

Energy and economic growth in Ethiopia – research findings for a transformative energy policy agenda

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This Policy Brief summarizes headline findings from recent research by five teams of investigators and a country study related to efficiency-enhancing measures and the expansion of electricity access in the Ethiopian energy sector.

Key messages and recommendations

Ethiopia needs to focus on key energy policy areas and interventions to meet its ambitious targets for improved electricity supply, universal access to electricity, and productive use of the electricity.

- Improvements in electricity system and consumption efficiency are achievable as households accept tariff increases to improve electricity reliability. Private metering is an additional enabler alongside appliance performance standards and measures to raise awareness of energy efficiency opportunities in households and businesses.
- Electricity access expansion can be realised more cost effectively with greater reliance on mini-grid and off-grid solutions alongside private-sector renewable energy investments for which simplified procedures, easier access to information and clarity on repatriation of funds for foreign investors are needed.
- Productive uses of energy, particularly for irrigation, can be a key enabler for improved agriculture output, resilience, and overall economic development of Ethiopia.

Ethiopia's energy policy agenda

Increasing electricity access and securing reliable electricity services is fundamental to Ethiopia's vision to transform into a manufacturing and agro-industrial hub, and to address some of the intractable development and poverty challenges the country faces. Five teams of Ethiopian and international researchers plus a team undertaking country level assessments worked over three years as part of the Energy and Economic Growth (EEG) programme in Ethiopia on research projects that speak to the two main components of the country's energy policy agenda. First, a comprehensive power sector reform roadmap is continuously developed to tackle key challenges of large utility debts, poor reliability, and sector inefficiencies at the supply and demand side. Second, the National Electrification Programme (NEP II) encapsulates several important questions on the road to universal access to electricity related to generation capacities, on- versus off-grid solutions, and productive uses of the – in part newly available – electricity. Using state-of-the-art methodologies from economics, engineering, and political sciences, the research outputs listed in the Box to the right range from simulations and development of new methods, to in-depth survey results, impact assessments, and institutional analyses.

Sector interventions to improve system and consumption efficiency

Tariff increases can be used to tackle historically low levels of cost-recovery by the national electricity utility and for investments in enhanced grid reliability. A first study found that such improved electricity service delivery is valued by

households and makes them willing to pay a price premium. ^[1] For example, they are willing to pay 13 to 16% of the average monthly electricity bill to avoid three-hour power reductions. Other studies assessed the medium-term impacts two years after a first in a series of tariff increases by the national utility in 2018, with electricity price increases of up to 60% for high-consumption customers. ^[2] ^[3]

Studies as part of the EEG Ethiopia programme

- [Urban households' valuation of power outages](#)
- [Electricity tariff reform and electricity consumption](#)
- [Pre-paid meters and household electricity use behaviour](#)
- [Promoting energy efficiency and conservation](#)
- [Fuel and appliance adoption in urban Ethiopia](#)
- [Impacts of energy auditing on small enterprises](#)
- [Governance, efficiency and implementation in electrification](#)
- [Pathways to an electrified Ethiopia](#)
- [Off-grid energy development by the private sector](#)
- [Renewable energy procurement by private suppliers](#)
- [Irrigation demand forecasting](#)
- [Productive use of grid electricity in rural Ethiopia](#)
- [Energy solutions for irrigation](#)
- [Country report on Ethiopian electricity market](#)

The analysis suggests that households reduced electricity consumption in the first half year after the price rise, but then broadly returned to the long-term trend of increased household consumption. Yet, customers with pre-paid

meters, for whom price increases are more salient, seemed to substantially reduce their consumption of electricity, while appliance ownership was found to differ only little between pre-paid and post-paid customers.

Another team of researchers found households to adopt coping strategies to the tariff increases. ^[4] 42% of sampled households mentioned that they reduced the frequency of cooking and baking, or shifted to other fuels, such as biomass. Another 31% mentioned to have implemented energy-saving measures, namely turning off light bulbs and other devices when not in use or, to a much lesser extent, adopting energy-efficient appliances.

Broader adoption of energy-efficient appliances likely requires demand-side policy interventions. A survey among households concluded that two such interventions may be effective: first, mandating imported products to carry information in local languages to reduce information barriers and, second, policies to increase availability of instalment-based credits for energy-efficient products to overcome financial barriers. ^[4] Another study found investments in energy-efficient appliances (particularly a switch from traditional biomass to clean electric cooking) to be more likely if constant and sufficient voltage levels are supplied, linking back to the issue of electricity service quality. The study also proposed to promote private instead of shared metering, given that tenants often restrict the use of certain appliance types. ^[5] In addition, energy efficiency needs enhancing in business, for example via energy audits. A study among enterprises in the capital, Addis Ababa, found audits to increase the use of energy efficient appliances by 14% and to reduce electricity consumption by 10%. However, resulting monthly cost savings of one US dollar are unlikely to outweigh the costs of the audits and efficiency measures from the firms' perspective. Hence, audits would need to be publicly subsidized or made compulsory to be more widely used. ^[6]

Regulatory measures in the appliance market may complement user-oriented interventions to improve consumption efficiency in the energy sector. Ethiopia is in the development of Minimum Energy Performance Standards (MEPS) for electric appliances. Research suggests that savings involved can be substantial, but that a robust MEPS programme enabled by effective governance that secures full implementation is to be prioritised over a fast-tracked timetable. ^[7]

Shaping electricity access expansion

Beyond improvements of the existing electricity system, policy efforts to expand electricity access are another priority. Scenario analyses expose an increased vulnerability to droughts due to the country's expansion of large hydropower capacity, which should be mitigated through

diversification in the power sector. ^[8] Mini-grid and off-grid systems could particularly play a larger transition role in areas where demand is developing slowly. This could lower financial pressure in the near term, reducing the overall cost of electrification by up to 40%. ^[7]

Mini-grid development in the country, however, lags behind targets and the technology's potential because of significant implementation gaps. Despite committed policy, particular challenges remain in terms of unclear procedures for compensations and integrating infrastructure into the grid when it arrives, as well as lengthy, complex and inefficient licensing procedures. Research identified streamlined processes, stronger devolved and less top-down institutions, and multi-stakeholder collaboration as critical to reduce this gap. ^[7] These findings are echoed by a survey among private-sector actors in the off-grid sector. ^[9] Political uncertainty engendered greater pessimism among Ethiopian respondents than among respondents from other studied East-African countries – Kenya, Tanzania, and Uganda. For Ethiopia, major barriers are furthermore perceived from the lack of information needed to assess the market (37% of respondents), the high cost of doing business (29%), and the scarcity of foreign exchange as a country-specific barrier.

Independent power producers (IPPs) from the private sector can play a vital role in extending the availability of low-cost renewable energy capacity. An EEG study assessed the policy landscape for IPPs and found the biggest challenges for IPP developers and debt financiers to overlap with those identified by the broader spectrum of private-sector actors in the off-grid sector. Notably, these challenges lie in institutional weakness and inconsistency paired with the shortage of foreign currency and convertibility of the Ethiopian birr to international currency. ^[10] This foreign exchange risk and the lack of government guarantees are preventing lenders from convincing their credit committees that Ethiopian IPPs are bankable. ^[14] Key institutions experience dire shortages of expertise in finance, law and the preparation of bid documents, and organisational tensions occur due to overlapping roles and responsibilities. Proposed solutions are a (re)allocation of agency tasks based on competencies, committing to a timeline for profit repatriation and to address the human capacity shortages through improved salary scales and career pathways. A 'one-stop shop' website is an additional recommendation to ensure access to all critical bid documents and other information for potential private-sector investors.

Productive use potentials in the agricultural sector

Two EEG teams assessed the opportunity for productive use of newly available electricity for irrigation. A first study

used predictive data analytics to more cheaply and quickly identify locations with existing diesel-powered irrigation, since these represent sites more likely to adopt electricity and to provide stable revenue from electricity sales.^[11] The developed model used satellite-measured pollution data and correctly identified areas with diesel-powered irrigation with 75% accuracy. A complementary farm household survey found that, under current conditions, few farmers adopt electricity for irrigation. This is not only because of switching costs from diesel to grid-electricity motorised pumps, but primarily because of the unavailability of grid electricity at their fields.^[12] Policy may therefore consider decentralised solutions such as solar-powered pumps based on their relative cost-effectiveness vis-à-vis on-grid irrigation. A study of this cost-effectiveness found variation by crop and by location, but that, overall, on-grid electricity is the most cost-effective energy solution in areas close to the electricity transmission network.^[13] At the same time, there is groundwater irrigation potential that is located outside the service area of the electricity grid and thus needs to rely on off-grid energy sources. Here, solar PV tends to be advantageous in the north and in eastern lowlands.

Priorities for policy-relevant research

The body of evidence from the EEG programme illustrates key insights for Ethiopia's policymakers. All projects found that consumers, existing producers and potential investors require more information to make full use of the opportunities for electricity in Ethiopia. Knowledge gaps have been one constraint for improving access to electricity, grid reliability, uptake of clean and efficient technologies, and investment into renewable energy. Low tariffs and challenges in securing financing (in part due to currency convertibility limits and the structure of Ethiopia's banking sector) have been additional barriers for both grid and off-grid private sector investments. Amid an evolving institutional set-up in Ethiopia, the political commitment and legal frameworks are emerging together with incentive packages to unlock the potential for electricity.

A concluding workshop of the EEG programme brought together policymakers, regulators, the utility, private-sector

representatives, donors and other interested parties as well as representatives from our research projects in September 2022 in Addis Ababa. It confirmed that solutions abound, but human capacity and knowledge gaps remain chief barriers among policy makers to rapidly turn ambitions for universal access to electricity into reality. This implies priorities for future policy-relevant research in Ethiopia, chiefly: 1) impact assessments of tariff reforms on households and consumers to determine viability of more cost-reflective future electricity prices; 2) assessments of availability and applicability of energy-efficient solutions for households and businesses; and 3) integrated energy-agriculture-water analysis for holistic planning of grid infrastructure, implied opportunities for IPP investment and productive uses of energy.

The views expressed in this Policy Brief do not necessarily reflect the UK government's official policies.

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