholders. These initiatives are aimed at establishing a sustainable and economically viable energy system for Ghana's population and various economic sectors. Notably, significant capital investments are allocated to the transport sector initially, followed by a focus on power, hydrogen, industry, and buildings, which aligns with the plan's strategic investment objectives.[43]

[42] GHANA ENERGYTRANSITION AND INVESTMENT PLAN

[43] FINAL GHANA'S NATIONAL ENERGY TRANSITION FRAMEWORK_2023

5.1.2.Funding Sources for the ETP

Ghana's Energy Transition Plan is primarily funded through a combination of core finance providers' i.e. (private sector capital and Domestic public sector) and de-risking instruments provided by a variety of actors, including commercial financial institutions, corporations, households and individuals, public institutions, multilateral development finance institutions, bilateral development finance institutions, national development finance institutions, green finance funds, private foundations, and major pension funds. It is also expected that Private Financiers and Beneficiaries will contribute a substantial amount to the total cost since the end-use technologies, including vehicles and cookstoves, will be largely financed by the private sector.

Domestic funding for Ghana's Energy Transition plan will be through government budget allocations and revenue from energy-related taxes and levies. The government will also use funds from the energy sector, including grants from state-owned firms like the Ghana National Petroleum Corporation (GNPC) and the Volta River Authority (VRA). These monies will be distributed in accordance with the Energy Transition Plan's strategic priorities, which include the development of renewable energy sources, energy-saving projects, and improving rural electricity access.

Internationally, Ghana can obtain finance through collaborations with multilateral organisations such as the World Bank, the African Development Bank (AfDB), and the International Monetary Fund (IMF). These collaborations include grants, concessional loans, and technical assistance to help with various components of the Energy Transition Plan, such as capacity building, technology transfer, and infrastructure development.[44]

Additionally, public-private partnerships (PPPs) can be explored to leverage private sector expertise and investment for energy transition projects. These partnerships can facilitate the deployment of innovative technologies, attract capital investment, and create opportunities for local businesses and job creation.

The transition plan establishes the amount of approximately USD 550 billion as total capital investment. A sizable share, roughly 90%, is reserved for the power and transportation sectors, reflecting their critical role in the investment environment. Transport takes the largest proportion of investment, accounting for over 70% of the total allocation. This considerable shift is mostly due to rising ownership prices for private vehicles and other modes of transportation, which are being driven by a notable growth in incomes.

Meanwhile, the power and hydrogen sectors jointly account for a considerable share, around 20%, of the total investment requirement. This underscores the crucial role these sectors play in the transition towards a sustainable energy system. On the other hand, industry and buildings, while integral components of the transition plan, represent a smaller share of investment, collectively amounting to less than 10% of the overall capital investment.

[44] GHANA ENERGYTRANSITION AND INVESTMENT PLAN

Innovative financing mechanisms and partnerships play a crucial role in mobilizing additional funding for Ghana's Energy Transition Plan. One such mechanism is the Green Climate Fund (GCF), which provides financing for climate-related projects, including renewable energy and adaptation initiatives. Ghana has accessed GCF funding for projects like the Renewable Energy Mini-Grids for Rural Development Program, which aims to increase energy access in off-grid areas.

5.2 Projected Revenues from the Transition

The energy transition in Ghana presents a promising landscape of opportunities, not just in terms of sustainable development, but also economically. According to the Ghana Energy Transition and Investment Plan, there are significant projected revenues and economic benefits associated with this transition. These benefits stem from various sources, including renewable energy projects, carbon pricing mechanisms, and other transition-related activities.
One of the key drivers of revenue generation in Ghana's energy transition is the expansion of renewable energy projects. The plan outlines a target to increase the share of renewable energy in the country's energy mix to 10% by 2030. This shift towards renewables, particularly solar and wind power, is expected to unlock substantial economic benefits. For instance, the plan estimates that by 2030, the total investment in renewable energy projects could reach approximately $4.5 billion, generating significant revenue streams through project development, operations, and maintenance.

Furthermore, carbon pricing mechanisms play a crucial role in incentivizing low-carbon investments and activities. Ghana's commitment to reducing greenhouse gas emissions aligns with global efforts to mitigate climate change. The implementation of carbon pricing, such as carbon taxes or emissions trading schemes, not only encourages industries to adopt cleaner technologies but also creates new revenue streams for the government. The plan suggests that carbon pricing mechanisms could contribute up to $200 million annually to Ghana's economy by 2030.

Apart from direct investments in renewable energy and carbon pricing, the energy transition brings about a range of other economic benefits. These include job creation in the renewable energy sector, reduced import dependency on fossil fuels, improved energy access in rural areas through decentralized renewable energy solutions, and improved energy security. The plan emphasizes the potential for fostering innovation and entrepreneurship in clean energy technologies, which can further stimulate economic growth and competitiveness.

In conclusion, Ghana's energy transition makes a compelling case for revenue generation and economic prosperity. With a strategic focus on renewable energy, carbon pricing mechanisms, and fostering a conducive environment for clean energy investments, Ghana is poised to harness the economic benefits of transitioning towards a sustainable energy future.

5.3 Effectiveness of Landscape in Incentivizing Investment

The current financial landscape appears to have a mix of core finance providers and de-risking instruments that could help incentivize investment in Ghana's energy transition. Ghana's efforts to incentivize investment in the energy transition are progressing, thanks to supportive policies like the Renewable Energy Act 2011 (Act 832), the National Energy Policy, and the Ghana Energy Transition & Investment Plan. However, challenges persist, including limited access to affordable finance and risks like currency fluctuations. Collaborative partnerships and risk mitigation measures are crucial for attracting more private sector investment.

Global green funds and energy transition investors are undoubtedly eyeing opportunities that align with various factors such as environmental sustainability, affordability, favourable investment conditions, emerging growth sectors, enhanced energy security, improved trade balances, and positive employment impacts. However, despite these promising prospects, potential barriers and challenges exist in attracting private-sector investment.

These challenges encompass regulatory complexities, financial uncertainties, political stability concerns, and market volatilities, which can deter investors from committing to projects in developing nations like Ghana. Mitigating specific factors like high capital costs, currency fluctuations, lengthy negotiation processes, and bureaucracy is crucial to encouraging substantially increased levels of financing for the energy transition. Addressing these risks, whether real or perceived, is essential to build investor confidence and promote sustainable investment in Ghana's energy sector.[45]

In comparison to other countries, Ghana seems to be making strides towards achieving net-zero emissions by 2060 through its Energy Transition and Investment Plan. However, policy and regulatory framework reforms that could accelerate the investment climate in Ghana, and ensure net-zero emissions by 2060 are achieved.

[45] https://www.weforum.org/agenda/2023/08/financing-energy-transition-developing-economies/#:~:text=Overcoming%20energy%20investment%20challenges&text=%E2%80%9CAttracting%20much%20higher%20levels%20of,currency%20risks%20and%20political%20risks.

6 INSTITUTIONAL READINESS FOR THE TRANSITION / SECTORAL ANALYSIS OF THE ETP

Energy transition inherently involves a **complex interplay of policies, technologies, and stakeholders across multiple sectors.**

The successful implementation of Ghana's Energy Transition Plan (ETP) and achievement of the set targets is anchored in a comprehensive framework that encompasses various sectors and therefore requires the readiness and active participation of the institutions that make up these sectors. Energy transition inherently involves a complex interplay of policies, technologies, and stakeholders across multiple sectors. Understanding the roles, responsibilities, and capacities of key institutions and sectors is crucial for identifying gaps, challenges, and opportunities in the implementation of the ETP.

This chapter will examine the readiness of five key sectors: power, transport, oil and gas, environmental oversight, and building and infrastructure development. For each sector, the role of relevant ministries, regulators, and government institutions in driving the energy transition will be identified. Furthermore, the current state of each sector will be assessed and its alignment with the overall objectives and targets of the ETP. The specific expansion strategies outlined for each sector are also outlined here, focusing on renewable energy deployment, grid modernization, energy efficiency measures, and other relevant initiatives. It is key to note that the private sector plays a vital role in the energy transition, bringing innovation, investment, and expertise to the table.

By conducting a comprehensive institutional and sectoral analysis, this chapter aims to provide a clear understanding of the current state of readiness for Ghana's energy transition and identify areas where further capacity building, policy support, and stakeholder engagement may be required.

6.1 Power Sector

Main Stakeholders	Role in the Transition	Expansion Strategies in the Framework
Ministry of Energy	Sets overall policy direction and manages the power sector.	▪ Increase the share of renewable energy in the power generation mix. ▪ Modernize grid infrastructure. ▪ Encourage private sector participation.
Energy Commission	Regulates and supervises the utilization of energy resources, including renewable energy.	▪ Licensing, regulation, and supervision of energy resource utilization.
Volta River Authority	Responsible for electricity generation.	▪ Invest in cleaner fuel technologies. Implement emission reduction ▪ measures in exploration and production activities.

[45] https://www.weforum.org/agenda/2023/08/financing-energy-transition-developing-economies/#:~:text=Overcoming%20energy%20investment%20challenges&text=%E2%80%9CAttracting%20much%20higher%20levels%20of,currency%20risks%20and%20political%20risks.

Ghana Grid Company	Responsible for electricity transmission.	▪ Modernize grid infrastructure to support renewable energy integration. ▪ Improve transmission capacity and efficiency.
Electricity Company of Ghana (ECG)	Main distribution utility, responsible for electricity distribution.	▪ Improve distribution infrastructure and efficiency. ▪ Enhance electricity access in underserved areas. ▪ Promote clean cooking solutions.
Northern Electricity Distribution Company (NEDCo)	Distributes electricity in Northern Ghana.	▪ Expand electricity distribution network to cover more areas. ▪ Promote renewable energy adoption in distribution networks.

To successfully integrate variable renewable energy sources, modernize grid infrastructure, and improve energy efficiency, Ghana must overcome technical, capacity, and infrastructural barriers that are common among developing nations. Integrating variable renewable energy sources, such as solar PV and wind power, into existing grid infrastructure is a complex technical challenge that requires sophisticated grid management systems and advanced forecasting capabilities. Ghana's current grid infrastructure lacks the flexibility and resilience needed to accommodate high levels of intermittent renewable energy. Compared to global leaders in renewable energy integration, such as Denmark and Germany, which have achieved renewable energy shares of 50% and 38% respectively[46], Ghana's renewable energy penetration remains low at around 5%.[47]

To manage grid stability and reliability with increasing shares of renewable energy, Ghana must invest in advanced metering infrastructure (AMI) and smart grid technologies. AMI enables real-time monitoring and control of electricity consumption, while smart grid technologies optimize grid operations and reduce transmission and distribution losses. In Ghana, transmission and distribution losses average around 25%, significantly higher than the global best practice benchmark of 6-8%.[48] Implementing these technologies will require significant technical expertise and financial investments.

Pertaining to capacity-related challenges, Ghana faces a critical shortage of local expertise in renewable energy technologies, energy efficiency, and grid management. The limited technical capacity and skills in designing, installing, and maintaining renewable energy systems hinder the widespread adoption of solar PV, wind power, and other clean energy technologies. In comparison, countries like India and China have successfully developed robust local supply chains and skilled workforces for renewable energy through targeted capacity-building programs and industry partnerships.[49]

[45] International Energy Agency (IEA). (2020). Renewable Energy Market Update. https://www.iea.org/reports/renewable-energy-market-update

[47] Energy Commission. (2020). National Energy Statistics 2000-2019. https://www.energycom.gov.gh/planning/data-center/energy-outlook-for-ghana

[48] World Bank. (2018). Electric Power Transmission and Distribution Losses (% of output). https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS

[49] International Renewable Energy Agency (IRENA). (2019). Renewable Energy and Jobs – Annual Review 2019. https://www.irena.org/publications/2019/Jun/Renewable-Energy-and-Jobs-Annual-Review-2019

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To bridge this skills gap, Ghana must invest in comprehensive training and education programs for energy professionals, engineers, and technicians. Collaborative partnerships between government agencies, educational institutions, and private sector companies can help develop curricula and training programs aligned with industry needs. Establishing centres of excellence for renewable energy research and development can also foster innovation and knowledge sharing.

Ghana's overloaded power grid infrastructure poses significant challenges for integrating renewable energy and improving energy efficiency. The country's transmission and distribution networks are inadequate to accommodate the expected growth in electricity demand and the integration of large-scale renewable energy projects. In addition, Ghana lacks sufficient infrastructure for energy storage systems, which are critical for balancing intermittent renewable energy supply and ensuring grid stability. To address these infrastructural challenges, Ghana must prioritize investments in grid modernization and expansion. This includes upgrading transmission and distribution lines, constructing new substations, and deploying smart grid technologies to improve grid efficiency and resilience. Developing a comprehensive energy storage roadmap that identifies suitable storage technologies, such as batteries and pumped hydro storage, and prioritizes strategic locations for storage infrastructure development can help manage the variability of renewable energy generation.

6.2 Transport Sector

Main Stakeholders	Role in the Transition	Expansion Strategies in the Framework
Ministry of Transport	Sets policy direction and manages the transport sector.	▪ Promote sustainable transportation. ▪ Develop electric vehicle infrastructure. ▪ Encourage cleaner fuels.
Driver and Vehicle Licensing Authority (DVLA)	Registers and licenses vehicles.	▪ Implement regulations and standards for vehicle emissions and efficiency. ▪ Promote electric vehicle adoption.
National Road Safety Authority (NRSA)	Promotes road safety and reduces accidents.	▪ Enhance road safety measures and regulations. ▪ Promote eco-friendly transportation practices.

Ghana's transport sector is heavily reliant on fossil fuels, with a significant portion of vehicles being old and inefficient, leading to high levels of greenhouse gas emissions and air pollution. However, there is growing interest in electric vehicles and the use of cleaner fuels, presenting opportunities for transformative change.

Compared to global leaders in sustainable transportation, such as Norway and China, which have achieved electric vehicle market shares of 75% and 6% respectively,[50] Ghana's uptake of electric vehicles remains nascent. The limited availability and affordability of electric vehicles, coupled with inadequate charging infrastructure, pose significant barriers to widespread adoption.

On the capacity front, the country grapples with a dearth of expertise in planning and implementing sustainable transportation solutions, such as bus rapid transit (BRT) and light rail transit (LRT) systems. Moreover, the scarcity of trained personnel proficient in managing and maintaining electric vehicle fleets and charging infrastructure poses a significant impediment to progress. To overcome these challenges, Ghana must prioritize capacity-building initiatives encompassing traffic management, urban planning, and the development of non-motorized transport infrastructure.

Inadequate road infrastructure and chronic congestion in urban areas act as formidable barriers to the widespread deployment of electric vehicles and public transportation systems. Furthermore, the lack of essential infrastructure for pedestrian and cycling facilities curtails efforts to promote non-motorized transport modes. Addressing these infrastructural deficiencies necessitates concerted efforts to enhance road networks and alleviate congestion, alongside investments in dedicated lanes and infrastructure tailored to support BRT and LRT systems.

6.3 Oil and Gas Sector

Main Stakeholders	Role in the Transition	Expansion Strategies in the Framework
Ministry of Energy	Sets policy direction and manages the oil and gas sector.	▪ Promote the use of cleaner fuels. ▪ Implement measures to reduce emissions. ▪ Encourage private sector participation.
Petroleum Commission	Regulates and manages the utilization of petroleum resources.	▪ Regulation and oversight of oil and gas activities. ▪ Promote cleaner fuel usage and emission reduction measures.
Ghana National Petroleum Corporation (GNPC)	Responsible for oil and gas exploration and production.	▪ Invest in cleaner fuel technologies. Implement emission reduction ▪ measures in exploration and production activities.
Tema Oil Refinery (TOR)	Refines crude oil.	▪ Explore cleaner refining technologies. ▪ Promote the use of low-sulfur fuels.
Bulk Oil Storage and Transportation Company (BOST)	Stores and distributes petroleum products.	▪ Invest in infrastructure for cleaner fuel storage and distribution. ▪ Implement measures to reduce environmental impact.

[50] International Energy Agency (IEA). (2021). Global EV Outlook 2021. https://www.iea.org/reports/global-ev-outlook-2021

The oil and gas sector in Ghana holds a pivotal position within the country's economy, yet it confronts substantial hurdles in transitioning towards a more sustainable, low-carbon trajectory. Contributing significantly to greenhouse gas emissions, particularly through the practice of flaring and venting associated gas, this sector stands at a crossroads as global trends steer towards cleaner energy alternatives. In contrast to leading examples like Norway, where flaring intensity stands at a mere 0.3% of total gas production, Ghana's figures paint a starkly different picture, with flaring intensity lingering around 15%.[51] To surmount its existing challenges, Ghana's agenda must prioritize the deployment of emission mitigation strategies, encompassing measures like leak detection and repair (LDAR) programs, vapour recovery units (VRUs), and the integration of flaring and venting reduction technologies

6.4 Environmental Oversight

Main Stakeholders	Role in the Transition	Expansion Strategies in the Framework
Ministry of Environment, Science, Technology, and Innovation (MESTI)	Sets policy direction and manages environmental issues.	▪ Strengthen regulatory capacity. ▪ Promote environmental impact assessments (EIAs). ▪ Encourage best practices for environmental management.
Environmental Protection Authority (EPA)	Regulates and manages environmental impacts.	▪ Monitor and enforce compliance with environmental regulations. ▪ Conduct environmental impact assessments for energy projects.

Ghana's environmental oversight sector plays a critical role in ensuring that the country's energy transition is sustainable, equitable, and aligned with national and international environmental commitments. However, compared to global best practices in environmental monitoring and enforcement, Ghana's environmental oversight sector lags in the adoption of advanced technologies and data-driven approaches. For example, countries like the United States and China have deployed extensive networks of air quality monitoring stations and satellite-based remote sensing tools to track emissions and enforce environmental regulations[52] [53].

Improving environmental monitoring and data management systems, alongside strengthening the technical capabilities of environmental oversight institutions, stands as a crucial goal for Ghana. In this pursuit, Ghana can glean invaluable insights from successful initiatives like the Partnership for Clean Fuels and Vehicles (PCFV) in Africa. This program has been instrumental in facilitating the adoption of fuel quality standards and the establishment of monitoring infrastructure across

[51] Ministry of Energy. (2021). National Energy Statistics 2000-2020. https://www.energycom.gov.gh/planning/energy-statistics

[52] Environmental Protection Agency (USA EPA). (2021). Interactive Map of Air Quality Monitors. https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors

[53] Ministry of Environment and Ecology (MEE). (2021). Satellite Environmental Application Center. http://www.secmep.cn/

several countries in the region.[54] Through the PCFV case study, Ghana can discern the significance of capacity-building endeavours aimed at enhancing the expertise of environmental regulatory bodies. Moreover, it underscores the importance of fostering technology transfer and knowledge exchange initiatives among stakeholders to bolster environmental governance and improve the efficacy of collaborative efforts with regional and international partners in addressing environmental challenges comprehensively and sustainably.

6.5 Building and Infrastructure Development

Main Stakeholders	Role in the Transition	Expansion Strategies in the Framework
Ministry of Works and Housing	Sets policy direction and manages building and infrastructure development.	▪ Promote energy-efficient building design and construction. ▪ Develop sustainable urban infrastructure. ▪ Encourage renewable energy use in buildings.

Ghana's building and construction sector has not sufficiently progressed in the adoption of energy-efficient technologies, materials, and design principles. For example, countries like Singapore and the United Arab Emirates have implemented comprehensive green building rating systems and standards, such as the Green Mark Scheme and the Estidama Pearl Rating System, to promote energy efficiency and sustainability in the built environment[55] [56]. Ghana must therefore prioritize the development and implementation of green building codes and standards, as well as the promotion of sustainable design and construction practices.regulatory bodies. Moreover, it underscores the importance of fostering technology transfer and knowledge exchange initiatives among stakeholders to bolster environmental governance and improve the efficacy of collaborative efforts with regional and international partners in addressing environmental challenges comprehensively and sustainably.

[54] United Nations Environment Programme (UNEP). (2020). Partnership for Clean Fuels and Vehicles. https://www.unep.org/explore-topics/transport/what-we-do/partnership-clean-fuels-and-vehicles

[55] Building and Construction Authority (BCA). (2021). Green Mark Scheme. https://www1.bca.gov.sg/buildsg/sustainability/green-mark-certification-scheme

[56] Department of Urban Planning and Municipalities (DPM). (2021). Estidama Pearl Rating System. https://pages.dmt.gov.ae/en/Urban-Planning/Pearl-Building-Rating-System

7

THE ROLE OF CRITICAL MINERALS IN GHANA'S ENERGY TRANSITION PLAN

7.1 Ghana's Critical Minerals

The shift from fossil fuels to a low-carbon future has brought to the fore the significance of some minerals considered 'critical' to this process. Lithium, cobalt, nickel, manganese, and graphite are essential in the production of clean energy technologies, including solar panels, wind turbines, rechargeable batteries for electric vehicles (EVs), and grid battery storage.

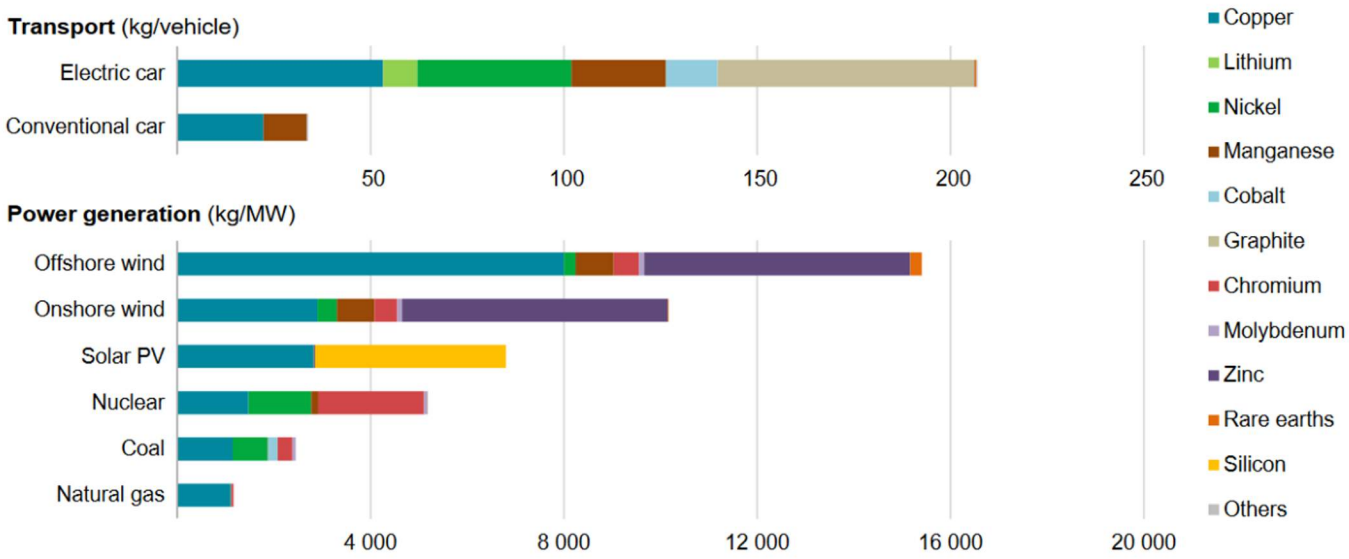

Figure 11: Minerals Used in Selected Clean Energy Technologies
Source: International Energy Agency, 2021

Large reserves of these critical minerals, also termed transitional minerals, are located in the Global South, with the African continent possessing a fourth of global reserves, including nearly 20% of those needed for electric vehicles.[57] To achieve the goals of the Paris Accord, the IEA estimates that more than 3 billion tonnes of critical minerals are needed to produce clean energy technologies.[58]

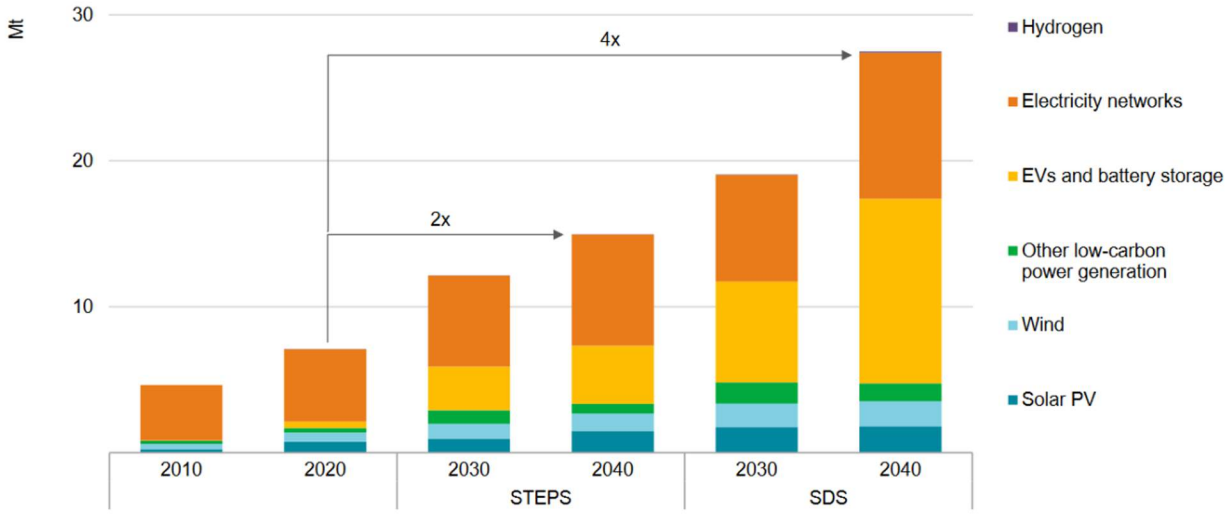

Figure 12: Total Mineral Demand for Clean Energy Technologies by Scenario
Source: International Energy Agency, 2021

[57] https://unctad.org/publication/technical-note-critical-minerals
[58] https://www.iea.org/news/clean-energy-demand-for-critical-minerals-set-to-soar-as-the-world-pursues-net-zero-goals

Ghana is endowed with significant deposits of critical minerals and metals, vital in the energy transition process. The recent discovery of lithium and graphite in commercial quantities, in addition to existing deposits of industrial metals including manganese, bauxite and iron ore, highlights Ghana's potential to become an energy transition hub in the sub-region, with the right policy framework and investment.

7.1.1 Lithium

Ghana discovered lithium in commercial quantities in 2018[59] and has subsequently granted a subsidiary of Atlantic Lithium Limited, Barari DV Ghana Limited, a 15-year Mining Lease to commence the construction and mining of lithium at Ewoyaa in the Central Region.[60] Lithium, considered one of the most important transitional minerals, is used in the production of lithium-ion batteries used in electric vehicles. The Mineral Resource Estimate ("MRE" or the "Resource") of the Ewoyaa project has recently been upgraded to 35.3Mt at 1.25% Li2O by Atlantic Lithium, with an estimated life mine of revenues exceeding $4.8 billion.[61]

Recognizing that the export of raw materials in the form of concentrates is not economically beneficial, the Energy Transition Framework emphasizes the government's commitment to efficiently utilize lithium resources through value addition to position Ghana as a hub for electric vehicles and the production of battery technologies.[62]

7.1.2 Graphite

The Ghana Geological Survey Authority has confirmed significant deposits of graphite, a critical mineral used in the production of Lithium-Ion Batteries (LIB) in Ghana. The Authority however notes that further exploration is required to establish the feasibility of graphite for commercial mining.[63] Australian exploration company, Castle Minerals, 2012 announced a maiden resource estimate for its Kambale Graphite of 14.4mt @ 7.2% C (graphitic carbon) for 1.03mt contained graphite (Inferred Resource). The company has recently announced it is surveying to define the extent of graphite deposits in Kambale.[64] Similar to Lithium, the Energy Transition Framework advocates for the efficient extraction and utilization of Ghana's Graphite resources through value addition, and the development of an integrated renewable energy hub.

7.1.3 Silica Sand

Ghana is known to have significant deposits of silica, even though there hasn't been any recent technical geological study on the critical mineral, with existing data dating back to the 1960s. In the transition process, silica sand is used in the production of solar panels, necessary for harnessing solar energy. Ghana's Energy Transition Framework however does not place significant emphasis on utilizing Ghana's silica deposits in the transitional process.

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[59] https://www.graphic.com.gh/news/general-news/ghana-discovers-lithium-in-commercial-quantities.html
[60] https://mlnr.gov.gh/index.php/ghana-to-have-its-first-lithium-project-with-increased-royalties-state-participation-and-value-addition/
[61] https://miif.gov.gh/miif-plans-initial-investment-of-up-to-thirty-million-dollars-in-newly-found-lithium-deposits-as-it-begins-negotiations-with-atlantic-lithium/
[62] National Energy Transition Framework
[63] National Energy Transition Framework
[64] https://www.ghanabusinessnews.com/2022/03/14/australian-company-discovers-graphite-in-ghana/

7.1.4.Manganese, Bauxite and Iron Ore

Bauxite and Manganese mining in Ghana predates the energy transition conversation, with the country the 3rd biggest producer of both minerals on the continent.[65] Ghana also has significant deposits of iron ore in the Western (Opon Mansi), Northern (Shieni) and Upper West (Pudo) regions. However, as has pertained to the extraction of gold in Ghana, these minerals have been exploited and exported without value addition, limiting the fiscal and socio-economic benefits of the minerals.

Ghana's Energy Transition Framework advocates for the establishment of refineries to process and add value to these resources before export – in line with the mandate of the Ghana Integrated Aluminum Development Corporation (GIADEC) and Ghana Integrated Iron and Steel Development Corp (GIISDEC) to develop an integrated bauxite, manganese and steel ecosystem to efficiently harness Ghana's resources.[66]

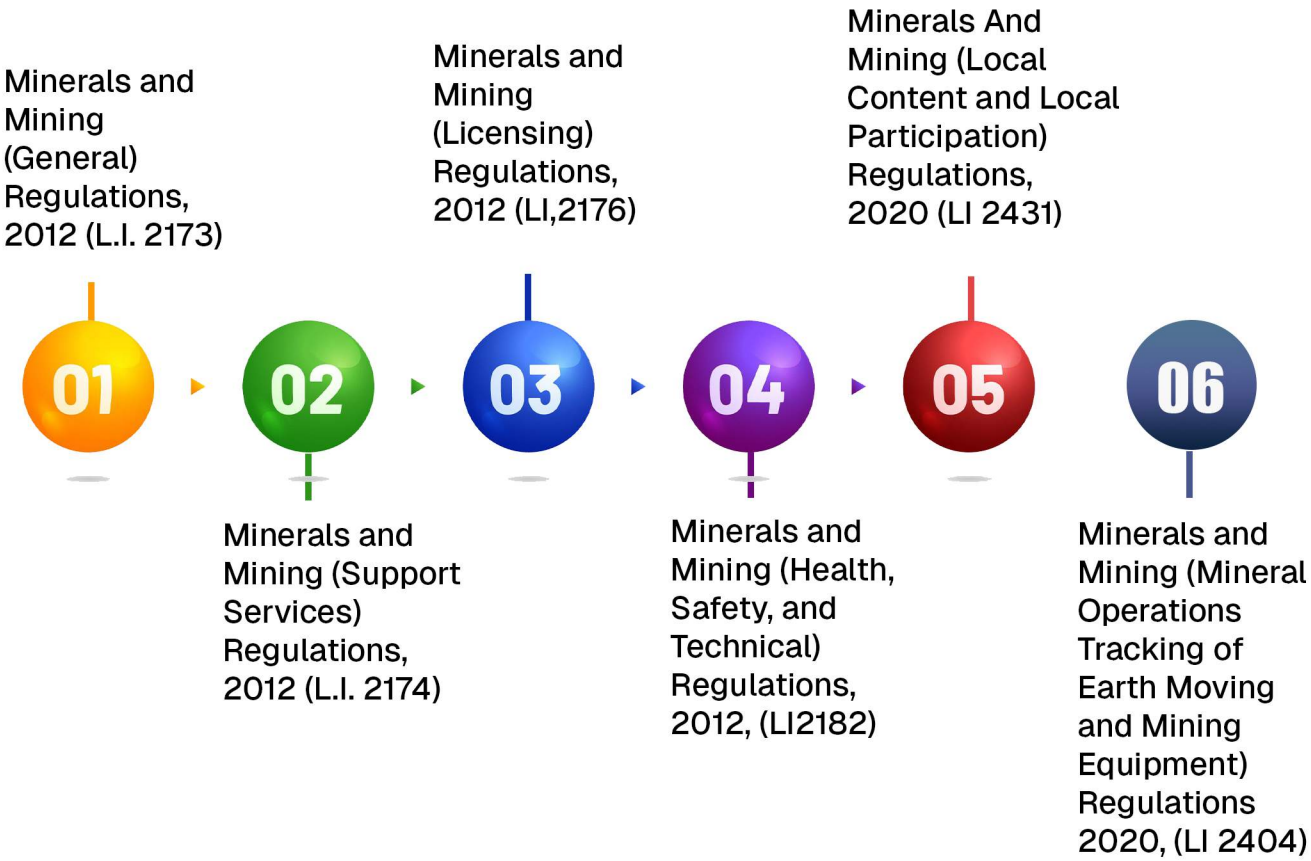
7.2 Legal and Institutional Governance of the Exploration and Production of Critical Minerals

The mining sector has remained a significant contributor to the socio-economic development of Ghana, with mining activities dating back to the 15th century. Consequently, the sector is governed by a robust legal and regulatory framework, which also governs the exploitation and production of critical minerals, as Ghana does not have a dedicated legal framework for critical minerals.
Article 257(6) of the 1992 constitution establishes a mineral ownership regime in Ghana – vesting all minerals in its natural state within the territory of Ghana in the President, on behalf of, and in trust for, the people of Ghana. Article 36 of the constitution, under the Directive Principle of State Policy, also makes provision for the utilization of mineral proceeds for equitable and inclusive development.

The Minerals and Mining Act, 2006 (Act 703), amended by the Minerals and Mining (Amendment) Acts of 2015 and 2019, the Minerals Commission Act, 1993 (Act 450), and the 2014 Minerals and Mining Policy are the principal laws and policies that govern the exploration, exploitation, and management of mineral resources in Ghana, including critical minerals, ensuring responsible and sustainable mining practices.
In addition to the aforementioned laws that provide the broad framework for minerals extraction in Ghana, there are several Acts of Parliament that regulate different aspects of the mining industry. They include the Minerals Development Fund Act, 2016 (Act 912), the Minerals Income Investment Fund Act, 2018 (Act 978), and the Kimberley Process Certificate Act, 2003 (Act 652).

[65] https://www.mincom.gov.gh/wp-content/uploads/2023/02/WHY-INVEST-IN-GHANA-BROCHURE-1.pdf
[66] National Energy Transition Framework

Also, subsidiary regulations that guide mining operations in the country, include;



Beyond the mining-specific legislation, the sector is also governed by other related laws. The Environmental Protection Act, 1994 (Act 490), the Forestry Commission Act, 1999 (Act 571), the Water Resources Commission Act, 1996 (Act 522), the Companies Act, 2019 (Act 992), the Ghana Investment Promotion Centre Act, 2013 (Act 865), and the Income Tax Act, 2015 (Act 896) and their subsidiary regulations address specific issues in the sector.

Even though Ghana does not have a dedicated legal regime for the exploration and exploitation of critical minerals, the Ghana Integrated Iron and Steel Development Act 2019 (Act 988) and Ghana Integrated Aluminium Development Corporation (GIADEC) Act, 2018 (Act 976) contain specific provisions that govern the exploitation and management of two transitional minerals – iron ore and bauxite.

Ghana also does not have a dedicated fiscal regime for the critical minerals sector. However, the various mining agreements prescribe the fiscal obligations of the mining companies based on the current royalty-tax system in the mining sector.

[65] https://www.mincom.gov.gh/wp-content/uploads/2023/02/WHY-INVEST-IN-GHANA-BROCHURE-1.pdf
[66] National Energy Transition Framework

On the institutional governance of the sector, the administration and regulation of the mining industry in Ghana primarily fall under the purview of the Ministry of Lands and Natural Resources and the Minerals Commission. The Minerals Commission plays a vital role in overseeing the utilization of mineral resources and coordinates relevant sector policies. This Commission grants mining licenses, ensures compliance with regulations, and promotes sustainable mining practices. The Water Resource Commission, Ghana Geological Survey Authority (GGSA), Lands Commission, and the Environmental Protection Agency (EPA) also provide regulatory oversight in the sector.

7.3. Exploration and Production Challenges and Opportunities

7.3.1.Exploration and Production Challenges

Mining in Ghana has undergone critical technical and technological reforms aimed at improving efficiency in resource extraction while advancing responsible and sustainable mining practices. Yet, significant technical challenges exist in the sector, that could impact exploration and production of critical minerals. The absence of comprehensive geological data on Ghana's critical minerals is a significant technical challenge that requires urgent redress. For instance, despite the Ghana Geological Survey Authority noting that Ghana has significant deposits of silica sand and graphite, the Authority has yet to conduct a geological assessment to ascertain whether these critical minerals are in commercial quantities, to accelerate the needed investments.[67] [68]

Also, the enforcement of existing legal and regulatory provisions in the small-scale sub-sector has remained a challenge, particularly with the influx of Chinese and the introduction of sophisticated mining equipment, including the Chang fa. This phenomenon is largely attributed to the limited capacity of the Minerals Commission and the strong interference of the political class in the regulation of the sub-sector. Enhancing the institutional capacity of the Minerals Commission to conduct periodic monitoring and ensure compliance in the exploration and production of critical minerals in Ghana will be vital in surmounting anticipated capacity and logistical risks.

While the growth of critical minerals will play a key role in enabling a clean energy transition, if poorly managed, the production and processing of these minerals can also have negative repercussions on the environment. For instance, significant greenhouse gas emissions arising from energy-intensive exploitation and processing activities can increase Ghana's carbon footprint, while extraction activities can cause biodiversity losses and pollution, as exists in the ASM sub-sector.[69] Integrating sound environmental practices in the mining of Ghana's critical minerals is imperative to mitigating associated environmental risks.

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[67] National Energy Transition Framework

[68] https://www.ghanaweb.com/GhanaHomePage/business/Ghana-in-catch-22-situation-Atuabo-sits-on-prime-silica-deposit-425918

[69] https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

7.3.2 Socio-Economic Impacts

The mining sector has played a critical role in the socio-economic development of Ghana, contributing significantly to revenue mobilization and employment creation. With the right policy framework and investment climate, Ghana can equally leverage its critical mineral deposits to accelerate industrialization and propel socio-economic growth and development. For instance, according to the Minerals Income Investment Fund, Ghana can leverage the Ewoyaa Lithium project and the current Automobile Development Policy to become an industrial hub for the production of electric vehicles in the sub-region and benefit significantly from the US$7 trillion market opportunity for EVs between 2023 and 2030, in the short term. The EV market is expected to expand further in the medium to long term (US$46 trillion) between 2023 and 2050, presenting additional viable business and employment opportunities for Ghanaians.[70]

Conversely, the extraction and production of critical minerals presents enormous risks for a resource-rich country like Ghana, as prices of minerals and metals tend to be volatile. This can significantly affect government revenue projections, and impact development outcomes.

On the social front, critical minerals may also present governance, health and safety, and human rights risks, if not adequately managed. For example, there is a limited correlation between Ghana's vast mineral wealth and improved living standards of Ghanaians, while the risk of artisanal miners working in perilous environments without access to safety equipment in the critical minerals value chain remains high. Lastly, the exploitation of critical minerals may disproportionately impact women, while incidences of forced child labour may rise, as pertains to cobalt mines in the DRC; necessitating robust safeguard measures.[71]

The Ministry of Lands and Natural Resources announced the approval of a Green Mineral Policy to provide the policy framework for the exploitation, management, and regulation of critical minerals.[72] It is critical that the policy explicitly prescribes cogent solutions to increasing the benefits of the mines to local communities while addressing the associated social and environmental risks.

7.3.3 Innovation and Technology

Mining is a specialized industry, driven by technological advancement and innovation. Consequently, mineral-rich countries and mining companies invest heavily in research and development (R&D), ensuring they have access to cutting-edge and efficient technology. However, in Ghana, low investment in R&D has remained a significant barrier to harnessing the full potential of Ghana's mineral wealth. This deficiency has to change if Ghana is to maximize full benefits from the exploitation of its critical mineral deposits. It is therefore essential for the government to allocate resources to fund the geological investigation activities of the Ghana Geological Survey Authority, Minerals Commission, GIISDEC, and GIADEC to improve data quality on critical

[70] https://miif.gov.gh/miif-plans-initial-investment-of-up-to-thirty-million-dollars-in-newly-found-lithium-deposits-as-it-begins-negotiations-with-atlantic-lithium/

[71] https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

[72] https://mlnr.gov.gh/wp-content/uploads/2023/08/WEEKLY-MLNR-E-NEWSLETTER-AUG-07-11-2023.pdf]

This will enable the government to negotiate mining contracts from a position of strength, increasing fiscal uptake, catalyzing industrialization, and propelling socio-economic growth.[73]

To achieve a cardinal objective of the Energy Transition Framework of utilizing Ghana's critical minerals to position Ghana as a renewable energy hub, there is an urgent need to leverage technology and innovation to refine and process critical minerals in-country and deviate from the traditional method of exporting minerals in its raw state.

7.3.4 International Cooperation

Ghana currently hosts the AfCFTA Secretariat, an arm of the AU that seeks to remove trade barriers and promote intra-Africa trade, while boosting Africa's trade position in the global market. This presents a unique opportunity for Ghana to leverage its significant deposits of critical minerals to become a renewable energy hub for Africa. This will be achieved through a deeper appreciation of Ghana's resource potential, (ascertained through extensive geological investigations), and harnessing of value chain opportunities.[74] Similar international cooperation can be explored through ECOWAS at the sub-regional level.

Finally, Ghana can pursue mutually beneficial bilateral agreements with countries and corporations to facilitate technology transfer, knowledge exchange, and capacity building in the value chain to scale up exploration and production activities in the critical mineral space.

[73] Acheampong, T. (2022). The Energy Transition and Critical Minerals in Ghana: Opportunities and Governance Challenges. Ghana Extractive Industries Transparency Initiative – GHEITI, Accra, Ghana. Creative Commons Attribution CC BY 3.0 IGO

[74] Acheampong, T. (2022). The Energy Transition and Critical Minerals in Ghana: Opportunities and Governance Challenges. Ghana Extractive Industries Transparency Initiative – GHEITI, Accra, Ghana. Creative Commons Attribution CC BY 3.0 IGO

8 CONCLUSIONS AND WAY FORWARD

8.1 Summary of Key Findings

Ghana's Energy Transition Framework Sets Ambitious Targets, but Implementation Challenges Exist

Ghana's National Energy Transition Framework establishes ambitious targets for decarbonizing the energy sector and achieving net-zero emissions by 2070. However, the successful implementation of the framework faces challenges related to technological readiness, financial constraints, and institutional and regulatory frameworks. The proposed clean energy technologies, such as carbon capture and storage and hydrogen fuel cells, are still in the early stages of development, and their cost-effectiveness in the Ghanaian context needs to be carefully considered. Mobilizing the necessary funding for capital-intensive projects and strengthening institutional capacity and coordination among stakeholders will be crucial for overcoming these challenges.

Significant Investment Required, with the Power and Transport Sectors Dominating

The Ghana Energy Transition and Investment Plan estimates a total investment requirement of USD 561.8 billion by 2070, with the power and transport sectors accounting for approximately 90% of the total investment needs. The transport sector alone is projected to account for around 70% of the total investment, primarily driven by the increasing ownership of private vehicles as incomes grow. The power sector, including investment in renewable energy and hydrogen, is expected to account for around 20% of the total investment. Mobilizing such substantial funding will require a combination of public and private resources, as well as access to international climate finance.

Renewable Energy and Energy Efficiency are Key Drivers of Decarbonization

Increasing the share of renewable energy in Ghana's energy mix and implementing energy efficiency measures across various sectors are identified as critical components of the energy transition framework. The plan aims to increase the installed renewable energy capacity to 1,363.63 MW by 2030, with a focus on solar, wind, and hydropower. Energy efficiency measures, such as introducing standards, promoting energy-efficient appliances, and encouraging behavioural changes, are emphasized to optimize resource use and reduce energy consumption. These efforts are expected to contribute significantly to the overall decarbonization goals.

Transport Sector Electrification and Clean Fuels Offer Significant Emission Reduction Potential

The transport sector is a major focus of Ghana's energy transition efforts, with the framework aiming to promote the adoption of electric vehicles, develop charging infrastructure, and encourage the use of cleaner fuels like compressed natural gas (CNG) and biofuels. The analysis report highlights that transport electrification could drive around 40% of the total emission reductions by 2060. The plan envisions all road and rail mobility to be powered by electricity and hydrogen by 2070, leading to substantial reductions in greenhouse gas emissions and improvements in urban air quality.

Critical Minerals Present Economic Opportunities, but Sustainable Exploitation is Crucial

Ghana's recent discoveries of critical minerals, such as lithium and graphite, offer significant opportunities for economic diversification and the development of a clean energy industry. The energy transition framework advocates for the efficient utilization of these resources through value addition and positioning Ghana as a hub for electric vehicle and battery technology production. However, the analysis report emphasizes the importance of developing these resources sustainably, considering the potential environmental and social impacts. Establishing a transparent and competitive licensing process, implementing robust safeguards, and prioritizing local value addition will be key to maximizing the economic benefits while minimizing the risks.

Socioeconomic Impacts and Stakeholder Engagement are Essential for a Just Transition

The energy transition is expected to have significant socioeconomic impacts, including job creation, poverty alleviation, and improved energy access. The framework estimates that the implementation of the energy transition plan could support around 400,000 additional jobs by 2060. However, the analysis report highlights the importance of ensuring that the benefits of the transition are distributed equitably and that vulnerable communities and workers in carbon-intensive sectors are not left behind. Engaging stakeholders, conducting impact assessments, developing targeted support programs, and investing in education and skills development will be crucial for achieving a just and inclusive transition.

Institutional Capacity Building and Access to International Climate Finance are Key Challenges

Implementing Ghana's energy transition plan will require strong institutional readiness and capacity building across various sectors. The analysis report identifies technical, capacity, and infrastructural challenges in sectors such as power, transport, oil and gas, environmental oversight, and building and infrastructure development. Strengthening the capacity of relevant institutions, providing training and resources, and establishing dedicated units for coordination will be essential for successful implementation. Additionally, accessing international climate finance remains a challenge due to the lack of sufficient capacity within institutions to prepare high-quality proposals. Building institutional capacity and streamlining processes for accessing climate funds will be critical for securing the necessary financial support.ctions in greenhouse gas emissions and improvements in urban air quality.

8.2 Recommendations to Optimise Ghana's Energy Transition Plans

Prioritize Realistic and Achievable Targets

Given the current economic situation and resource constraints, Ghana must reassess the energy transition plan and prioritize realistic and achievable targets. While the long-term vision of reaching net-zero emissions by 2060 remains important, the government should focus on setting pragmatic short-term and medium-term goals that align with the country's economic realities. The timeline for large-scale renewable energy projects, such as utility-scale solar and wind farms, should be paced based on the country's financial capacity and investment climate. Phasing the development of these projects over a longer period will allow for gradual scaling up as the economic situation improves and funding becomes available. Towards the same effort, the rehabilitation and upgrade of existing power infrastructure, such as transmission and distribution networks needs to be prioritized before embarking on extensive expansion projects. This can help improve system efficiency, reduce losses, and enhance reliability while being more cost-effective than building entirely new infrastructure.

Focus on Low-Hanging Fruits and Cost-Effective Measures

To set in place an optimised and feasible energy transition strategy, the country needs to prioritize energy efficiency initiatives across sectors, such as promoting energy-efficient appliances, implementing building energy codes, and optimizing industrial processes. In addition to garnering the support and awareness of the production industry and commercial and residential sectors, these measures often have shorter payback periods and can yield significant energy savings without requiring substantial investments. Furthermore accelerating the deployment of small-scale, distributed renewable energy solutions, particularly in off-grid and underserved areas which include solar home systems, mini-grids, and solar water pumps for agriculture may be cost-effective and can provide immediate benefits to communities.

Ensure Efficient Exploitation of Critical Minerals

Ghana's recent discoveries of critical minerals present a significant opportunity to support the energy transition and drive economic growth. To capitalize on this potential, the government should develop a clear strategy for the efficient exploitation of these resources. This includes conducting comprehensive geological assessments to determine the extent and feasibility of critical mineral deposits, establishing a transparent and competitive licensing process, and implementing robust environmental and social safeguards. Furthermore, the government should prioritize value addition and the development of local processing capabilities to maximize the economic benefits of critical mineral exploitation. By adopting a strategic approach to critical mineral development, Ghana can position itself as a key player in the global clean energy supply chain.

Engage Stakeholders and Address Social Impacts

Effective engagement of stakeholders who will be directly affected by the energy transition is essential for ensuring a just and inclusive transition. The government should establish mechanisms for meaningful consultation and participation of communities, workers, and vulnerable groups in the planning and implementation of

transition initiatives. This includes conducting impact assessments to identify potential social and economic risks, developing targeted support programs for workers in carbon-intensive sectors, and promoting alternative livelihood opportunities. Additionally, the government should prioritize investments in education, skills development, and social protection measures to mitigate the potential adverse impacts of the transition on vulnerable populations. By actively engaging stakeholders and addressing social impacts, Ghana can build public support and ensure a more equitable and sustainable energy transition.

Enhance Institutional Capacity for Accessing International Climate Funds

Accessing international climate funds is crucial for financing Ghana's energy transition efforts. However, the country currently lacks sufficient capacity within its institutions to prepare high-quality proposals and effectively navigate the complex funding landscape. To address this challenge, the government should invest in building the institutional capacity of relevant agencies and organizations. This includes providing training and resources to enhance the technical expertise of staff in proposal development, project design, and financial management. Additionally, the government should establish dedicated units or task forces within key institutions to coordinate and streamline the process of accessing international climate funds. By strengthening institutional capacity, Ghana can improve its ability to secure much-needed financial support for its energy transition initiatives.

Strengthen the Legal and Regulatory Framework

A robust legal and regulatory framework is essential for creating an enabling environment for the energy transition. Ghana should review and update its existing laws and regulations to align with the goals and targets outlined in the energy transition framework. This includes introducing policies and incentives to promote renewable energy deployment, energy efficiency standards, and the adoption of clean technologies. Additionally, the government should establish clear guidelines and regulations for the development of critical mineral resources, ensuring transparent and sustainable exploitation practices. Strengthening the legal and regulatory framework will provide clarity and certainty for investors, encourage private sector participation, and facilitate the implementation of energy transition initiatives.

Develop a Comprehensive Technology Advancement Plan

To support the energy transition and drive technological innovation, Ghana should develop a comprehensive technology advancement plan. This plan should outline strategies for promoting research and development (R&D) in key sectors such as renewable energy, energy storage, electric vehicles, and clean cooking solutions. The government should invest in establishing research centers, fostering collaborations between academia and industry, and providing incentives for private sector participation in R&D activities. The plan should include measures for technology transfer, capacity building, and the localization of clean energy technologies to enhance Ghana's technological capabilities and create new economic opportunities.

Foster Regional Cooperation and Knowledge Sharing

Ghana should actively engage in regional cooperation and knowledge-sharing initiatives to accelerate its energy transition efforts. Collaborating with neighbouring countries and regional organizations can provide opportunities for joint projects, technology transfer, and capacity building. The government should explore avenues for regional integration of energy systems, such as cross-border electricity trade and the development of regional renewable energy corridors. Additionally, Ghana should participate in regional and international platforms for sharing best practices, lessons learned, and innovative solutions related to the energy transition. Leveraging regional cooperation and knowledge sharing would provide benefits to Ghana from collective expertise, resources, and economies of scale in advancing its energy transition agenda.

Establish a Dedicated Energy Transition Fund

To support the financing of energy transition initiatives, Ghana should establish a dedicated Energy Transition Fund. This fund should be designed to mobilize and allocate financial resources specifically for the implementation of projects and programs outlined in the energy transition framework. The government should explore various funding sources, including domestic budgetary allocations, international climate finance, and private sector contributions. The Energy Transition Fund should have clear governance structures, transparent allocation criteria, and robust monitoring and evaluation mechanisms to ensure the effective utilization of resources. Establishing a dedicated fund will provide a stable and predictable financing mechanism for Ghana's energy transition efforts.

8.3 Recommendations to Increase Youth Participation in Ghana's Energy Transition Implementation

Establish a Comprehensive Clean Energy Skills Development Program

92% of the survey's respondents identified technical skills as most valuable for clean energy careers highlighting the need for a comprehensive skills development program that benefits existing and upcoming professionals. The program can be implemented by partnering with educational institutions to develop specialized curricula, creating industry-aligned vocational training programs, and offering online courses in renewable energy technologies and energy efficiency. Hands-on training modules, internship programs, and innovation-type competitions can also be implemented with clean energy companies to provide practical experience and engender interest.

Launch a Youth Clean Energy Entrepreneurship Fund

With 93% of respondents expressing high interest in youth-led renewable energy startups, and 86% citing lack of funding as a major barrier, there is a need for a dedicated Youth Clean Energy Entrepreneurship Fund to precipitate an influx of financing to the burgeoning sector through youth-led initiatives. This includes establishing a grant program for innovative clean energy ideas, creating a

low-interest loan scheme for youth-led startups, and setting up a mentorship network connecting young entrepreneurs with industry veterans. Collaboration opportunities can be explored with international development partners and private sector entities to expand the fund's capacity.

Develop a Digital Platform for Energy Transition Awareness and Engagement
To boost awareness of Ghana's Energy Transition Plans and the impact on youth and communities this study highlights the need for a comprehensive and strategic information campaign tailored specifically to Ghana's youth demographic. For example, a user-friendly digital platform for information dissemination and engagement that features interactive learning modules about the energy transition, a job board for clean energy opportunities, and a forum for youth to share ideas and collaborate on projects. Also important, social media campaigns and gamification elements can be integrated to increase engagement. The recommendation is to leverage digital tools popular among Ghanaian youth to build a community of young energy transition advocates.

Implement a "Youth Energy Transition Leaders" Program
Recognizing that 71.43% of respondents rated their interest in participating in youth-led initiatives at the highest level, we recommend the establishment of a "Youth Energy Transition Leaders" program. This includes selecting and training youth representatives from each region to act as energy transition ambassadors, organizing youth-led community workshops and awareness campaigns, and involving these leaders in national energy policy discussions. This program can empower youth to drive grassroots change and ensure their voices are heard in national energy planning.

Create Industry-Academia Partnerships for Applied Research and Innovation
A popular misconception is that Ghana lacks sufficient educated capacity or technical knowledge to develop renewable energy solutions. To highlight that the nation does not need "renewable energy engineers" but rather all engineers and educational backgrounds to apply their skills towards providing services applicable in the space, partnerships must be forged between universities, research institutions, and clean energy companies to drive innovation. This includes establishing joint research programs focusing on localized clean energy solutions, creating innovation hubs or living labs on university campuses, and offering research grants for projects that promote interdisciplinary collaboration, bringing together expertise from fields such as engineering, economics, environmental science, and social sciences to address the multifaceted challenges of energy transition. By bridging academia and industry, Ghana can cultivate a culture of innovation and position its youth at the forefront of clean energy technological advancements.

STRATEGIC YOUTH NETWORK FOR DEVELOPMENT

SYND is a youth-oriented NGO that promotes youth inclusion in the governance of the Natural Resources and Environmental (NRE) sector. We do this through Research and Advocacy as well as Youth Engagement.

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