POLICY BRIEF

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MINISTRY OF ENERGY AND MINERAL DEVELOPMENT

Evaluating the Macroeconomic Impacts of Energy Efficiency Improvements in Uganda

Abstract

Uganda's energy demand is growing steadily, with consequences for the economy and the environment. Without energy efficiency measures, massive investments in new energy generation capacity are needed, and deforestation will continue unabated. Uganda commits itself to protect the climate by signing the Paris Agreement and submitting the Nationally Determined Contributions. Efficiency measures are an important pillar to reduce greenhouse gas (GHG) emissions and preserve carbon sinks. To explore possible benefits and challenges from energy efficiency measures, the e3.ug model was applied to evaluate their socio-economic and environmental impacts.

The results from the simulation of this policy scenario indicate that energy efficiency improvements are of advantage for Uganda. Economic, social, and environmental benefits are possible. Economic growth is accelerated, and additional jobs are created. Positive effects can be expected not only in sectors directly profiting from efficiency measures. Income-induced impacts can also be seen in agriculture, transport, and trade. However, policymakers should consider the financial barriers and information deficits that impede the diffusion of efficiency measures. Targeted support helps to achieve the expected benefits and limit implementation barriers.

Introduction

The current energy policy in Uganda aims at providing affordable and reliable energy. The efficient use of energy is one pillar to reduce energy consumption and emissions.

So far, efficiency improvements are limited. While electricity losses in the power generation sector could be significantly reduced, the dependency on firewood and charcoal is still high (IEA, 2019). Biomass accounts for over 88% of final energy consumption (MEMD, 2020). The use of inefficient cookstoves has led to rapid deforestation.

Further potentials for biomass and electricity savings are seen for several sectors of the economy (e.g., residential, and industrial sector) (MEMD, 2017, 2022a, b). With moderate expectations, electricity savings of up to 16% are economically achievable for the residential, commercial, and industrial sector by 2030 (MEMD, 2017). Uganda Electricity Transmission Company Limited (UETCL) (2022) expects further reduction of transmission and distribution losses to 15.3% by 2030.

According to the updated Energy Policy and Uganda's updated Nationally Determined Contributions (NDC), 10% (1.2 Mn. households) of all private households and 10% (4,000 institutions) of institutions are expected to adopt improved cookstoves which are more efficient but are still using wood or charcoal by 2025 (MEMD, 2022b, Harries et al. 2021). With moderate expectations, energy savings from improved cookstoves of 35% are possible (First Climate, 2020). The implementation of the envisaged efficiency improvements is expected to exhibit various benefits for the economy and the environment. These impacts are analysed with the e3.ug model to provide policy makers with an evidence-based analysis.

Methodology

The e3.ug model is applied to study the economic impacts of energy transition scenarios. This policy brief presents the impacts of an energy efficiency improvement scenario which are analysed by comparing them to the impacts of the business-as-usual scenario (BAU scenario) that does not include this policy.

Scenario	Key Assumptions
Energy Efficiency Improvements	• Electricity savings of 15% (16%) by 2030 in residential and commercial sector (industrial sector) • Further reduction of transmission and distribution losses in the energy sector to 15.3% by 2030 • 10% of all private households and institutions are expected to adopt improved cookstoves by 2025 • Biomass savings of 35% are possible with improved cookstoves

Table 1: Key Scenario Assumptions

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 input of greenhouse gas emissions into the environment. Impacts for the whole economy, single economic sectors as well as on social balance and the environment can be quantified. It allows for discovering not only direct impacts but also impacts stemming from second round effects and feedback loops. This integrated modelling approach of the 3Es in one model assures a consistent view of policy scenarios.

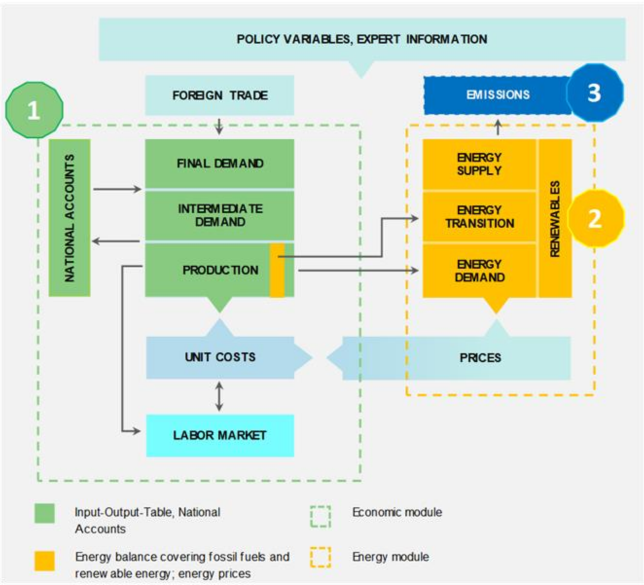

Figure 1: e3.ug model at a glance. Source: Adapted from GWS, 2022

Key Findings

1. Energy efficiency improvements have positive impacts in terms of GDP and employment.

The scenario results show that additional investments and household expenditures for efficient electrical appliances, machinery and improved cookstoves accelerate economic growth (+0.6% in 2030).

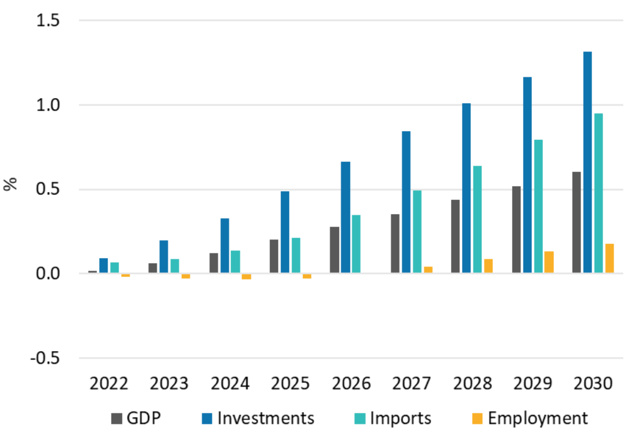

Figure 2: Macroeconomic impacts of energy efficiency improvements (deviations in % from BAU scenario for selected years).

Most of the investments are assumed to be replacements of burnout or retrofits. Additional investment sums up to 2,351 Bn. UGX by 2030. Incremental costs per average annual electricity savings are in the range of 0.01 to 1.95 USD per kWh (MEMD, 2017). An improved cookstove is approximately 21,000 UGX more expensive than a metal cookstove that costs around 4,000 UGX (MECS, 2020). With further reduction of grid losses, 27 Bn. UGX investments are associated to the energy sector.

Overall, GDP is up to 0.6% per year higher compared to a situation without further efficiency improvements. The overall impacts on employment and income are positive as economic growth creates additional jobs enabling households to spend more on consumption. At maximum, 41,000 additional jobs (+0.2% p.a.) per year can be achieved.

Saved electricity is exported to neighbouring countries which increases exports by 1.4% p.a. compared to the BAU.

However, under the energy efficiency scenario the pre-existing import dependency of the manufacturing sector causes increased need for imports which limits economic growth.

2. Positive effects not only for directly affected economic sectors.

Manufacturing sectors such as electrical equipment, machinery, and fabricated metal products profit directly from higher demand in terms of production and employment (Figure 3).

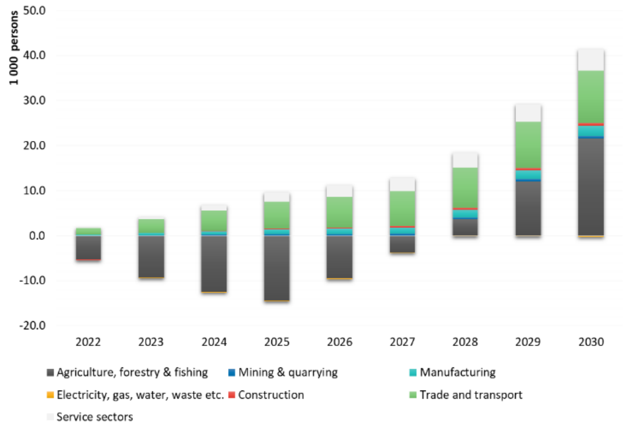

Figure 3: Impacts on employment by economic sectors of energy efficiency improvements (deviations in % from BAU scenario for selected years).

Additional household expenditures for more costly energy-efficient appliances are assumed to be financed at the expense of non-essential household expenditures. Thus, the demand for accommodation and food services is at a lower level compared to a situation without this energy efficiency policy measure (BAU scenario). Less biomass use and less demand for accommodation and food service activities have a negative impact on employment in the aforementioned sector as well as agriculture, forestry and fishing. With a higher growth path and more income, this effect is reversed as households' consumption expenditures increase.

3. Less energy use reduces energy costs for consumers and helps to reduce energy poverty.

The avoided energy consumption cuts consumers' energy bills by up to 16% per year. However, especially vulnerable households should be supported to finance the upfront costs of improved cookstoves so that they can also benefit from energy savings.

4. Energy efficiency gains have the potential to enhance energy security and reliability.

Improvements in energy efficiency reduce dependence on fuel imports, which may have a stabilising effect on the domestic economy by reducing its vulnerability to fluctuating world market prices.

Efficiency gains limit the waste of resources financially and physically. Electricity systems are more reliable due to less losses.

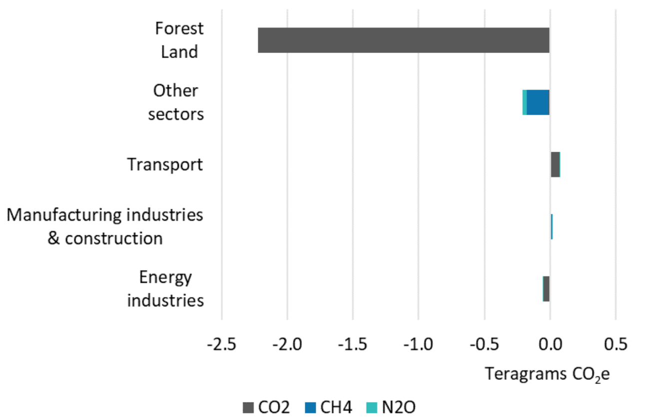

Figure 4: Impacts on GHG emissions of energy efficiency improvements (deviations in % from BAU scenario in 2030).

5. Increased energy efficiency mitigates emissions.

Less biomass use for cooking reduces GHG emissions, limits deforestation and preserves carbon sinks. Firewood and charcoal demand are reduced which limits bioenergy combustion and thus emission in "other sectors" including residential sector as well as forest land sector.

By 2030, 2.4Tg GHG emissions resp. 2.7% are expected to be saved of which 2.2 Tg CO_2 emissions are accounted for in forest land.

Electricity savings contribute less to GHG emission reduction as electricity generation is largely based on hydro power and the use of electricity is not yet the dominant energy source in Uganda.

The transport, manufacturing and construction sectors emit more GHG compared to the BAU scenario due to higher economic activity. No additional mitigation measures are presumed for these sectors in this scenario. Thus, the rebound effect curtails to a very limited extent the reduction of the GHG emissions.

Policy Recommendations

The results from the scenario analysis with the e3.ug model indicate that energy efficiency improvements are of advantage for Uganda. Economic, social, and environmental benefits are possible. To achieve these benefits, policy makers should support efficiency efforts by:

1. Promote energy-efficient appliances

(i) Reduce financial barriers to accelerate the uptake of energy-efficient equipment. Support from the government helps to reduce the financial burden for households, companies, and institutions.

(ii) Attract international donors and carbon offsetting projects to generate additional financial resources. At the COP27, developed countries promised to donate 100 Bn, USD p.a. for adaptation and mitigations projects in developing countries. International carbon offsetting projects may provide a funding option.

(iii) Foster access to finance for companies and low-income households. For example, government provides a "cooking tariff" to promote electric cooking.

2. Raising awareness

(i) Information campaigns should raise the awareness on the (long-term) benefits of energy savings in terms of

a) finance (reduced energy bill),

b) time (less time needed for collection of firewood) and

c) environment (reduced exposure to indoor air pollution)

(ii) Inform about available energy-efficient technologies and practices. Energy Service Companies could be established to advise on and implement appropriate technologies (e.g. https://mecs.org.uk/blog/scaling-up-electric-cooking-in-uganda/; https://e3p.jrc.ec.europa.eu/node/190).

(iii) Setting energy efficiency standards and implementing labelling programs of energy-efficient appliances.

(iv) Perform energy audits and inform about energy saving measures and opportunities.

3. Boost local production and capacity building

(i) Promote suitable local manufacturing capabilities to manufacture improved cookstoves.

(ii) Train local employees to conduct energy audits and inform the public on suitable energy-efficiency measures.

4. Promote the use of "green" electricity

The electricity saved should be used in a meaningful way either as exports or used domestically e.g., in industrial parks. Electricity may be also accumulated for later use. The storage of electricity is challenging and costly depending on the method (hydrogen, accumulator, or pumped storage power plant). In both cases, additional investments might be needed.

5. Monitor efficiency achievements

(i) Define indicators and timelines that measure target achievements to monitor development and be able to readjust policy measures.

(ii) Check efficiency improvements regularly.

Conclusion

Uganda has a significant energy-saving potential, but it is largely untapped. The scenario results show that energy efficiency improvements provide various benefits for the people, the economy, and the environment.

Efficiency gains involve additional costs that will be offset in the medium to long term, but the investments must be realised now. Thus, additional costs should be at least partially covered by the government and / or international donors to limit financial burdens.

To exploit the full benefits, efficiency improvements should be also considered in other sectors such as transport and building. The economic and environmental benefits would be even better than those presented in this policy brief.

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