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Ghana Climate Change Policy Brief

ENERGY SECTOR

Introduction

Globally, the energy sector is a major contributor to climate change due to the burning of fossil fuels, which emit high levels of carbon dioxide and other greenhouse gases. Ghana's latest greenhouse gas inventory report shows that, since 2016, the energy sector has overtaken agriculture, forestry, and other land uses (AFOLU) as the highest emitter of greenhouse gases. Between 1990 and 2019, emissions increased significantly—over 840 percent—as a result of increased electrification. Electrification increased access to energy, which has both supported Ghana's development and increased its carbon footprint. Energy-related emissions continue to grow, increasing 22 percent between 2016 and 2019. Driving this increase is the growth of thermal electricity generation, a high emitter, in the last decade in response to rising electricity demand and erratic rainfall patterns. Thermal and hydropower currently account for 66.4 percent and 32.9 percent of electricity generation, respectively. Besides hydropower, other renewables, including solar photovoltaic (PV) technology and biogas, account for less than one percent of electricity generation. Firewood—the primary energy source for domestic uses, especially in rural areas—is a major contributor to CO2 emissions through deforestation and combustion. The burning of firewood for domestic uses also increases exposure to woodsmoke, which contains harmful particulate matter (resulting from the incomplete combustion of fossil fuels [i.e., black carbon] that can cause respiratory illness and other ill effects on human health.[1]

The energy sector is already experiencing the impacts of climate change, both in terms of increased demand and potential decreased supply of energy, which is expected to worsen. On the demand side, rising temperatures increase the demand for electricity (e.g., refrigeration, air-conditioning). Ghana's growing population, along with rising rates of urbanization and industrialization, is expected to further increase demand. At the same time, climate change will affect electricity generation. For example, hydropower generation will be affected by increasing evaporation rates as temperatures continue to increase and rainfall becomes more unpredictable (i.e., shifts in timing and quantity). Hydropower operators will need to factor climatic changes and increased economic development into operation and maintenance activities, particularly as sedimentation rates continue to rise, affecting dam safety and capacity. Future energy systems will need to incorporate these factors into their design, construction, operation, and maintenance. The high incidence of extreme weather events, such as floods, sea-level rise, and tidal floods also negatively affect energy infrastructure along the coast and further inland. To address these and other impacts, Ghana must identify and pursue interventions to lower the sector's CO2 emissions and make it resilient against climatic impacts.

Climate Change Assessment

This policy brief on the energy sector is part of the Ghana Policy LINK Activity's broader climate change assessment, which focused on six key areas—agriculture, water, energy, forest, coastal systems, and climate finance. The assessment methodology included a literature review as well as inclusive stakeholder consultations through interviews, focus group discussions, and sector workshops in Tamale and Accra. The Ghana Policy LINK Activity consulted 43 institutions and groups, including USAID and its implementing partners, other development partners, the Government of Ghana, academia, civil society organizations, farmer groups, the private sector, and the media. The policy briefs will be used to further engage stakeholders to prioritize transformative actions to achieve a climate resilient future.

1 Bede-Ojimadu O, Orisakwe OE. Exposure to Wood Smoke and Associated Health Effects in Sub-Saharan Africa: A Systematic Review. Ann Glob Health. 2020 Mar 20;86(1):32. doi: 10.5334/aogh.2725. PMID: 32211302; PMCID: PMC7082829.

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This policy brief on the energy sector—part of a broader climate change assessment—details: (i) the impacts of climate change on the sector, (ii) the constraints to addressing these impacts, and (iii) recommended interventions to reduce these impacts and deliver a climate-resilient energy sector.

Climate Change Impacts on the Energy Sector

The energy sector is already experiencing climate change impacts, and models predict they will only worsen in the future. The following impacts were identified in the assessment:

Temperature-induced rising electricity demand. Ghana's electricity demand has been increasing at an annual growth rate of 10.3 percent over the last five years.[2] While increased demand can be attributed partly to growth in the service and industry sectors, rising temperatures and resultant heat stress—which increase the need for refrigeration, air-conditioning, and water consumption—are also to blame. Climate-induced migration and the country's high urbanization rate continue to drive electricity demand as well. With temperatures projected to increase by up to three degrees Celsius by 2080[3]—coupled with growing electricity demand related to economic development—demand could exceed supply.

Climate-induced migration and the country's high urbanization rate continue to drive electricity demand.

Decreased capacity and reliability of hydropower generation. To meet the rising demand for electricity, energy generation and efficiency must also increase. Unfortunately, climactic changes, such as erratic rainfall patterns and rising temperatures, are expected to reduce the capacity and reliability of hydropower generation, one of Ghana's primary and most affordable energy sources. Ghana has already experienced the interactions between climate and hydropower production. Between 2013-2015, low water levels in Akosombo Dam led to power rationing and an increase in the percentage of energy generated by thermal power. Over the last decade, the share of hydropower-generated electricity in total energy production has declined, from 67.5 percent in 2011[4] to 32.9 percent in 2020[5] largely as a result of erratic rainfall patterns, which make hydropower generation less reliable. Both existing and planned hydropower systems must be evaluated given the current and future projected climatic impacts to ensure continued reliability.

Infrastructure damage. Sea-level rise along Ghana's coast has increased the incidence of tidal floods and coastal erosion in recent years. Studies have estimated that the sea level has risen by 5.3 cm in the past two decades,[6] while projections point to a rise of about 20 cm by 2050.[7] Moreover, tidal floods are expected to increase in frequency and intensity in the coming years. Sea-level rise, tidal floods, and extreme weather events are a grave threat to Ghana's thermal plants, most of which are strategically located along the coast to be closer to fuel reserves (e.g., natural gas from oil fields). For example, the Takoradi Power Station, which consists of three thermal power plants, is located on the coast in Aboadze. Flooding of installations such as electricity transmission and distribution sub-stations has already been observed in Accra, where it led to supply disruptions.

Operation of thermal plants. Thermal plants require large volumes of water for cooling and steam operations to ensure safe and effective operations. As such, the impacts of climate change on water resources will affect thermal energy generation by increasing water scarcity and competition for water resources between various uses and users (e.g., energy, agriculture, domestic consumption). Considering that thermal generation accounts for about 67 percent of electricity generation, future declines in water availability due to climate change could have a significant impact on the energy sector.

Constraints to Addressing Climate Change Impacts on the Energy Sector

The assessment identified the following constraints to addressing climate change impacts on the energy sector:

Policy challenges. As a party to the Paris Agreement, Ghana has committed to transitioning from fossil fuels (e.g., oil, gas, coal) to renewable energy. At the same time, the country is an emerging oil and gas producer. Currently, there is no clear guidance on how the country should balance its desire to benefit from its natural resources with its commitments to transition to clean energy. There is little coherence between the country's policies on clean energy and oil and gas, for example. Policies are also unclear on how Ghana should strategically position itself to extract and use its strategic minerals such as lithium and bauxite—important for inputs for battery storage—to facilitate the local and global energy transition. Conflicting policy priorities stifle progress toward reducing Ghana's carbon footprint, especially as the generation capacity of traditional energy sources is potentially reduced. It also results in missed opportunities for Ghana to benefit from being a technological leader in the global transition to renewable energy.

Limited innovation, funding, and feasibility studies. Limited applied research on innovative renewable energy technologies is another constraint to addressing climate change impacts on the

2 Energy Commission, 2021. 2021 Energy Outlook for Ghana. Energy Commission: Ghana.
3 Klutse, N.A.B., Owusu, K. and Boafo, Y.A., 2020. Projected temperature increases over northern Ghana. *SN Applied Sciences*, *2*(8), pp.1-14.
4 Energy Commission, 2012. 2012 Energy Outlook for Ghana. Energy Commission: Ghana.
5 Energy Commission, 2021. 2021 Energy Outlook for Ghana. Energy Commission: Ghana.
6 Evadzi, P.I., Zorita, E. and Hünicke, B., 2017. Quantifying and predicting the contribution of sea-level rise to shoreline change in Ghana: Information for coastal adaptation strategies. *Journal of Coastal Research*, *33*(6), pp.1283-1291.
7 Röhrig, F., Lange, S., Aschenbrenner, P., Chemura, A., Gornott, C., Murken, L., Grams, E., Klockemann, L., Romanato, E. and Haider, J., 2019. Climate Risk Profile: Ghana.

energy sector. Experts noted that Ghana is mainly an adopter of renewable energy technology, not an innovator. While there has been some applied research on renewable energy technologies such as solar and wind, other technologies—which could be supported with indigenous knowledge and local natural resources—have received little attention. Bioethanol, for example, could benefit the country greatly thanks to the immediate availability of feedstock (e.g., corn, soya beans, woodchips, etc.). Adaptive research on this alternative energy source, however, has been limited because few institutions carry out this kind of research, and those that do have limited bandwidth to spearhead these research and development efforts. Developing feasibility studies (including financing and operational plans) for renewable energy technologies could help increase uptake.

Limited awareness and education. Awareness of energy efficiency regulations is critical for reducing electricity demand and usage. While the Energy Commission has developed several energy efficiency regulations, most consumers are unaware of the regulations. More broadly, education on climate change's impacts on the energy sector is lacking, and not enough Ghanaians understand they can reduce these impacts by adopting renewable energy and energy-efficient technologies (e.g., cleaner cookstoves and appliances) and practices. Specific government programs with incentives to change consumer behavior (e.g., to buy energy-efficient appliances) are also limited.

Inadequate enforcement of regulations and standards. Enforcement of energy efficiency regulations and standards is relatively weak due to limited human and financial resources. Notably, Ghana's regulator, the Energy Commission, has sub-national offices in only three of the country's 16 regions, significantly constraining its awareness-raising, monitoring, and enforcement efforts.

Unfavorable tariff structure and business environment. The current electricity tariff structure disincentivizes private investment in off-grid renewable energy systems because the tariffs tend to make investment unprofitable. Whereas urban consumers enjoy subsidized tariffs, rural residents who connect to off-grid systems set up by private investors do not. Rural residents are unable to afford the high tariffs, which results in private investors incurring major losses. This tariff scheme, coupled with the lack of clear policy direction on net metering (a billing mechanism that credits solar energy system owners for the electricity they add to the grid), discourages investment in renewable and off-grid energy technologies.

Complex political economy. Political economy factors are a major constraint to improved energy sector performance in terms of efficiency and greenhouse gas emissions. For example, while importing inefficient appliances was prohibited more than a decade ago, these appliances are still imported and sold openly (and with impunity) in the Ghanaian markets as a result of poor enforcement regimes. This dynamic is likely to worsen as the demand for inexpensive, inefficient imported appliances continue due to increased economic development and warmer temperatures.

Limited collaboration between government and civil society. The relationship between government agencies and civil society in the energy sector is often confrontational rather than collaborative. For example, CSOs often challenge the government on the lack of transparency in the oil and gas industry (e.g., in awarding oil blocks and revenue management). Policy implementation suffers as a result, as does the enforcement of regulations.

Recommended Interventions

Recommended interventions to reduce the impact of climate change on the energy sector are described below.

Review energy sector policies. Stakeholders emphasized the need to make energy sector policies, especially those related to renewable energy and oil and gas, more coherent. Stakeholders want clear policy direction on how Ghana can benefit from extracting minerals that support the production of clean technologies

(e.g., lithium, bauxite). Stakeholders are hopeful that the National Energy Transition Policy, which is currently under development, will address these concerns. Furthermore, policies should address unfair tariff regimes that disincentivize private sector investment in renewable energy systems and technologies in remote areas. In addition, a review of the Science, Technology, and Innovation Policy at the Ministry of Environment, Science, Technology, and Innovation is needed to strengthen support for the research and development of renewable energy technologies, including those that can integrate indigenous practices. Stakeholders also recommended mainstreaming gender considerations into energy sector policies since households are the main users of energy (e.g., wood fuel) and electricity.

Undertake applied research, as well as feasibility and financing studies, on renewable energy technologies. Stakeholders said Ghana urgently needs to strengthen applied research and practical feasibility studies for the adoption of renewable energy technologies, including solar and wind. Sector stakeholders specifically mentioned renewable technologies that leverage indigenous knowledge and local resources (e.g., waste-to-energy/bioethanol). While some of these technologies can be deployed on a small scale, scaling up promising renewable technologies will require applied research on feasibility, financing, and adoption. In addition, applied research should be done in close collaboration with an inclusive set of stakeholders that includes farmers, the private sector, and the media. Technology transfer from other countries that have been successful in developing certain technologies should also be considered.

Strengthen local capacity. Stakeholders recommended building local capacity to adopt and scale renewable energy technologies, especially among youth. One approach is equipping technical universities and innovation hubs with the resources and facilities to do applied research, planning, and budgeting for small- and large-scale renewable energy systems. To reach the youth, stakeholders recommended strengthening and expanding student competitions such as the senior high school renewable energy challenge.[8] These competitions help build interest in young people, strengthen their capacity, and develop potential solutions that can be used to promote the adoption and scaling of renewable energy technologies.

Promote awareness and education. Stakeholders recommended raising awareness of the environmental benefits of adopting renewable energy technologies as well as purchasing energy-efficient appliances. To educate Ghanaians on these issues—and facilitate behavior change—it is important to build the media's capacity to report on climate change and its impacts. This reporting should also inform citizens about how they can reduce their carbon footprint by adopting energy-efficient technologies. In addition, educational curricula at the lower levels should be re-examined and updated with contemporary information as a way of inculcating in young children core renewable energy and energy efficiency concepts and practices.

Strengthen the enabling environment for renewable energy deployment. Stakeholders stressed the importance of creating a policy-enabling environment that reduces the barriers to private sector participation and investment in renewable energy. For example, innovative partnership and financing mechanisms are needed to encourage the private sector to deploy off-grid systems to island and remote communities.

Promote hybrid energy systems. To reduce the impact of climate change on the energy sector, stakeholders recommended developing more hybrid energy systems, i.e., systems that combine two or more renewable energy technologies. An example is the integration of solar in the Bui hydropower scheme in center-west Ghana. Electrical grids can be designed to integrate multiple technologies, such as mini-hydro, solar, biogas, and/or wind to maintain operations even if one technology fails.

Encourage collaboration and enforcement. Stakeholders said that increased collaboration between government agencies and other stakeholders (including sub-national actors) is needed to support policy implementation and enforcement of regulations. For example, due to limited human resources, collaboration between the national energy regulator, Energy Commission, and sub-national stakeholders (e.g., metropolitan, municipal, and district assemblies, local NGOs/CSOs) is needed to enforce energy efficiency regulations at the community level.

8 http://www.energycom.gov.gh/school-challege.