POLICY BRIEF

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MINISTRY OF ENERGY AND MINERAL DEVELOPMENT

Macroeconomic Impacts of Reducing Household Biomass Energy Demand in Uganda

Abstract

While biomass energy resources produce renewable energy, its unsustainable and inefficient utilisation in Uganda undermines the efforts towards the reduction of greenhouse gas (GHG) emissions. With a focus on reducing household biomass energy demand, this brief simulates and presents the macroeconomic impacts of energy transition in Uganda using the e3.ug model. To model these impacts, scenario simulations that are consistent with Uganda's Energy Policy to reduce GHG emissions were considered. Results show that the stated scenario simulations are associated with positive effects on economic growth through increased expenditures by households, businesses, and government. In addition, there are observed considerable reductions in GHG emissions, largely from the forest land. Three (3) policy implications are derived: (i) support households to reduce the dependency on biomass for energy needs, (ii) scale-up the electrification of underserved and unserved communities, and (iii) public awareness on the threats of GHG emissions.

Introduction

Uganda's energy sector is aligned to the global energy sector targets of transition to clean and modern energy, and reduction of CO2 emissions. This implies that energy production and consumption should meet the climate targets (IRENA, 2022). At the national level, the Energy Policy envisages that all households in Uganda should have at least one source of clean and modern energy, including on-grid and off-grid by 2030. Similarly, this policy targets to increase electricity consumption per capita from the current 225kWh to 578 kWh by 2030. Achieving these energy targets includes strategies that reduce GHG emissions.

CO2 emissions in Uganda emanate from agriculture, forestry and land use (AFOLU) activities. It is projected that AFOLU net emissions, if left unabated, will reach 122.2 MtCO2e in 2030 (NDC, 2022). In addition, biomass accounts for over 88% of energy needs by the population. These occurrences are suggestive of the need for models that evaluate and support the aspirations of energy transition. This brief capitalises on this dominance of biomass for energy needs at household level by modeling the macroeconomic impacts of reducing household biomass energy demand. Importantly, the findings infer critical interventions needed to contribute to energy transition in Uganda.

Methodology

The analysis employed a scenario-based simulation using the e3.ug model (Fig.1). The e3.ug model is an integrated modelling tool that assesses the macroeconomic impacts of policy changes or interventions on Uganda's energy, environment, and economic system.

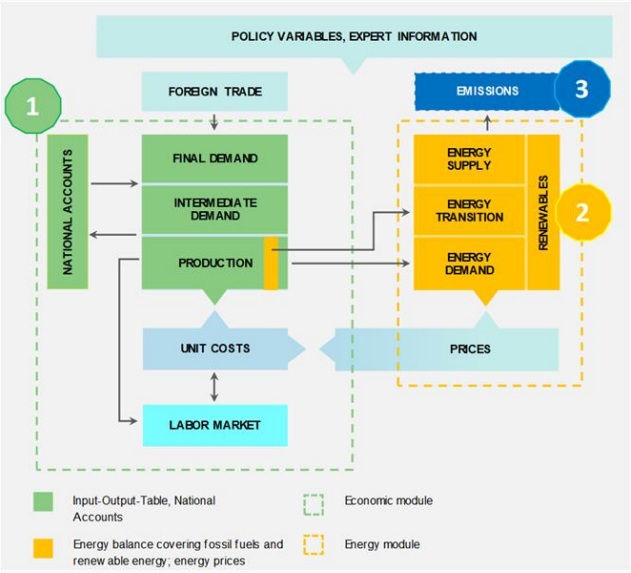

Fig. 1: Structure of the e3.ug model. Source: GWS, 2022

The e3.ug model covers the structure of the Ugandan economy and its main connections to the environment, i. e. the use of energy resources and the contribution of

greenhouse gas (GHG) emissions into the environment. Impacts on the whole economy, single economic sectors, and social balance and environment can be quantified using this model.

Scenario assumptions undertaken in this brief are supported by the evidence that households in Uganda are the dominant users of biomass energy. Specifically, Uganda's current energy balance shows that household account for 71% of the final consumption for biomass and waste (MEMD, 2022). Thus, to progressively contribute towards Sustainable Development Goal (SDG) 7.1, strategies to reduce GHG emissions should target reducing biomass energy demand for households more, relative to other sectors. Households can either transition to electricity for their energy needs or can be supported to efficiently and sustainably utilise biomass in an environmentally friendly and cleaner manner.

In this context, a decrease in CO2 emissions through reducing household biomass energy consumption is considered, and modelled as the Energy Transition (ETRANS) scenario. The associated assumptions of the "ETRANS" scenario are presented in Table 1. To model this scenario, results are reported as deviations from the Business As Usual (BAU) scenario to assess the potential macroeconomic impacts of this policy intervention.

Scenario Assumptions

Table 1: Key Scenario Assumptions

Scenario	Scenario Description	Key Assumptions
Energy transition	To meet the SDG 7.1 targets, simulations in line with Uganda Energy Policy to model reduce CO2 emissions are considered. Household biomass demand reduces gradually between 2022 and 2050.	• Reduce household biomass energy demand to 50% by 2050. • Household sector transitions from biomass to electricity by investing in electrical equipment and appllianes • Additional 2 million households replace traditional cookstoves with electrical cookstoves 2050. • Additional household expenditures on electrical cookstoves. • Additional household electricity consumption for e-cooking per capita per year of 475 kWh/year • Government subsidises the cost of e-cookstoves

Key Findings

1. Energy transition positively contributes to economic growth

Results show that when households replace inefficient energy technologies such traditional 3 stone cooking methods with more cleaner and efficient energy alternatives such as electricity, there are direct and indirect impacts on GDP. Specifically, the assessed scenario depicts an increase in real GDP by approximately 0.6% in 2030 (Fig.2). Household consumption, investments, exports, and imports all reveal a positive trend.

This occurrence could be largely through the indirect impacts, and for two potential factors: First, when households, for instance, reduce biomass energy demand and replace with electricity, there are associated expenditures on electrical equipment and appliances such as electrical cook stoves. Indirectly, this expenditure induces the business investments in electrical appliances to satisfy this demand from energy transition. Second, reducing biomass energy demand implies that household consumption of electricity increases, which demands increased government investments in electricity generation capacity. Whether government subsidizes the cost of these investments or not, there are positive and compound effects on economic growth.

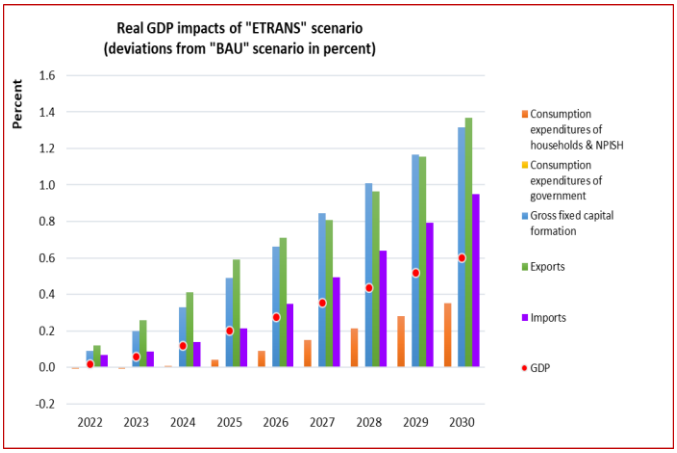

Figure 2: Real GDP impacts as deviations from the BAU scenario

These findings are commensurate with global evidence that links energy transition to economic growth. In particular, an evaluation by IRENA shows that the impact of a transition to 36% renewables would benefit economic growth, welfare and employment (IRENA, 2016). The implication is that energy policies should mainstream energy transition strategies in the development of sustainable energy systems.

2. Reducing household biomass energy demand reduces GHG emissions

Findings reveal that the stated scenario in this brief reduces GHG emissions from the forest land, energy industries, and other sectors. In 2030, reductions of Greenhouse Gas emission in CO2 equivalent (Gg CO2e) are approximately 2,200, 50, and 250 from the forest land, energy industries, and other sectors respectively (Fig.3). This trend shows that in Uganda, GHG emissions reductions are highest from the forest land sector.

This is attributable to the fact that households in Uganda use biomass in form of firewood and charcoal that are primarily sourced from forest land. However, findings indicate that GHG emissions increase over time in the transport sector. The justification is because the transport sector in Uganda is nearly 100% dependent on petroleum or fossil fuels for energy needs—a consideration outside the scope of this assessment.

A compelling conclusion is that reducing dependency on biomass delivers considerable decreases in GHG emissions (IRENA, 2022; 2016). In this perspective, the energy transition strategy for Uganda may involve two simultaneous steps: First, support households to gradually transit from firewood and charcoal use to electricity for cooking and other energy needs. This option may, however, require additional and deliberate government investment in electricity that is accessible and affordable by the households.

Second, sustainably utilise energy from biomass and waste by using more efficient cooking stoves. This strategy demands the production and use of gaseous biomass and related technologies in a sustainable manner (MEMD, 2022).

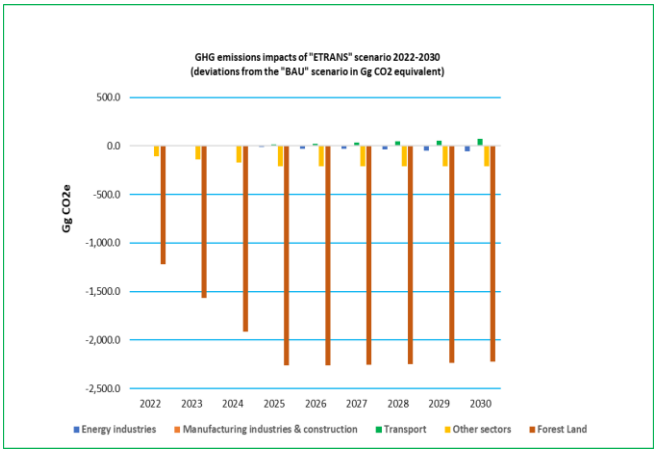

Figure 3: GHG emissions impacts as deviations from the BAU scenario

Policy Recommendations

Energy transition constitutes, among others, strategies and policies towards reducing energy-related CO2 emissions to mitigate climate change. In this process, electrification and efficiency are drivers of change, backed by renewables, and sustainable use of biomass resources (IRENA, 2022). In the context of this analysis, energy policies should:

1. Support households to reduce the dependency on biomass for energy needs

(i) Increase the use of alternative more efficient cooking fuels than charcoal and firewood.

(ii) Promote the efficiency of cooking in households using Improved Cooking Stoves (ICS).

(iii) Increase power generation from non-biomass renewable energy resources such as solar, hydro, wind, and geothermal.

(iv) Promote the use of biogas as an alternative cleaner mechanism for households and institutions such as schools and business enterprises.

(iv) Investment in the local manufacturers of Liquefied Petroleum Gas (LPG) cylinders and accessories.

2. Scale-up the electrification of underserved and unserved communities

(i) Strengthen the reliability of grid electricity supply to rural areas through expansion of transmission and distribution network.

(ii) Increase access to mini-grids and stand-alone systems in remote rural and island communities to induce households transition to electricity.

(iii) Diversify renewable energy in the electricity generation mix through production of gaseous biomass and related technologies in a sustainable fashion.

(iv) Coordination between grid distribution and off-grid solutions to accelerate access.

(v) Attract investment in the renewable energy sector from both local and international investors through implementation of the Feed-in tariff (FiT)

3. Intensify public awareness and social acceptance

(i) Trainings and sensitization on the threats of GHG emissions to economic and social livelihoods in the economy.

(ii) Seminars on sustainable cooking practices and technologies.

(iii) Implementation of the Electricity Connections Policy (ECP).

Conclusion

With a focus on reducing household biomass energy demand, this brief simulates and presents the macroeconomic impacts of energy transition in Uganda. To model these effects, simulations that are consistent with Uganda's Energy Policy to reduce greenhouse gas (GHG) emissions were considered. Results show that the stated scenario simulations are associated with positive impacts on economic growth through increased expenditures by households, business and government. In addition, there are observed considerable reductions in GHG emissions, largely from the forest land. For policy, integrating energy transition strategies into the national development plans carries economic and environmental benefits to the country.

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