Uganda 2023

Energy Policy Review

International Energy Agency

INTERNATIONAL ENERGY AGENCY

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Foreword

As the International Energy Agency (IEA) has opened its doors to emerging and developing economies, in-depth reviews have come to play an increasingly prominent role in our bilateral partnerships. We are very pleased this work now extends to Uganda, the first country in sub-Saharan Africa to participate in a comprehensive assessment of its energy system and policies.

The IEA has been actively involved in addressing African energy issues for more than two decades. We began with pioneering work on energy access data in 1999 in our flagship *World Energy Outlook*, but our efforts have expanded significantly since then, with a focus on the key tools needed to enhance energy access, economic development, affordability, sustainability and energy security. We hope this review provides a strong example for further collaboration in the region.

I congratulate Uganda for the progress it has made over the past two decades in providing access to electricity and expanding generation capacity. It is also impressive that the country's electricity sector is now almost fully based on renewable sources. The IEA looks forward to continuing to partner with Uganda as it builds on progress in reforming its electricity sector and works towards achieving universal energy access.

Much of this work will be facilitated by the newly launched Energy Policy for Uganda, a major contribution to the country's ambitious energy agenda. Notably, Uganda already has in place much of the technical expertise, government institutions and policy frameworks to reach its energy goals. It is also a leader in the region on high-quality energy statistics, which are crucial for evidence-based policy making. We commend Uganda for its efforts that have led to improved coverage, quality and timeliness of energy balances and data, and encourage further ambition.

For years, the IEA and the government of Uganda have collaborated closely, sharing energy data and knowledge. Ugandan leaders have participated in many important IEA events. This year, as part of its efforts to meet the goals of the Paris Agreement, Uganda's Ministry of Energy and Mineral Development also decided to draw on the IEA's expertise to support the development of the country's Energy Transition Plan. So far, the focus has been on further strengthening Uganda's modelling, energy data and statistics capacities. This in-depth review – which takes stock of the latest energy trends, assesses Uganda's energy policies and provides policy recommendations – will help inform the next steps.

The aim of this report is to support Uganda as it works to chart its path forward, achieve its goals to eradicate energy poverty, develop its energy resources, promote sustainable, clean energy, and bring prosperity to all Ugandans – as set out by national targets and international agreements. My hope is this in-depth review will guide Uganda in its energy development – and serve as a tool to deepen international partnerships at a moment when more are needed.

Dr. Fatih Birol

Executive Director

International Energy Agency

LIST OF FIGURES, TABLES AND BOXES

Figures

Tables

Boxes

Executive summary

Uganda has set an ambitious agenda to develop its substantial energy and mineral resources, promote economic development, end energy poverty, and lead the country to a just energy transition. Uganda's stated objective in Vision 2040 is to transform into "a modern and prosperous country", ensuring a better future for its citizens. The energy sector will play an important role in helping Uganda achieve this.

Uganda is endowed with abundant natural resources, including fertile soils; petroleum deposits; and reserves of iron ore, phosphates, copper, cobalt, aluminium and gold. The agricultural sector employs over 80% of the workforce, mostly in subsistence farming. Uganda had a population of 47 million in 2022, around 25% of which was urban. The country's fast population growth has undermined efforts to increase access to modern energy.

Final energy consumption was about 16 800 kilotonnes of oil equivalent (ktoe) (703 petajoules [PJ]) in 2021. Traditional biomass, mostly wood and charcoal used by households for cooking, accounted for around 87% of the total. Around 11% of final consumption was in the form of oil products, mostly petrol and diesel for transportation. Only around 2% was in the form of electricity, most of which was from hydropower. Households accounted for 61% of final energy consumption, industry 22%, transportation 7%, and commercial and public services together consumed around 9%.

The National Energy Policy for Uganda 2023 focuses on expanding the electricity transmission and distribution grid networks; increasing energy efficiency; promoting the use of alternative sources of energy; and strengthening the policy, legal and institutional framework. Uganda has developed a number of subsectoral policies, including the 2008 National Oil and Gas Policy (currently under review), the Renewable Energy Policy (2007), and the Electricity Connections Policy (2018).

In recent years, Uganda has improved the coverage, quality and timeliness of energy balances and related data. Although Uganda is a leader in the region in terms of energy statistics, as in many other countries, data collection, organisation and quality control often are not allocated sufficient and consistent resources.

Electricity

While electricity represents only around 2% of Uganda's total energy consumption, over 80% of generating capacity is based on hydropower. Most of the remainder is also renewable, including several solar photovoltaic (PV) installations and thermal power plants that burn sugar cane bagasse. The significant reliance on hydropower has implications for energy security, particularly due to uncertainties surrounding future climate change impacts on the region's water resources.

Uganda increased its electricity generating capacity from about 320 megawatts (MW) in 2002 to over 1 346 MW at the beginning of 2023 and now has a significant surplus relative to its peak demand of about 800 MW. The Karuma hydroelectric power plant, expected to come fully online in 2023, will add a further 600 MW.

Investment in transmission and distribution has not kept pace with generation, resulting in an inability to fully use a significant share of the country's generating capacity. Since past power purchase agreements (PPAs) signed with the state-owned system operator have often included take-or-pay clauses, the government has had to pay for energy that it has not been able to use, adding significantly to the cost of power.

The government has avoided subsidising electricity consumption. However, high tariffs have prevented many customers from consuming power, even when initial connections are subsidised. This, in turn, has made it challenging to finance grid extensions, as well as operation and maintenance; lowering the cost of power is one of the government's priorities.

The Cabinet recently decided to merge the three state-owned entities covering generation, transmission and distribution into a new, vertically integrated company. This is part of a general policy to rationalise government agencies. In the case of electricity, the government hopes that eliminating private shareholders' requirements for a guaranteed return on investment, as well as the ability of a government-backed company to obtain cheaper credit, will help reduce tariffs. It also cites the potential for closer co-ordination of transmission and generation investments as another benefit. However, some stakeholders, including some investors and development partners, have expressed concerns about the uncertainties related to the proposed merger and its timing.

Amendments to the Electricity Act passed in 2022 include the possibility for net metering and for generators to sell directly to customers instead of to the transmission company, which has served as the single buyer. However, regulations allowing market participants to take advantage of such measures have yet to be implemented.

The government has a scenario to develop a 1 000 MW nuclear power plant by 2031 and another 1 000 MW plant by 2040 in anticipation of rising demand. It is working with the International Atomic Energy Agency (IAEA), considered to be in Phase 2 of the IAEA Milestone Approach, and has signed non-binding agreements with companies in the People's Republic of China (hereafter "China") and the Russian Federation (hereafter "Russia") to explore options.

Renewable energy

Approximately 92% of Uganda's generating capacity is renewable, of which about 80% consists of large hydro, 8% sugar cane bagasse-fired plants and 4.5% solar PV plants. Uganda aims to increase its non-hydro renewable electricity generating capacity, particularly from solar. It introduced PPAs with feed-in tariffs for renewable energy projects under 20 MW in 2007.

Individual and commercial solar systems can help the government meet its electrification targets and spur economic development in rural areas. However, the market for solar home systems and components has been significantly undermined in recent years by faulty installations, the import of substandard systems and poor after-sales service.

Uganda appears to have significant geothermal potential, which could help reduce the power system's dependence on hydro. The main challenge for geothermal development in Uganda is the significant resource uncertainty and geological risk that private investors must bear in the absence of detailed data.

Given the high level of organic content in the country's municipal waste, significant increases in the urban population, and constraints on land available for new dumps and landfills, waste-to-energy projects appear to be a particularly promising way to diversify the energy supply. The government also hopes to develop biofuels and build up domestic production capacity.

Achieving universal access

Achieving universal access to clean and reliable energy sources for electricity and cooking remains a challenge in Uganda and is a high priority for the government in achieving economic and social development.

With around 30% of the population having access to electricity and less than 6% having access to clean cooking fuels, Uganda continues to have one of the lowest electrification and clean cooking rates in sub-Saharan Africa. Although the share of people with access to clean cooking fuels has rapidly increased since 2010, the rapid population growth has led to the actual number of people without access to effectively increase. In its National Energy Policy 2023, the Ugandan government aims to reach universal access to electricity and 50% access to clean cooking by 2040.

As of 2022, around 20% of the Ugandan population had access to electricity from the national grid, while a further 10% received electricity from solar home systems capable of providing a basic package of energy service. Another 20% benefitted from limited access through smaller solar lighting devices such as solar lanterns. It is estimated that approximately 50% of the country's health centres and 20% of its schools have access to electricity, either through grid or off-grid solutions.

Low power demand undermines the entire power system, thereby contributing to grid instability and an unreliable supply that, in turn, undermines consumption. Further, the scattered and sparse settlement patterns of the predominantly rural population compound the cost and complexity of the country's electrification efforts, making it necessary to consider both on- and off-grid solutions.

Around 95% of households rely on either wood or charcoal as their primary energy source for cooking, creating both social and environmental concerns. High reliance on biomass is contributing to deforestation in parts of the country. Millions of Ugandans are negatively affected each year by indoor pollution from cooking with biomass, which disproportionately impacts women and children.

Challenges include the high costs of improved cookstoves and fuels compared to biomass (which when collected is often perceived to be free), the lack of financing for stove distributers and potential customers, insufficient distribution infrastructure for liquefied petroleum gas (LPG), and cultural and awareness barriers. Even when households adopt clean cooking technologies, they often do so incompletely, continuing to use biomass for much of their cooking needs.

Affordability remains the main challenge to both electricity access and clean cooking fuel access. The government has implemented several instruments and mechanisms to lower the cost of electricity, such as a social/lifeline electricity tariff and a free connection plan. Yet the level of financial support for these initiatives has not been consistent, undermining efforts to help the 33 million people who still lack access to electricity. Similarly, a cooking tariff for electric cooking is available to all grid-connected customers, yet the low connection rate makes the option unavailable to most households.

While LPG for cooking is seen as a potential solution, it is not yet widely available outside urban areas; cylinders are not standardised across distributers; and there are currently no verifications of LPG quality or cylinder fill levels. The government is promoting the use of LPG, including through the distribution of free start-up kits (including free cylinders), the construction of filling stations outside Kampala and the standardisation of LPG cylinders, which could support increasing access through LPG expansion.

Reaching the 2040 access target for electricity and clean cooking will require more targeted government subsidies, foreign investment, awareness campaigns on cooking solutions, as well as better regulations on the sales of cooking fuels.

Extractive industries

Oil accounted for less than 10% of Uganda's total energy supply in 2021, with all oil products being imported through Kenya and the United Republic of Tanzania, and primarily used for transport.

Uganda's first commercial oil discovery occurred in 2006 in the Lake Albert basin. Petroleum resources in the explored part of the Albertine Graben are estimated to be 6.5 billion barrels, of which 1.2 billion are considered recoverable, with an additional 0.4 billion barrels of contingent resources.

Two oil development projects are being pursued by a consortium of TotalEnergies and China National Oil Corporation, along with the Uganda National Oil Company. Commercial production is scheduled to begin in 2025, and peak production from existing projects is expected to reach about 200 thousand barrels per day (kb/d) by 2028. The three main upstream investors are developing an oil export pipeline in partnership with the Tanzania Petroleum Development Corporation. The planned East African Crude Oil Pipeline (EACOP) will stretch from Hoima District in western Uganda to the Tanzanian coast at Tanga, providing an outlet for landlocked Ugandan crude oil to the international market. There are also plans for an oil refinery to serve the domestic and East African markets.

There is no production nor consumption of natural gas in Uganda, though estimated gas resources include 7.1 billion cubic metres (bcm) of associated gas and 9.5 bcm of non-associated gas. Both the Tilenga and Kingfisher projects are expected to produce some gas associated with their oil output, and both plan to use this to generate on-site power and produce LPG for the local market. Additionally, the governments of Uganda and Tanzania have agreed to work towards developing a natural gas pipeline from Tanzania to Uganda to supply natural gas for the iron and steel industry as well as for domestic and commercial uses.

All tax and non-tax revenues for the government from oil will be received by the Uganda Revenue Authority and will be deposited in the Petroleum Fund, which was established by the Public Finance Management Act 2015. The Fund is designed to ensure that the

revenues from petroleum resources are well managed and allocated for the benefit of current and future generations of Ugandans, with an emphasis on infrastructure development.

There have been some concerns expressed by international and local groups about the potential environmental and social impact of the EACOP oil project. Social and environmental assessments were conducted for the current oil projects and these have been approved by the respective regulatory agencies. The government sees oil development as a way to diversify energy supplies, improve energy security by cutting reliance on oil imports, build technical competencies for other industrial activities, and provide revenue for the country's economic and social development.

Uganda has no production of critical minerals, but initial exploration in the 2000s suggests that the country has reserves of several minerals critical for the energy transition. Moreover, Uganda's abundant hydropower and renewable energy could help make the country a relatively low-carbon source, potentially giving it a market edge over competing suppliers.

Energy efficiency

Higher upfront costs, low levels of access to modern energy and a lack of adequate data present important challenges for energy efficiency policy making in Uganda. Until recently, the absence of a legal framework for energy efficiency has stalled important measures, such as the enforcement of building codes, minimum energy performance standards (MEPS) and labelling regimes. Efforts are underway to develop a legal, regulatory and enforcement framework for energy efficiency following the adoption of the 2023 National Energy Policy and the anticipated adoption of the draft Energy Efficiency and Conservation Bill.

Uganda's fleet of predominantly older and imported vehicles is inefficient compared to global averages. For example, light-duty vehicles (which include passenger cars) consume over 25% more fuel than the average globally. E-mobility initiatives for two- and four-wheel vehicles are being deployed with the support of international donors. The government has set a target to electrify 30% of the motorcycle fleet by 2030.

As part of its efforts to expand affordable electricity access while growing demand for productive uses of energy, the government has an opportunity to lay the foundations for energy efficiency and ensure greater cost-effectiveness and affordability in the medium and longer term.

Climate change and the environment

Uganda's current CO_2 emissions from fuel combustion equal 5.7 million tonnes carbon dioxide (Mt CO_2), mostly from the transport sector. Electricity only accounts for 1% of emissions. Challenging environmental issues in Uganda's energy sector include deforestation, land degradation and indoor air pollution related to the use of biomass in residential cooking; the vulnerability of the country's large hydropower-generating capacity to climate change; and the future impact of oil and gas operations on land, water and air resources.

Uganda has signed and ratified the Paris Agreement on Climate Change, which requires parties to develop climate change policies, strategies and plans promoting adaptation and

mitigation. Priority adaptation actions for the energy sector considered in Uganda's Nationally Determined Contribution (NDC) include improving access to electricity to reduce dependence on biomass, promoting the use of renewable energy sources and energy-efficient technologies, increasing access to clean cooking options, and rehabilitating and climate-proofing electricity transmission infrastructure.

Investment

Reforms to improve the investment environment in Uganda include the Investment Code Act 2019, which created the Uganda Investment Authority to act as a one-stop shop to simplify administrative procedures. The Act also lays out a series of tax incentives and other key protections for international investors.

In the power sector, over USD 270 million have been mobilised into independent power producers (IPPs) with private involvement over the last decade. Transmission was recently opened to the private sector, with a pilot project currently under negotiation. Within the distribution sector, there are several private concessions, although ongoing sectoral reforms and the decision not to renew the largest distribution concession have created some uncertainty.

Oil investments so far have been led by Western and Chinese companies, though pressure on financiers, particularly in Europe, to align their portfolios with a net zero scenario may reduce the capital available for such projects going forward. Mining for critical minerals remains nascent but is likely to attract private capital once geological viability is confirmed and the regulatory framework fully established.

The cost of capital remains one of the major challenges. Small and medium-sized enterprises in the off-grid space rely heavily on local commercial banks, but these banks often struggle to assess the risk of off-grid solutions. They, therefore, can only provide loans at prohibitive rates. While there is potential for domestic institutional investors, especially pension funds, to play a larger role, high yields on government securities reduce the incentive to invest in alternative assets. Climate-related funds can serve as a source of capital for clean power projects, though the government's experience with such funds so far has been with procedures that are often long and complex. The Ugandan government has established the National Climate Change Mechanisms Taskforce in 2022 to address opportunities related to both Article 6 and voluntary carbon markets.

Key recommendations

- Develop, implement and track an Energy Transition Plan to chart a path for achieving Uganda's energy-related goals while aiming for a transition to a low-carbon, climate-resilient economy, including by considering new technologies and innovation, in line with the Paris Agreement and Uganda's Nationally Determined Contribution.
- Further develop the national energy statistics system to improve data coverage and quality to better inform policy decisions.
- Continue addressing transmission bottlenecks and stimulation of demand for productive uses of energy as priorities to take greater advantage of existing generation, increase grid stability, lower the cost of power and potentially serve more customers.

- Continue consultations on power sector reforms and provide clarity to stakeholders on details as soon as practicable. During the transition period, ensure continued investment in and maintenance of the distribution grid.
- Ensure that efforts to provide access to electricity are closely co-ordinated with other development plans so that new connections can foster economic development and productive uses of energy. This should include access to adequate and affordable financing schemes.
- Ensure that the national clean-cooking strategy under development covers as many technologies and consumer categories as possible; is integrated with a comprehensive action plan on sustainable biomass use; and employs complementary tools such as technical assistance, training, research, financial incentives and awareness raising.
- Continue working with the Extractive Industries Transparency Initiative and other partners regarding best practice for oil revenue transparency, management and investment, including the use of its Petroleum Fund, to ensure that Uganda's oil revenues help the country achieve its economic, social and sustainable development goals. Take the lead in exploring and identifying promising areas to attract investment in mineral production, in particular by financing the further exploration of several of the 18 mineral deposits already identified, prioritising the critical minerals necessary for the worldwide transition to renewable energies.
- Leverage the potential of energy efficiency as an enabler of affordable and sustainable energy access and demand growth in both rural and urban settings through incentives and dedicated funding instruments for the purchase of energy-efficient equipment by end users while also ensuring e-mobility plans are effectively implemented so the government can reach its objectives.
- Identify sectors and key projects for public-private partnerships that would allow for the design of mutually beneficial financing structures, including domestic sources of capital where appropriate.

1. General energy policy

Key data (2021)

Total energy supply: 22 Mtoe (bioenergy 90%, oil products 9%)

Total final consumption: 17 Mtoe (bioenergy 87%, oil products 11%, electricity 2%)

Country overview

Straddling the equator on the East African Plateau, Uganda is bordered by Kenya to the east, Tanzania and Rwanda to the south, the Democratic Republic of the Congo to the west, and South Sudan to the north. Although landlocked, it has a long shoreline on Lake Victoria and is part of the Nile River Basin. Uganda has a total surface area of 241 038 km², of which about 80% is land.

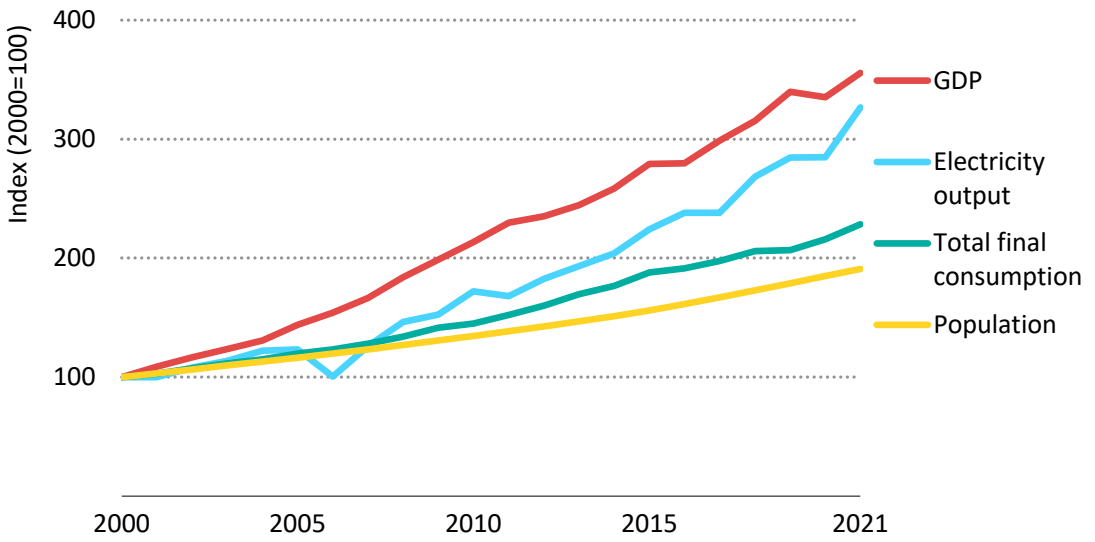
Uganda's population was 47 million in 2022. A little over 25% was urban, compared to an African average of 43%. The country has a relatively high population density of 230 inhabitants per km², and nearly half the population is under 15. The average number of persons per household is 4.6, though it is somewhat smaller in urban areas (UBOS, 2021). The country's high fertility rate has made it difficult for GDP and energy access to keep up with population growth of 3%[1]. The government's overall policy document, Vision 2040, projects a population of 61 million by 2040, though some sources suggest it could exceed 80 million by that time (World Bank, 2022).

In addition to the capital city of Kampala, the country is divided into 134 administrative districts. The main spoken languages are English and Swahili, along with regionally based languages such as Luganda and Luo. Approximately 85% of the population is Christian, while 12% is Muslim.

Between 1990 and 2010, Uganda had one of the highest GDP growth rates in Africa at around 8%, though economic growth since 2011 has barely surpassed population growth. In 2019, annual GDP growth was 6.8%, slowing to 2.9% in 2020, largely due to the impact of Covid-19 (World Bank, 2022). Vision 2040 aims for the country to become a lower middle-income country by 2017 and an upper-middle income one by 2032. As of January 2023, the World Bank continued to categorise Uganda as a low-income country, i.e. one with a per capita income of USD 1 085 or less.

[1] See World Bank Population growth for Uganda, https://data.worldbank.org/indicator/SP.POP.GROW?locations=UG

Figure 1.1 Energy demand and drivers, 2000-2021



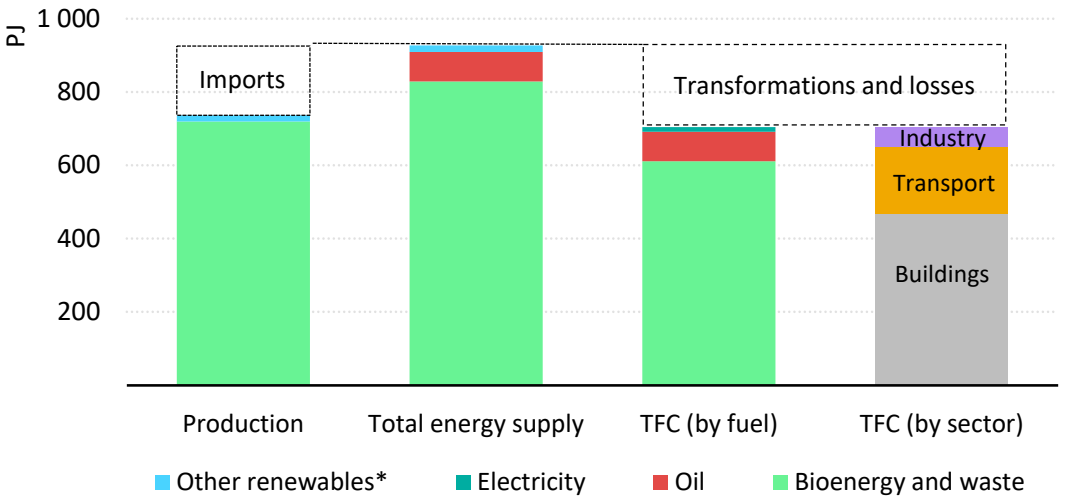
Note: GDP = gross domestic product.
Source: IEA (2023).

Uganda's natural resources include fertile soils; petroleum deposits; and reserves of iron ore, phosphates, copper, cobalt, aluminium, gold and limestone. The largest sources of GDP are agricultural processing, textiles, light manufacturing and cement. The country's most important exports include coffee, tea, maize, cotton, flowers, fish, gold and tobacco, while its main imports are petroleum products, machinery, manufactured goods, chemicals and grains. Future growth is likely to depend significantly on the development of agriculture and oil (IDA, 2022). The agricultural sector currently employs over 80% of the workforce, though mostly as subsistence farmers.

Uganda hosts more refugees than any other country in Africa. As of January 2022, it had 1.6 million refugees and asylum seekers, many of whom were residing in the West Nile Sub-region. Uganda's refugee policies are generally recognised as robust and closely aligned with the Global Compact on Refugees (World Bank, 2022). Uganda has developed and is currently implementing a number of "refugee and host community sector response plans", including a "Sustainable Energy Response Plan," which provides priorities and guidance for development partners to assist the government in this sector.

According to the World Economic Forum's *Global Gender Gap Report 2021* (WEF, 2021), Uganda tied for first (along with 28 others) out of 156 countries in terms of the narrow gap between men and women for outcomes related to "health and survival". (A smaller number/rank means a smaller gap.) It ranked 74th in "economic participation and opportunity" and 46th in "political empowerment", though 131st in "educational attainment".

Figure 1.2 Overview of Uganda's energy system by fuel and sector, 2021



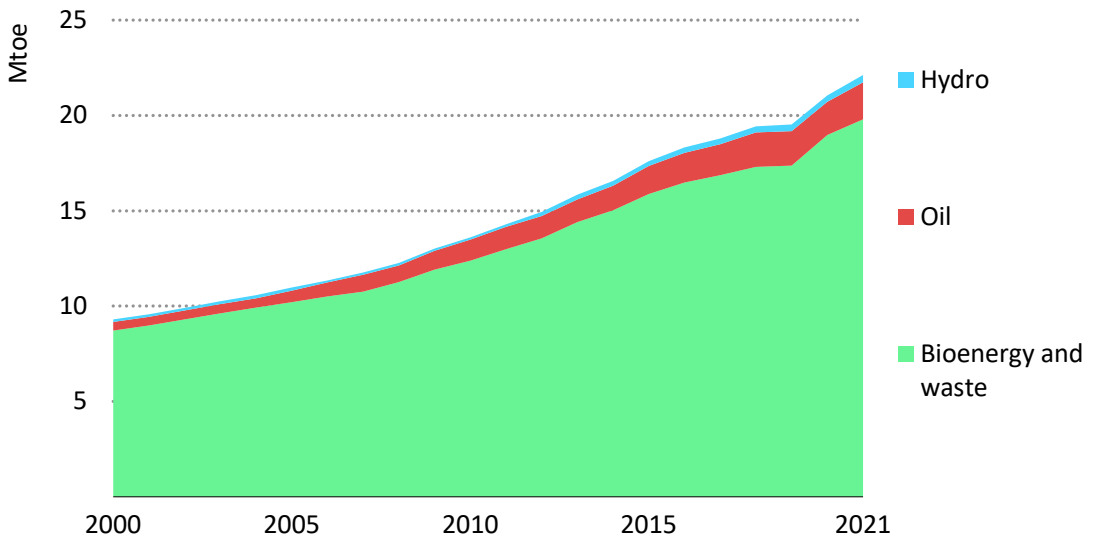
Notes: PJ = petajoule; TFC = total final consumption.
Source: IEA (2023).

Energy supply and demand

According to IEA data, total energy supply in Uganda in 2021 was about 22 million tonnes of oil equivalent (Mtoe) (925 PJ), up from 17.6 Mtoe (737 PJ) in 2015. Approximately 90% of the energy supply in 2021 was bioenergy, mainly wood and charcoal, slightly down from 94% in 2000. Imported oil products represented almost 9% and electricity almost 2% (Figure 1.3). Nearly all electricity in Uganda is from hydropower.

Final energy consumption in 2021 was about 17 Mtoe (703 PJ), up from about 14 Mtoe (579 PJ) in 2015. Around 87% of final consumption the same year was bioenergy, mostly wood and charcoal consumed by households for cooking, as well as some sugar cane bagasse for co-generation of electricity at several sugar-processing plants. Approximately 11% of final consumption was in the form of oil products, mostly petrol and diesel for transportation, as well as some heavy fuel oil and diesel for the country's small number of thermal power plants. Only around 2% of final consumption was in the form of electricity.

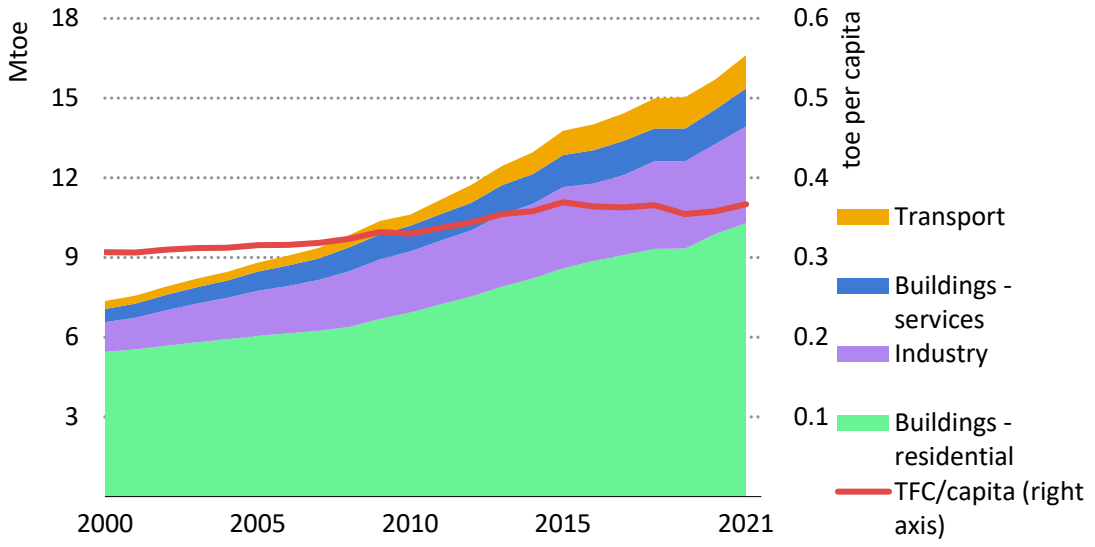
Figure 1.3 Total energy supply by fuel in Uganda, 2000-2021



Note: Mtoe = million tonnes of oil equivalent.
Source: IEA (2023).

Households accounted for about 61% of final energy consumption, industry 22%, transportation 7% and public services 9% (Figure 1.4). In 2021, total final consumption was around 0.37 toe per capita, up from 0.31 toe in 2000.

Figure 1.4 Total final consumption by sector and per capita in Uganda, 2000-2021



Notes: Mtoe = million tonnes of oil equivalent; toe = tonne of oil equivalent; TFC = total final consumption.
Source: IEA, (2023).

Uganda has one of the lowest grid-electricity connection rates in the world at around 20% in 2020, although a further 27% of the population has access to various off-grid solutions ranging from solar home systems to solar lanterns (MEMD, 2023a).

In Uganda, as in most countries in the region, the use of biomass such as firewood fuel (especially in rural areas) and charcoal (especially in urban areas) is predominant in the energy mix, mainly due to the extremely low access to modern energy cooking technology. In 2021, biomass represented around 87% of Uganda's final energy consumption, down from 93% in 2000, mainly due to the increased use of fossil fuels in the transport sector. However, the absolute amount of biomass consumed has more than doubled, from 7 Mtoe in 2000 to 15 Mtoe in 2021. Although most biomass consumption is connected to traditional cooking practices, it is also used in Uganda for more modern purposes, like electricity generation. Sugar cane bagasse accounts for the second-largest electricity generation source in Uganda after hydropower (see Chapters 2 and 3).

Key institutions in the energy sector

The **Ministry of Energy and Mineral Development (MEMD)** is the main government institution in Uganda's energy sector. Its roles include providing policy guidance, creating an enabling environment to attract investment, acquiring and interpreting data regarding the energy and mineral resource potential of the country, monitoring the activities of private companies, and overseeing regulatory institutions. The MEMD has three main directorates: Energy Resources Development, Petroleum, and Geological Survey and Mines, as well as a number of cross-cutting units, such as the Department of Policy and Planning.

The MEMD's policy goals are:

- "to meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner"
- "to use the country's oil and gas resources to contribute to early achievement of poverty eradication and create lasting value to society"
- "to develop the mineral sector for it to contribute significantly to sustainable national economic and social growth".

The MEMD's website notes the following "major strategies" in the energy sector:

- "increase the energy mix in power generation, promote and co-invest in the development of new power generation and transmission projects"
- "promote and/or implement rural electrification through grid extension, development of decentralized power supply systems and use of renewable energy resources"
- "promote and monitor petroleum exploration, development and production by the private sector for local consumption and export"
- "carry out energy audits and consumer awareness campaigns for energy efficiency"
- "promote more efficient modes of transportation, in order to maintain security of petroleum products supply and curb smuggling".

The MEMD is guided by national policies such as Vision 2040, the Third National Development Plan and the National Energy Policy for Uganda 2023 (see below).

Box 1.1 Proposed project for an Integrated Energy Resource Master Plan

The Ministry of Energy and Mineral Development is considering the development of an Integrated Energy Resource Master Plan (IERMP), with which it hopes to co-ordinate its various energy-related programmes and strategies. The overall goal would be to "provide national decision makers with the quantitative base for planning future energy sector development". The Concept Note for the IERMP observes that the Ministry's current planning function faces significant challenges "due to absence of a long-term energy master plan, understaffing and low technical capacity, lack of data and tools for proper planning and management of the sector." The Ministry envisions several components to its proposed IERMP project, including a low-carbon Energy Transition Plan, an Energy Data Platform, and capacity building and institutional support from development partners.

Source: MEMD (2023b).

The **National Environmental Management Authority (NEMA)** is a semi-autonomous body created in 1995 under the National Environment Act. It is the principal agency responsible for co-ordinating, monitoring, regulating and supervising environmental management. In the energy sector, it is responsible for issuing environmental clearance certificates, following its review and approval of environmental audits, impact assessments and resettlement plans.

The **Uganda Investment Authority** is a one-stop shop where investors may obtain applications for company registration and various licences, including for investment projects in the energy sector.

The **Uganda National Bureau of Standards (UNBS)** is a statutory body under the Ministry of Trade, Industry and Cooperatives. It formulates and promotes the use of national standards and develops and monitors quality control and assurance systems. In the energy sector, this notably includes standards for biofuel technologies and renewable energy components such as solar PV systems.

Other institutions include the following; they are discussed in relevant chapters of this review:

- Petroleum Authority of Uganda (PAU)
- Uganda National Oil Company (UNOC)
- Electricity Regulatory Authority (ERA)
- Rural Electrification Department of the MEMD
- Uganda Energy Credit Capitalisation Company (UECCC)
- Uganda Electricity Generation Company Limited (UEGCL)
- Uganda Electricity Transmission Company Limited (UETCL)
- Uganda Electricity Distribution Company Limited (UEDCL)
- Electricity Disputes Tribunal
- Atomic Energy Council.

Key policy documents

Vision 2040

In 2007, the government began a consultative and planning process that resulted in the publication of Vision 2040 in 2013. Vision 2040 aspires to "change the country from a predominantly low-income to a competitive upper-middle income country within 30 years" (NPA, 2017). Energy-related targets the country aims to achieve by 2040 include the following:

- raise per capita electricity consumption to 3 668 kilowatt hours (kWh), from 75 kWh in 2010 (by 2020 it was around 100 kWh)
- increase the share of the population with access to electricity to 80%, from 11% in 2011 (by 2020, 20% of the population was connected to the grid, while a further 27% benefitted from various off-grid solutions).

Third National Development Plan

Vision 2040 is being operationalised through a series of five-year national development plans. The government is currently implementing the Third National Development Plan (NDP III), which covers the period 2020/21 to 2024/25.

The NDP III focuses on "enhancing value addition in key growth opportunities (agriculture, tourism, minerals, oil and gas, and knowledge), which have the highest potential to generate employment for our people and positive multiplier effects on other sectors" (NPA, 2020). It features a shift to a programmatic approach from the sector-wide approach of the Second National Development Plan.

The NDP III contains 18 programmes, 2 of which are directly related to the energy sector: "Sustainable Development of Petroleum Resources" and "Energy Development". It also contains 20 "key development strategies", of which the most directly relevant for the energy sector are: "Fast track oil, gas and mineral-based industrialisation", and "Increase access to stable, reliable and affordable energy". (The energy-related development strategies and programmes are discussed later in this report.)

Additional strategies in NDP III include: "Promote science, technology, engineering and innovation as well as ICT", and "Increase government participation in strategic sectors". Regarding the government's participation in strategic sectors, there has been an apparent shift to more direct government involvement and investment in key areas, including energy. The NDP III notes that lessons learnt over the previous decade have led to Uganda revisiting the role of government, since "the market alone is unlikely to optimally drive Uganda's development process. A quasi-market approach is required" (NPA, 2020).

A World Bank assessment of the NDP III from March 2022 comments that the plan had been approved a few months into the Covid-19 pandemic, so it was "based on a set of expectations and projections that may have since changed considerably". Nevertheless, it notes that the NDP III "to a large extent reflects a broad national consensus" and addresses "the bulk of the development constraints and opportunities identified" by a recent World Bank diagnostic study (IDA, 2022).

National Energy Policy for Uganda 2023

The National Energy Policy for Uganda 2023 replaces the previous energy policy, which was adopted in 2002. It provides a detailed list of challenges and policy priorities in most energy
subsectors, including electricity, renewable energy, energy efficiency, rural electrification, clean cooking and nuclear power. The major subsector not covered is petroleum, which it notes is addressed by the 2008 National Oil and Gas Policy, which at that time was "currently under review" (MEMD, 2023a).

The overall objective of the new National Energy Policy is to "ensure [a] sustainable, adequate, affordable, competitive, secure and reliable supply of energy at the least cost geared to meet national and county needs while protecting and conserving the environment" (MEMD, 2023a).

The new National Energy Policy points out that a number of important contextual changes have occurred since the previous Energy Policy was adopted in 2002. These include moving from a situation of severe electricity capacity shortage to one of capacity surplus, as well as a shift from primarily private sector-led growth to increased use of public-private partnerships (PPPs) and public financing, aimed at increasing affordability. It also notes that the new Energy Policy is aligned with the key policies and international frameworks developed since 2022, including Vision 2040, the NDP III, and the 2030 Agenda and the Sustainable Development Goals (MEMD, 2023a).

The National Energy Policy identifies the following overall challenges facing the sector:

- "low levels of access to affordable and modern energy services"
- "constrained economic development due to inadequate energy sector investments"
- "high system power losses, poor quality of service, and unreliable power supply"
- "environmental degradation due to unsustainable utilization of biomass energy resources"
- "inefficient utilization of energy"
- "inadequate technical capacity in private and public institutions"
- "insufficient public awareness", leading to "low uptake of modern energy services".

The National Energy Policy notes the following key focus areas: "increasing power generation, expanding the electricity transmission and distribution grid networks, increasing energy efficiency, promoting the use of alternative energy sources, and strengthening the policy, legal and institutional framework" (MEMD, 2023a). It also lists challenges and policy priorities for each energy subsector, discussed in the corresponding sectoral chapters of this report.

Table 1.1 lists selected targets set out in the National Energy Policy.

Table 1.1 Selected targets from Uganda's National Energy Policy 2023

Indicator	Baseline (2021)	Target (2040)
Households with at least one source of clean and modern energy on- or off-grid	50%	100%
Rate of electricity access (grid-connected)	24%	65%
Electricity generation capacity (MW)	1 251	52 481
Electricity consumption (kWh per capita)	100	578
Population using clean cooking fuels and technologies	<15%	50%
Energy consumption from renewable sources	92.5%	>95%
Increased energy diversification (energy resources in the energy mix)	5	8
Energy intensity (MJ per 2017 USD GDP)	9.97	3.7
CO_2 emissions from energy activities (Mt CO_2-eq)	7.39	10.1

Notes: MW = megawatt; kWh = kilowatt hour; MJ = megajoule; USD = United States dollar; GDP = gross domestic product; Mt CO2-eq = million tonnes carbon dioxide equivalent.

Source: MEMD (2023a).

Related policies

In addition to these overall policy documents, Uganda has developed the following subsector policies, which are discussed later in this report:

- Renewable Energy Policy (2007) (Chapter 3)
- Oil and Gas Policy (2008) (Chapter 6)
- Electricity Connections Policy (2018) (Chapter 2).

Key laws in Uganda's energy sector include the:

- Electricity Act (1999, amended 2022)
- Petroleum Supply Act (2003)
- Mining Act (2003)
- Atomic Energy Act (2008)
- Petroleum Acts (upstream and midstream) (2013)
- Biofuels Act (2013).

Uganda has also produced the following cross-cutting and sectoral policies with relevance for the energy sector:

- Forestry Policy (2001)
- Gender Policy (2007)
- Transport Master Plan 2008-2023
- Agriculture Policy (2013)
- Land Policy (2013)
- Climate Change Policy (2015)
- Environmental and Social Safeguards Policy (2018)

- National Strategy for Private Sector Development 2017/18-2021/22
- Uganda Green Growth Development Strategy 2017/18-2030/31
- Sustainable Energy Response Plan for Refugees and Host Communities in Uganda 2021-2025.

Energy statistics

The Uganda Bureau of Statistics (UBOS) publishes energy data on a regular basis, including an annual Statistical Extract and several documents for the power sector.

The National Household Surveys, which UBOS conducts every four years, contain information on energy use, including the types of energy employed for cooking and lighting. The most recent survey took place in 2019/20 (with half of households visited before the Covid-19 pandemic and half during the pandemic). The next National Household Survey is due to take place during 2024/25.

The UBOS Act of 1998 delegates authority to various government ministries and agencies to collect statistics related to their sectoral jurisdictions on behalf of UBOS. For example, the ERA collects statistics from actors in the power sector, while the PAU does so in the oil and gas sector. The MEMD does not collect primary energy statistics but compiles data that it requests from other agencies into a Statistical Abstract, which the MEMD then disseminates to policy makers and makes publicly available online.

The National Energy Policy calls for energy-related statistics to be entered into an Energy Information Management System, which is to include data on energy resources and exploitation opportunities, feasibility studies, and funding. The intention is to make this database publicly available. The MEMD's Department of Sectoral Planning and Policy Analysis is developing the Energy Information Management System, which is intended to serve as a one-stop shop for all statistics compiled by the Ministry.

The MEMD has also created a Sector Statistics Committee to validate data with the collaboration of other sectoral bodies and UBOS. However, limited funding reportedly has made it difficult to carry out such work.

Given the importance of access to electricity, efforts to track access rates have combined grid connection data gathered by the regulator from distribution companies, with surveys capturing access through off-grid technologies. In addition, a GIS working group co-ordinates data collection and sharing for electrification planning, including grid connection data at the village level and electricity demand at the district level.

Energy-related research and development

Research organisations and academia often play an important role in developing energy solutions targeted to national and local circumstances. One of the NDP III's 18 programmes, "Innovation Technology Development and Transfer", calls for building a "well-coordinated [science, technology and innovation] eco-system". The programme's key targets include increasing gross expenditure on research and development to 1% of GDP by the end of the five-year programme, i.e. by mid-2025, up from a baseline of 0.4%. The priority sectors for investment listed in the NDP III are agriculture, oil and gas, energy, health, and transport. The NDP III also aims to increase Uganda's ranking in the World Intellectual Property Organization's Global Innovation Index from 102nd out of 129

economies, although by 2022, Uganda's Global Innovation Index ranking had fallen to 119th (out of 132), placing it 16th among the 27 economies of sub-Saharan Africa.

The National Energy Policy for Uganda 2023 lists "Continuous innovation, research and development" as one of its nine "guiding principles", and notes that "government will support research initiatives and promote the development and dissemination of locally adapted and designed solutions and technologies". It specifically calls for support to research in renewable energy technologies and solutions (p. 51), biomass (p. 60), thermal gasification technologies (p. 61), improved cookstoves (p. 84), biogas (p. 84), energy efficiency (p. 63), nuclear energy (p. 66), and the impacts of climate change on the country's power supply system (p. 84) (MEMD, 2023a).

The Science, Technology and Innovation (STI) Secretariat, a semi-autonomous entity under the Office of the President, co-ordinates energy research in Uganda. Its mandate is to "mobilize, coordinate and provide strategic oversight and policy guidance to scientists and stakeholders in ministries, departments and agencies, local governments, academic and research institutions, private sector, schools and vocational institutions, regulators, development partners, media, and the public along the prioritized industrial value chains to increase productivity, import substitution and export of knowledge-based products and services" (STI, 2023).

There are a number of parastatal research organisations under the auspices of the STI Secretariat. These include the Uganda National Council for Science and Technology, whose mandate is to "develop and implement policies and strategies for integrating science and technology (S&T) into the national development policies; to advise the government of Uganda on policy matters necessary for promoting S&T; and coordinating and guiding national research and development (R&D) in Uganda" (UNCST, 2023). Others conducting energy-related research include the Uganda Industrial Research Institute, whose Energy Systems Division has undertaken projects on topics such as energy-efficient cookstoves; wind and solar PV technologies; solar drying; briquette quality; biomass gasification; and bioethanol, biochar, biogas and biodiesel production.

The Centre for Research in Energy and Energy Conservation (CREEC), located at the College of Engineering, Design, Art and Technology of Makerere University, conducts research, training and consultancy projects with a focus on bioenergy, solar PV, pico-hydro, and energy efficiency and management. Among other projects, CREEC has conducted much of the testing that informs the energy-related standards developed by UBOS. CREEC notes that it does not currently offer any services in the areas of solar thermal, wind energy, geothermal or fossil fuel technologies, although Makerere University is partnering with a number of the oilfield service providers active in Uganda's petroleum industry to help train local personnel for technical careers in the oil and gas sector (CREEC, 2023).

Assessment

Uganda has set an ambitious agenda to develop its substantial energy and mineral resources, promote economic development, end energy poverty, and lead the country to a just energy transition. Uganda's stated objective in Vision 2040 is to transform into "a modern and prosperous country", ensuring a better future for its citizens. The energy sector can play an important role in helping Uganda obtain this worthy objective.

Uganda has the technical expertise, government institutions and policy frameworks in place to achieve its energy policy goals. Its strategies, including Vision 2040, the new National Energy Policy and the Third National Development Plan, among others, identify the challenges to overcome and set clear and ambitious targets. The recent shift from sector-wide to a programmatic approach in the NDP III, aimed at improving integration across the national-level programmes, creates a clear structure but will require effort to ensure co-ordination.

Given the cross-sectoral nature of energy and mineral resource policies and planning, co-ordination and consultation will be important for ensuring consistent, efficient and effective formulation and implementation. Uganda already has many specific energy-related policies and plans across the government. This increases the importance of a holistic approach to facilitate prioritisation, avoid duplication, streamline processes, and strengthen tracking and enforcement.

The MEMD's proposal to develop an Integrated Energy Resource Master Plan to enable long-term planning identifies many of these concerns and offers a framework to address them. A focused, well co-ordinated, long-term approach could provide greater clarity and certainty in terms of policy implementation, especially if accompanied by capacity building and heightened efforts to provide information and communicate both across government and to the broader public.

In the regional context, Uganda is part of the East African Community, the Intergovernmental Authority on Development and the East African Power Pool. Efforts to promote cross-border energy infrastructure and trade, notably for electricity and oil; the adoption and enforcement of standards at the regional level; and strategies to create hubs for new sectors could be beneficial.

Timely and reliable energy data are essential for evidence-based policy making. Disaggregated national energy balances represent the first step. In the context of sub-Saharan African countries, with relatively low access to modern energy and fast population and economic growth, estimating future demand correctly is critical for energy planning. Additional data, such as socio-economic information and geographically disaggregated (or GIS) data on the location of infrastructures, resources and communities is also important.

The IEA has co-operated with Uganda on energy data and statistics for several years. The country has made important efforts that have led to improved coverage, quality and timeliness of energy balances and related data. Nevertheless, a better understanding of national energy trends would require a further breakdown of final consumption data, especially in the industry and transport subsectors, but also by end uses for the residential sector.

Although Uganda is a leader in the region in terms of energy statistics, as in many other countries, data collection, organisation and quality control often are not allocated sufficient resources. Lack of adequate funding and capacity can lead to data gaps and delays, for instance reducing the frequency of energy surveys or limiting systematic data verification procedures. This, in turn, reduces the quality and usefulness of the data for policy making. In addition, the development of data platforms to facilitate collection and use across government and with key stakeholders improves transparency and enhances information sharing.

Given the importance of electricity access, further efforts are required to better track access to off-grid technologies, for example by establishing licensing frameworks that require accredited companies to report data (e.g. sales or connections). With a large majority of the population in Uganda using biomass (firewood and charcoal) as their main energy source, tracking the use of biomass will also be important.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Developing, implementing and tracking an Energy Transition Plan to chart a path for achieving Uganda's energy-related goals while aiming for a transition to a low-carbon, climate-resilient economy in line with the Paris Agreement and Uganda's Nationally Determined Contribution.
- Continuing efforts to enhance policy co-ordination across government and enable long-term planning could include developing and adopting an Integrated Energy Resources Master Plan.
- Prioritising communication and dialogue across government and with key stakeholders (local government, the private sector, civil society and development partners) to build awareness and understanding of policies and planned reforms to reduce uncertainty and strengthen confidence.
- Further developing the national energy statistics system to improve data coverage and quality to better inform policy decisions. This could involve expanding mandates and legal obligations to share data, further empowering the existing energy data working group, implementing data quality verification procedures (preferably embedded in the data collection and processing tools), and reinforcing the effectiveness of existing national energy data platforms.
- Ensuring sustainable funding and capacity building for the expanded collection, analysis and dissemination of energy-related data across government in co-ordination with key stakeholders, including local governments, the private sector and academic institutions. Specific resources could be allocated to ensure the expansion and regular update of GIS data, including the acquisition of software and hardware to collect, process and store data.
- Co-operating with international and regional entities such as the IEA and the African Energy Commission to align to international energy statistics standards for definitions and best practices.
- For tracking off-grid access to electricity, in particular, obtaining data from private players such as mini-grid operators and solar home system suppliers, for example by establishing licensing frameworks that require accredited companies to report sales or connections.
- Improving the access and dissemination of national energy statistics online by providing the most recent information on a regular basis and publishing in user-friendly formats such as spreadsheets or csv.

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2. Electricity

Key data (2021)

Total electricity generation: 5.2 TWh, +14% since 2020

Electricity generation mix: hydro 90%, bagasse-fired co-generation 7%, solar 2%, oil 1%

Electricity net exports: 0.40 TWh (imports 0.03 TWh, exports 0.43 TWh)[1]

Installed capacity: 1 346 MW

Peak domestic demand: 785 MW

Electricity consumption: 3.8 TWh (residential 22%, industry 66%, commercial 12%)

Overview

Uganda's generation mix depends heavily on hydropower, which typically accounts for over 80% of the country's electricity. Most additional capacity is also renewable, including several solar PV installations and thermal power plants running on sugar cane bagasse.

Since the unbundling of the electricity supply industry at the turn of the century, generation capacity has substantially increased, technical losses have been reduced and there has been a shift towards cost-reflective tariffs. However, Uganda continues to have one of the lowest electricity access rates in sub-Saharan Africa due, in part, to connection costs that are too high for most potential customers. Even when connections have been subsidised, consumption typically has been low, due largely to the high cost of power. Low consumption makes it challenging to fund grid maintenance and expansion, as well as to maintain grid stability on long, low-demand networks.

Lack of adequate transmission and distribution infrastructure also prevents the full use of a significant share of Uganda's power plants, although available capacity is still above peak demand. Take-or-pay contracts with many generators require the government to purchase a significant amount of unused energy, contributing to high consumer tariffs (relative to the sub-Saharan average), which the government has avoided subsidising.

The government unbundled the power sector beginning in 1999, creating three separate state-owned companies – one for generation, one for transmission and one for distribution. Several of the country's major power plants and its main distribution assets were placed under concessions in the early 2000s, and the high guaranteed rates of return in these contracts have also contributed to the high consumer tariffs.

[1] Electricity Regulatory Authority Database, 2022.

Government priorities in the sector include finding ways to lower the cost of power and increase electricity access and demand, focusing on economically productive uses of energy, particularly in the agricultural sector. It cites cost reduction as the main reason for not renewing the major concession contracts in generation and distribution when they expire in 2023 and 2025 and for plans to remerge the three state-owned companies in the sector.

Governance

The Ministry of Energy and Mineral Development, through its **Directorate of Energy Resources Development,** is responsible for overall policy making in the power sector.

The **Electricity Regulatory Authority** is an independent body established in 2000 under the Electricity Act 1999. Its five-member board is appointed by the Minister of Energy and Mineral Development. The ERA regulates the generation, transmission, distribution, sale, export and import of electricity and issues and monitors licences in these areas. It also approves tariff structures, performance standards, and service terms and conditions.

The **Electricity Disputes Tribunal** was established by the Electricity Act 1999 to arbitrate cases when stakeholders appeal a decision by the ERA. The tribunal has the powers of the High Court of Uganda.

The **Atomic Energy Council** was established by the Atomic Energy Act 2008 to "regulate the peaceful applications of ionizing radiation". It is responsible for the "production and use of radiation sources and the management of radioactive waste", as well as Uganda's compliance with international safety standards in this area. Uganda currently does not have any nuclear power plants, but the 2023 Energy Strategy calls for developing a nuclear industry, including nuclear power (MEMD, 2023a).

Other government bodies that play a role in the power sector include the **Uganda National Bureau of Standards** and the **National Environmental Management Authority** (see Chapter 1). See Chapter 4 for a discussion of the **Rural Electrification Department** of the MEMD (formerly the Rural Electrification Agency). Additional bodies, such as state-owned and private companies in the power sector, are discussed in relevant sections of the present chapter.

Major policy documents and legislation

Important policies and laws governing the power sector notably include:

- Vision 2040 and NDP III
- 2023 Energy Policy
- Electricity Act 1999, including the 2022 amendments
- Statutory Instruments and Guidelines issued by the ERA
- Renewable Energy Policy 2007
- Electricity Connections Policy (2018-2027)
- National Electrification Strategy (2021-2030)
- National Environmental Act
- Grid Development Plan
- Generation Development Plan (draft).

Several of these are discussed below while others are discussed in other chapters.

Third National Development Plan

The NDP III, which operationalises the government's Vision 2040 strategy, contains the following main objectives for the power sector: increase access to and use of electricity and increase generation capacity (NPA, 2020).

"Key results" to be achieved in the power sector over the five years of the NDP III (i.e. between FY 2018/19 and 2024/25) include: increasing the proportion of the population with access to electricity from 24% to 60%; increasing per capita electricity consumption from under 100 kWh to 578 kWh; and nearly doubling the total length of transmission lines from 2 354 km to 4 354 km.

The NDP III lists "Core projects" in the sector, including developing the 840-MW Ayago hydropower plant, upgrading specific substations, and constructing particular transmission and distribution lines. It also lists "key implementation reforms required to fully implement the programme and realise expected goals in the next five years" (*implementation status as of May 2023 in italics*):

- "Develop and implement service delivery standards for energy services." The ERA has developed several different standards and guidelines for service delivery.[2]
- "Consider restructuring the sector to reduce the multiplicity of players to lower costs, increase efficiency and improve coordination." *The government announced it is planning to remerge the three state-owned generation, transmission and distribution companies into a vertically integrated national electricity company; the World Bank is helping it obtain the services of a consultant to study the options.*
- "Review the Electricity Act, 1999 and amend the distribution voltage to 66 kV to enable utilities to distribute power at a relatively higher voltage to minimize distribution losses." *The amendments approved by parliament in May 2022 include such a provision.*
- "Review the existing policies to address gaps in alternative sources of energy for cooking, sustainable exploitation of biomass, and development of nuclear and geothermal resources for power generation." *This policy review is ongoing, but action already includes the introduction of a cooking tariff, which was launched by the ERA in January 2022.*
- "Revise Energy Policy of 2002 to align it with regional and international frameworks and ensure that the government is well positioned to address the emerging socio-economic challenges of the energy sector." *After three years of review and stakeholder consultation, the Cabinet approved a revised Energy Policy in April 2023.*
- "Develop a framework for net metering." Net metering is now allowed in principle by the 2022 amendments to the Electricity Act, although supporting regulations have yet to be adopted.

2023 Energy Policy

The Cabinet approved a new Energy Policy in April 2023, replacing the 2002 Energy Policy. Important contextual changes to Uganda's power sector since the previous version include a shift from large generation shortage to large surplus, increased electrification

[2] See: https://www.era.go.ug/index.php/resource-centre/regulatory-instruments/guidelines-and-standards

(from 5% in 2002 to 26% in 2022), and several decades of experience with concessions in the generation and distribution subsectors.

The most important challenges in the power sector as highlighted by the 2023 Energy Policy are access levels, which remain low compared to other African countries, high system power losses and unreliable supply. Additional "key issues" include:

- "undiversified electricity generation mix", with a high reliance on hydropower
- "uncoordinated execution for power generation in line with transmission and distribution infrastructure"
- "high generation tariffs arising from commercial loan financing, among other unfavourable financing terms affecting end-user tariffs"
- "high upfront connection costs […]".

The new Energy Policy provides the following policy statement for the power sector: "The government shall promote safe, reliable and sustainable electricity supply based on integrated planning, and facilitate stable regional electricity trade" (MEMD, 2023b). The new Energy Policy's main overall objectives for the power sector are:

- "strengthen electricity generation, transmission and distribution infrastructure
- "increase electricity access"
- "promote nuclear energy development".

As of mid-2023, the government was planning a "second generation" of power sector reforms. However, the 2023 Energy Policy does not discuss these, presumably since important details remain to be decided (see below).

Electricity Act – recent amendments

The main legislation governing the power sector is the Electricity Act 1999, which was passed at a time of severe power deficit and unsustainable government subsidies in the sector. Uganda's generation capacity has since grown and now surpasses consumption, though high tariffs have constrained demand.

The government is planning changes to the sector that it hopes will help lower tariffs and promote further development of the sector and economy. To pave the way for these changes, it drafted a set of amendments to the Electricity Act, which was passed by parliament in 2022.

The 2022 amendments notably include provisions that allow for:

- the formation of a new, vertically integrated Uganda National Electricity Company, reversing the earlier unbundling and paving the way for a "second generation" of sector reforms
- wheeling, and circumstances under which a generator may supply electricity to customers directly
- net metering
- private participation in the transmission sector.

Most of these provisions have yet to be operationalised and require further details to be worked out, including changes to the supporting regulatory framework.

Market structure and reforms

Uganda carried out a comprehensive "Power Sector Restructuring and Privatisation Strategy" in the late 1990s and early 2000s, under which it unbundled the vertically integrated Uganda Electricity Board in 2001 into three state-owned companies that respectively cover generation, transmission and distribution. It also introduced the possibility of private sector participation, which in practice has included a number of concession contracts, public-private partnerships and IPPs. At about the same time, the government created the independent ERA. Motivations for the reforms at the time included a lack of adequate generation and transmission capacity, very low electricity access rates, weak sector finances, and a lack of institutional capacity.

The government is planning a "second generation" of power sector reforms that would remerge the three state-owned companies, the organisation of the sector as of mid-2023 is described below.

The **Uganda Electricity Generation Company Limited** is the state-owned body created in 2001 to handle the generation activities of the old Uganda Electricity Board. Two of the UEGCL's main generating assets have been operated by South Africa's Eskom Uganda Limited since 2004 under a 20-year concession contract for the 180 MW Nalubaale hydro power plant (HPP) and 200 MW Kiira HPP. This concession came to an end in March 2023 and was not renewed. The UEGCL has also been involved in developing several new large hydropower assets, including the 183 MW Isimba HPP and the 600 MW Karuma HPP.

In addition to plants owned by the UEGCL, there are several large hydropower stations operated as public-private partnerships, as well as over 30 small IPPs, including HPPs, grid-connected solar PV installations and co-generation plants running on sugar cane waste (bagasse).

The **Uganda Electricity Transmission Company Limited** is the state-owned body created in 2001 to take over the transmission and system operation activities of the old Uganda Electricity Board. The UETCL owns and operates all transmission infrastructure in the country above 33 kV. In addition to having responsibility for transmission, dispatch and system operation, the UETCL has been the single buyer of electricity from grid-based generating companies and single supplier to distribution companies connected to its transmission system. Although amendments made in 2022 to the Electricity Act ended the UETCL's single-buyer status, most generators and distribution companies continue to have contracts with the UETCL, since there is not yet a regulatory framework in place allowing generators to sell to customers directly. There are currently no end users directly connected to the transmission grid.

The UETCL is also responsible for electricity export and import and has a licence from the Uganda Communications Commission to lease out the extra capacity of its fibre-optic communications system to Internet providers (UETCL, 2023).

The **Uganda Electricity Distribution Company Limited** is the state-owned body created in 2001 to take over the distribution activities of the old Uganda Electricity Board. It owns all grid-connected distribution infrastructure rated 33 kV and below. Responsibility for managing most of these assets was transferred to a private company, Umeme, in 2005

under a 20-year concession agreement (see Box 2.1). Umeme, whose network primarily covers urban and peri-urban areas, is currently responsible for distributing over 90% of grid-based electricity in Uganda. The government has decided not to renew Umeme's concession when it expires in 2025.

Several smaller distribution companies, mostly co-operatives, have rural concessions under which they lease distribution assets from the UEDCL that were funded and built by the Rural Electrification Agency (now a department within the MEMD) in the mid-2010s. The UEDCL also operates the distribution grids in nine rural territories directly.

In 2021, the government announced it was planning a "second generation" of power sector reforms, under which it would re-consolidate the previously unbundled UEGCL, UETCL and UEDCL into a new, vertically integrated Uganda National Electricity Company. The government is still defining the details and timing of such reforms, although it has already paved the way for them with several amendments in 2022 to the Electricity Act, following a Power Sector Reforms Study in 2017. The proposed reforms are taking place within the context of a wider programme of rationalisation and merger of government agencies to reduce costs and improve efficiency, which has already included the absorption of the former Rural Energy Agency into the MEMD as a ministerial department.

The main stated motivation for the future reforms is to lower costs and better co-ordinate infrastructure planning between generation and transmission. In particular, the government feels that a vertically integrated national company would rationalise costs compared to three separate companies, require a lower rate of return than private sector concessionaires and obtain cheaper capital on international markets.

A major issue on the timing of the reforms is the expiry dates for the main concessions since ending these early would imply substantial costs. Eskom's 20-year concession to operate the 180 MW Nalubaale and 200 MW Kiira hydropower expired in 2023, after which the government has already decided that the UEGCL would take over the plants. Umeme's 20-year concession to run the country's main distribution network comes to a natural end in 2025 and the government has announced this will not be renewed either.

The World Bank notes that the government "has informed development partners that they will ensure that Uganda's electricity sector rationalization process will be undertaken in a transparent and consultative manner, supported by comprehensive analytical findings and recommendations" (World Bank, 2022a). The World Bank, which has been one of Uganda's most active development partners in the power sector over the past few decades, has agreed to provide the government with technical assistance for the new reforms. This technical assistance will aim to "establish the extent to which the [government's] set objectives are likely or unlikely to be met under the reforms, addressing any risks likely to be met in carrying out the reforms". Following a tendering process, a consultant was expected to be engaged by May 2023. The chosen consultant "shall propose a strategy, roadmap, impact and action plans for implementing the second-generation power sector reforms, to ensure effective and competitive operations within the electricity supply industry". In Phase I, the consultant will conduct a "detailed analysis and generat[e] key recommendations". In Phase II, they will provide "transaction advisory services in implementing recommendations adopted by the government" (MEMD, 2023d).

Box 2.1 Development assistance in the power sector in Uganda

The World Bank has been closely involved in Uganda's electricity sector since before the initial reforms of the early 2000s, playing important advisory, technical and funding roles in the decades since. This includes the ongoing Energy for Rural Transformation Project, now ending its third and final phase (ERT III), and the Power Sector Development Project, which is "aimed at reducing short-term power shortages and financial imbalances and facilitating orderly longer-term expansion of electricity service" (World Bank, 2022b). Other major World Bank programmes in the power sector include the Electricity Sector Development Project (2011-2019), which was aimed at strengthening and expanding the transmission network to make fuller use of new capacity additions such as the Bujagali hydropower plant.

The World Bank is currently preparing a major new power sector programme entitled the Uganda Energy Access Scale-up Project. While focusing primarily on energy access, one component will fund the consultant who will advise the government on its plans for new power sector reforms (World Bank, 2022a).

Uganda's other development partners in the power sector include Germany (KfW and GIZ), Norway, Japan (Jica), the European Union, the African Development Bank, the Islamic Development Bank, the OPEC Fund for International Development, the Arab Bank for Economic Development in Africa and the Saudi Development Fund. Many of these have contributed to projects to expand access.

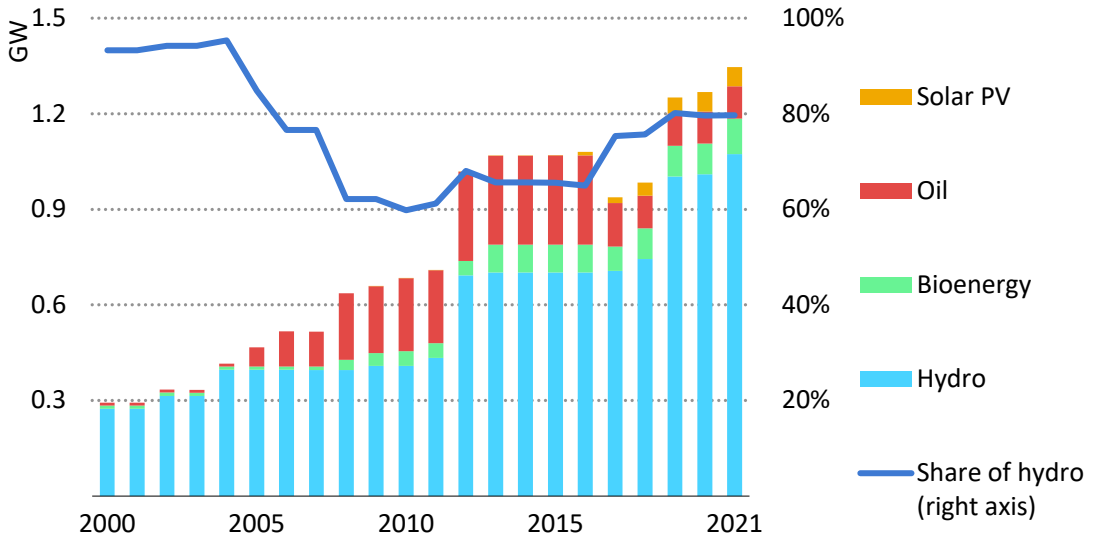
Sources: World Bank (2022a; 2022b).

Generating capacity

Current generating capacity is over three times the 317 MW that existed in 2002. The country experienced significant power deficits in the past, particularly between 2005 and 2012, at which point the long-delayed 250 MW Bujagali HPP finally came online. Since then, several other HPPs have been added, most under public-private partnerships. The number of plants has grown from just 3 in 2002 to over 50 by 2021, including a large number of small, independent HPPs. In 2021, Uganda's generating capacity was 1 346.6 MW, of which 80% was hydroelectric, 8% was sugar cane bagasse-fuelled co-generation, 7.5% heavy fuel oil thermal and close to 5% PV solar.

Once the 600 MW Karuma HPP comes fully online (expected in 2023), installed capacity will increase by nearly 50%. This will raise the share of hydropower capacity to over 85% and the overall renewable component in generating capacity to about 95%.

Figure 2.1 Installed generating capacity by source in Uganda, 2000-2021



Notes: GW = gigawatt; PV = photovoltaic.

Hydropower plants

Uganda's current generation mix is dominated by hydropower. The country's main hydroelectric plants are:

- **Nalubaale HPP** (180 MW) was originally commissioned as a 150 MW plant in 1954 and refurbished in the 1990s. Formerly known as the Owen Falls Dam, it is located on the White Nile in Jinja District. It is owned by the UEGCL and has been operated by Eskom Uganda Limited since 2003 as part of a 20-year concession contract.
- **Kiira HPP** (200 MW) was built between 1993 and 2003. Formerly known as the Owen Falls Extension, it is located near the Nalubaale HPP and is the only major HPP operating with a reservoir. It is owned by the UEGCL and operated by Eskom Uganda Limited under the same concession contract as Nalubaale. Eskom's concessions for both plants expired in 2023 and were not renewed.
- **Bujagali HPP** (250 MW) was built between 2007 and 2012, and its completion nearly doubled the country's existing generating capacity at the time. It received major financing from the Aga Khan Fund for Economic Development, among others. It is owned and operated by Bujagali Energy Limited, which is required to transfer ownership to the UEGCL after 30 years. As of 2023, the main shareholder was Scatec (formerly SN Power), which purchased US-based Sithe Global Power's 65% share in 2018. (The original developer, AES, pulled out of the project in 2003.)
- **Isimba HPP** (183 MW) was commissioned in 2019. Located on the White Nile 4 km downstream from Simba Falls, it is owned and operated by the UEGCL and was largely financed by a loan from China's EXIM Bank.
- **Achwa 1 and 2** (41 MW and 42 MW) are located on the Achwa River in Gulu District. They were built by private developers and commissioned in 2021 and 2019, respectively.

Major hydropower projects under construction or development notably include:

- **Karuma HPP** (600 MW) has been under construction since 2013 and is expected to be fully commissioned sometime in 2023, at which point the country's total capacity would reach nearly 2 000 MW. Karuma is located on the Victoria Nile in Kiryandongo District. Owned by the UEGCL, it has been largely financed by a loan from China's EXIM Bank.
- **Muzizi** HPP (44.7 MW) in Kibaale District, is being developed by the UEGCL, which is currently looking for funding sources.

Additional large hydropower projects that are proposed for development or further study in the NDP III include **Ayago** (840 MW), **Kiba** (330 MW) and **Oriang** (392 MW) (NPA, 2020). More than 25 small hydropower plants are operating on over 20 different rivers,[3] most with individual capacities below 10 MW. The combined capacity of the small HPP is over 200 MW (MEMD, 2023c).

Co-generation plants (bagasse-fired)

At least five sugar-processing plants produce power and heat for their own use by burning sugar cane bagasse, a waste product from their operations. They are licensed to sell excess power to the national grid. The largest of these are:

- **Kakira** Thermal Power Station (51.5 MW), owned by the Madhvani Group in Kakira, Jinja District, was completed in 2005 and upgraded from 12 MW in 2013.
- **Kinyara** Thermal Power Station (40 MW), owned by Kinyara Sugar Works Limited in Kinyara, Masindi District. It was completed in 2009 and upgraded from 14.5 MW in 2015.
- **SCOUL** Thermal Power Station (25 MW) was built in 1998 and upgraded from 9.5 MW in 2020.

Other plants fuelled by sugar cane bagasse include **SAIL** (11.9 MW) and **Mayuge** (9.2 MW) (MEMD, 2023c).

Thermal power plants (oil-fired)

Between 2008 and 2010, to overcome severe power shortages while waiting for the Bujagali HPP to be completed, the government commissioned 130 MW of thermal power generating capacity designed to run on fuel oil:

- **Namanve** Thermal Power Station (50 MW), completed in 2008, is owned by the government of Uganda and operated by the UEGCL, following the expiry of the Implementation Agreement of Jacobsen Limited in 2021.
- **Tororo** Thermal Power Station (80 MW), completed in 2010, is owned and operated by Electro-Maxx Limited.

At around 0.27 USD/kWh, the cost of most of the country's existing oil-fired thermal capacity is exceptionally high relative to that of its other capacity. Although these plants are only used for peaking, the take-or-pay provisions in their PPAs are reportedly one factor contributing to high overall electricity tariffs.

[3] Rivers where small hydropower plants are operating include: Achwa (2 sites), Amoa, Ishasha, Kagera, Kayambura, Kisiizi, Lubilia, Mahoma, Maziba, Mpanga, Mubuku (3 sites), Ndugutu, Nile (4 sites), Nkusi, Nyagak, Nyamasagani, Nyamwamba, Rwimi, Sindila, Siti (2 sites), Waki and Wambabya.

TotalEnergies E&P Uganda reportedly has been studying the construction of a 146 MW gas-fired plant that would utilise associated gas from the Tilenga petroleum project.

Grid-connected solar PV

There are six grid-connected PV solar electricity generating plants operating in Uganda, most rated 10 MW or lower. These include:

- **Soroti** Solar Power Station (10 MW) in Soroti District, completed in 2016 and owned by Access Uganda Solar Limited. (This is the first solar project in the country.)
- **Tororo Solar North** Power Station (10 MW) in Tororo District, completed in 2017 and owned by Tororo Solar North Ltd.
- **Kabulasoke** Solar Power Station (20 MW) in Gomba District, completed in 2018 and owned by Xsaba Power Limited.
- **Mayuge** Solar Power Station (10 MW) in Mayuge District, completed in 2019 and owned by Emerging Power U Ltd.

More information on solar power plants can be found in Chapters 3 and 4.

Future capacity

According to Vision 2040, Uganda will require 41 738 MW by 2040 to meet the government's per capita [annual] consumption goal of 3 668 kWh. This is more than 30 times the country's current generating capacity. Since there are limits to hydropower development potential (est. 4 100 MW), Vision 2040 expects nearly 60% (24 000 MW) of capacity by 2040 would need to be nuclear (NPA, 2017). This is noted in the following breakdown:

- 4 500 MW (10.8%) hydropower
- 1 500 MW (3.6%) geothermal
- 24 000 MW (57.4%) nuclear
- 5 000 MW (12%) solar
- 1 700 MW (4.1%) thermal based on biomass (presumably bagasse)
- 800 MW (1.9%) thermal based on peat
- 4 300 MW (10.3%) thermal based on fuel oil.[4]

The UETCL's 2018 Grid Development Plan uses Vision 2040's consumption goals as one scenario but provides a base case under which the required capacity is expected to reach 3 536 MW by 2040, or about 2.5 times the current capacity. This scenario does not include nuclear, but a generation mix that continues to be dominated by hydropower (73%), followed by solar and wind (together 20%), geothermal (3%), bagasse-fired co-generation (2%), and oil-fired thermal (2%) (UETCL, 2018).

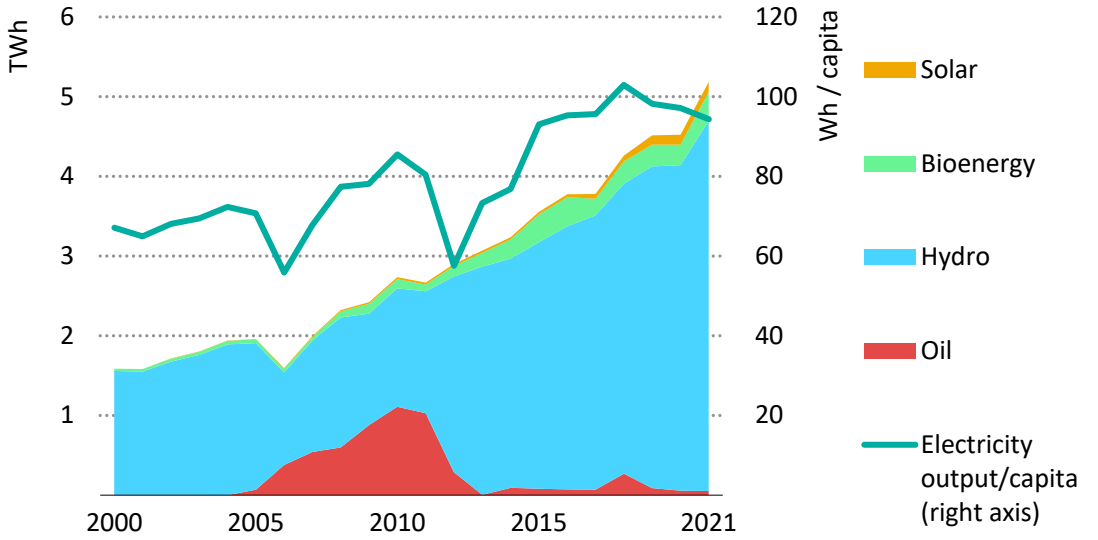
Although the 2023 Energy Policy references the generation mix from Vision 2040, the MEMD notes that current plans for nuclear power call for the development of 2 000 MW by 2040 (MEMD, 2023b) (see the section on nuclear below).

[4] Total equals 48 100 MW.

Generation

Uganda generated 5 211 gigawatt hours (GWh) in 2021, up from less than half this amount in 2007 (Figure 2.2). During 2021, most electricity came from HPPs (90%). Co-generation plants burning sugar cane bagasse provided the next largest amount (7%), followed by solar PV plants (2%) and thermal plants running on fuel oil (1%). Relative annual shares depend significantly on available hydropower capacity, which is influenced by rainfall and water levels, particularly from Lake Victoria.[5]

Figure 2.2 Electricity generation in Uganda, 2000-2021



Notes: TWh = terawatt hour; Wh = watt-hour.
Source: IEA (2023).

Transmission

The UETCL's transmission network consisted of 3 385 km at the end of December 2021 (MEMD, 2023c), nearly double the 1 165 km that existed in 2003 (World Bank, 2022a). Most lines are 132 kV. The backbone of the system links the Bujagali, Kiira and Nalubaale power plants in Jinja District to Kampala, though some parts of the country are not well covered, particularly in the north.

In addition to managing the transmission grid, the UETCL serves as a system operator and single buyer, although its monopoly in the latter role is set to end, according to amendments made to the Electricity Act in 2022.

[5] There are an estimated 250 million tonnes of peat in Uganda, mostly located in the western and south-western parts of the country. Considering the varying quality of the peat, however, and the rather strict wetland policy in the country, only about 10% of the country's peat is thought to be realistically available for future extraction and power generation. Nevertheless, this reportedly would be enough to fuel around 800 MW of generating capacity for around 50 years (ERA, 2014). So far, however, peat is not used as an energy source in Uganda.

All of the UETCL's customers are distribution companies, the largest of which is Umeme. There are currently no end users connected directly to the transmission system. The possibility for large consumers to connect directly to the UETCL's grid was established by the 2022 amendments to the Electricity Act, though the ERA is still elaborating the regulatory framework.

Although almost all generators continue to have PPAs with the UETCL (until recently, the single buyer), in practice, some smaller generators are not connected to its grid but to the distribution system of Umeme or one of the smaller concessionaires, which wheel the power to UETCL substations.

The inadequate transmission and distribution system continues to be a significant constraint on the full use of the country's generating capacity and has resulted in high costs for the UETCL in take-or-pay contracts. The grid capacities of intermediate distribution networks are often insufficient to fully transmit power from distributed power generation plants to demand centres.

The NDP III calls for the transmission network to be expanded to 4 354 km and provides a list of priority lines for rehabilitation and construction (NPA, 2020). There are also plans for a possible regional 220 kV ring network around Lake Victoria for future interconnection with the East African Community Grid (World Bank, 2022b).

Uganda has developed a framework for private sector investment in transmission that includes regulations, investment guidance and standardised agreements to increase investment and lower costs. The first pilot projects for private sector involvement in transmission are currently being negotiated. While the details have not yet been fully defined, they reportedly may involve private construction and ownership of transmission lines and substations. The operation of the assets would be either by the UETCL or the private entity under a concession arrangement. Eventual ownership may then be transferred to the UETCL (or its successor company) after the concession period.

According to the ERA, the UETCL purchased 4 722.9 GWh (generation + imports) and sold 4 536.6 GWh in FY2020/21, implying transmission losses of about 3.9% (ERA, 2021).

Distribution

In 2005, the UEDCL's existing distribution network, including the right to a radius of 1 km around it, was transferred to Umeme under a 20-year concession contract (World Bank, 2022a). See Box 2.2 for more information on Umeme.

Box 2.2 Umeme

Umeme is a private company founded in 2004 by several investors, including South Africa's Eskom and the United Kingdom's Commonwealth Development Corporation. The company was taken public in 2011 and is listed on the Uganda Securities Exchange and cross-listed on the Nairobi Securities Exchange. In 2022, Umeme had over 6 000 shareholders, the largest of which was Uganda's National Social Security Fund, which held 23.34%.

In 2018, the government instructed the Minister of Energy and Mineral Development to begin negotiations with Umeme on extending or renewing the concession agreement, which otherwise was set to end on 31 March 2025. However, in 2021, Cabinet decided not to renew the concession.

An important item in the negotiations was Umeme's guaranteed return on investment, which is 20% under the current contract. Although this return on investment reportedly reflected the perceived risk for investors at the time the contract was negotiated, it is cited by many as a major reason for Uganda's high tariffs.

Uncertainty regarding contract renewal reportedly has made it difficult in recent years for Umeme to raise money on capital markets to finance further investments in the network. For example, regarding the terms of a USD 70 million syndicated loan secured by Umeme in 2019, the International Finance Corporation country manager commented that the lack of certainty about the extension had negatively affected the conditions of the loan, in particular by limiting the term to the current end date of the concession (Monitor, 2019a).

For more information, see https://www.umeme.co.ug

Source: Monitor (2019a).

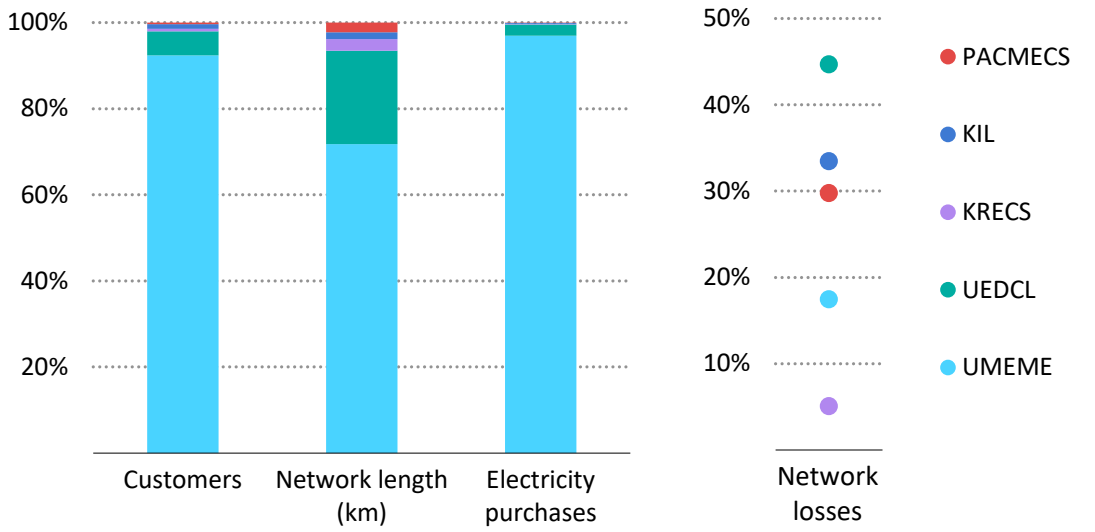
In 2013, following the formulation of a Rural Electrification Strategy and Plan, Uganda was divided into 14 rural service territories, excluding Umeme's concession area. The Rural Electrification Agency (REA; later absorbed into the MEMD as the Rural Electrification Department in 2021) contracted out several of these to service providers, which included both co-operatives and private companies. The concessionaires took over new distribution networks whose construction was overseen by the REA using government and donor funding.

Of the 14 non-Umeme concessions, 4 are operated by co-operatives or private companies and connected to the UETCL's transmission network: Hydromax, Kilembe Investments, Pader Abim Community Multipurpose Electricity Cooperative Society and Kyegegwa Rural Electricity Cooperative Society.

In 2021, the ERA suspended the licence of Bundibugyo Electricity Cooperative Society and reassigned its Rwenzori service territory to the UEDCL, which was already directly responsible for eight other rural service territories connected to the transmission system but not under concession contracts (ERA, 2021).

In addition, there are two isolated concessions whose service territories are not connected to the UETCL transmission grid: the West Nile Rural Electrification Company and Kalangala Infrastructure Services.

Figure 2.3 Selected distribution share of total customers, network and purchase by the transmission utility (left) and level of network losses in Uganda, 2021

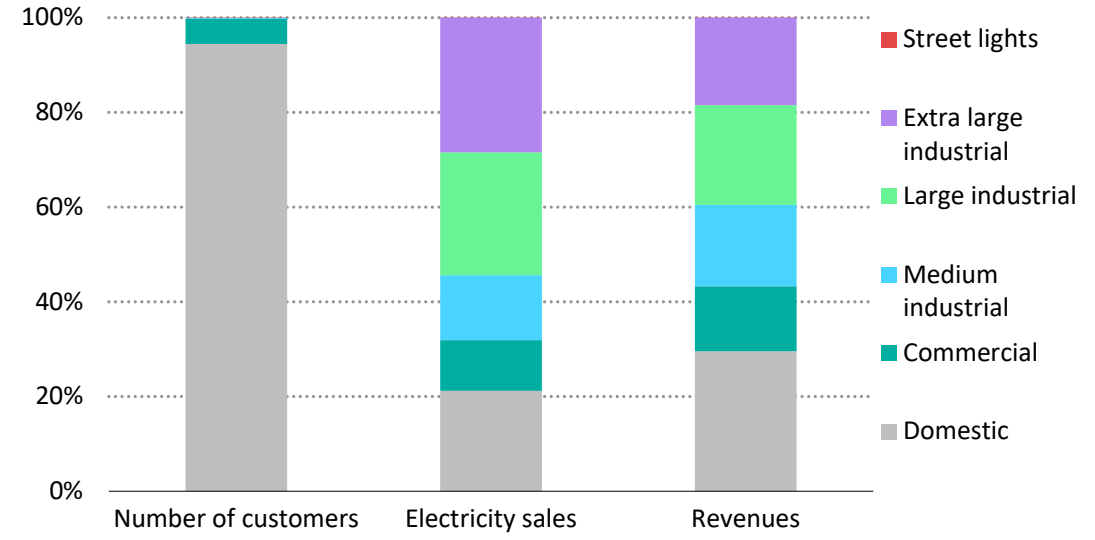


Source: IEA based on data from Umeme (2022).

Umeme, whose service territory is primarily urban and peri-urban, accounts for well over 90% of the country's distributed electricity. As of the end of FY2020/21, the other distribution companies collectively had 126 445 customers, while the Umeme customer base was over 1.6 million (ERA, 2021).

During Q2 of 2021, households represented over 94% of Umeme's customers but only accounted for about 21% of electricity sold and around 30% of revenue. "Large" and "extra-large" industrial customers together represented less than 1% of Umeme's total customer base but accounted for about 54% of electricity sold and around 40% of revenue (Figure 2.4).

Figure 2.4 Umeme customers by tariff category, 2021



Source: IEA based on data from Umeme (2022).

In 2022, Umeme reported that its collection rate was over 99.7%, in large part because nearly all its domestic customers were on pre-payment meters (Umeme, 2022). The company notes that "the customer side is fully automated from application, vending, meter reading, bill delivery, collections, service and complaints management" (Umeme, 2022).

Umeme has more than doubled the length of its network since taking over its concession in 2005, from an initial 16 000 km to 40 642 km by 2022. The ERA reported that the length of all distribution lines in the country increased by about 3 400 km during FY2020/21, of which about two-thirds was on Umeme's network (ERA, 2021).

Umeme's current distribution infrastructure includes:

- 178 terminals or metering points connected to 22 UETCL substations
- 75 distribution substations and switching stations
- 16 635 km of medium-voltage network (33 kV)
- 15 542 distribution transformers
- 22 405 km of low-voltage network (11 kV and below)
- 1.7 million customer metering points (Umeme, 2023).

Umeme reports that it has invested over USD 600 million in its distribution network since 2005, approximately 44% of which has been debt-financed (Monitor, 2019a). In 2019, it announced that it planned to invest an additional USD 450 million between 2019 and 2025 (Monitor, 2019b). However, since the government's decision not to renew the concession, Umeme may have little incentive to significantly invest in the system.

Distribution losses

When Umeme took over its concession in 2005, distribution losses were reportedly around 40%. Losses on Umeme's network reached a low of 16.4% in 2019, rose the following two years to reach 18% in 2021 and fell again to 16.8% in 2022 (Umeme, 2023). The ERA reports that losses on the other concessions averaged over 40% during FY2020/21, up significantly from 24.7% in FY2016/17. Increased losses in 2020 and 2021 have been blamed in part on the Covid-19 pandemic, which led to "significant restrictions impacting [the] ability to execute field activities" (Umeme, 2022). Umeme reported in 2019, i.e. prior to the announcement that its concession would not be renewed, that it aimed to reduce its loss rate to 13% by 2025 (Monitor, 2019a). There is no official breakdown between technical and non-technical losses (i.e. electricity theft through illegal connections).

A significant factor in the high loss rates on Uganda's distribution networks has been long distances covered by low-voltage wires that might normally be covered by higher voltage transmission lines. The 2022 amendments to the Electricity Act include a provision allowing utilities to distribute electricity at 66 kV to help minimise losses, although this provision has yet to be implemented.

Losses have also been attributed to significant vandalism and theft. Umeme reports that it has experienced "heightened incidents of vandalism" in recent years. For example, in 2021, it lost 180 km of conductor wire, 200 poles and 73 distribution transformers (Umeme, 2022). Umeme suggests that recent increases in theft and vandalism may be due in part to the frustration of customers who have applied for free connections under the

Electricity Connections Policy only to experience long delays due to limited funding for the programme (Umeme, 2022) (see the section “Access”).

New amendments to the Electricity Act allow heavier deterrent penalties for power theft and vandalism.

Figure 2.5 Operational distribution lines in Uganda, 2017

Cross-border interconnections and trade

Uganda’s main 132 kV transmission network currently has one interconnection each with Kenya and Tanzania, though the interconnection with Tanzania only allows Uganda to export. There is also a new 220 kV line connecting the Bujagali HPP to Rwanda, to be commissioned in 2023, as well as distribution-level connections to the Democratic Republic of the Congo. Additional interconnections currently under study include three 400 kV lines to South Sudan, the Democratic Republic of the Congo and Tanzania.

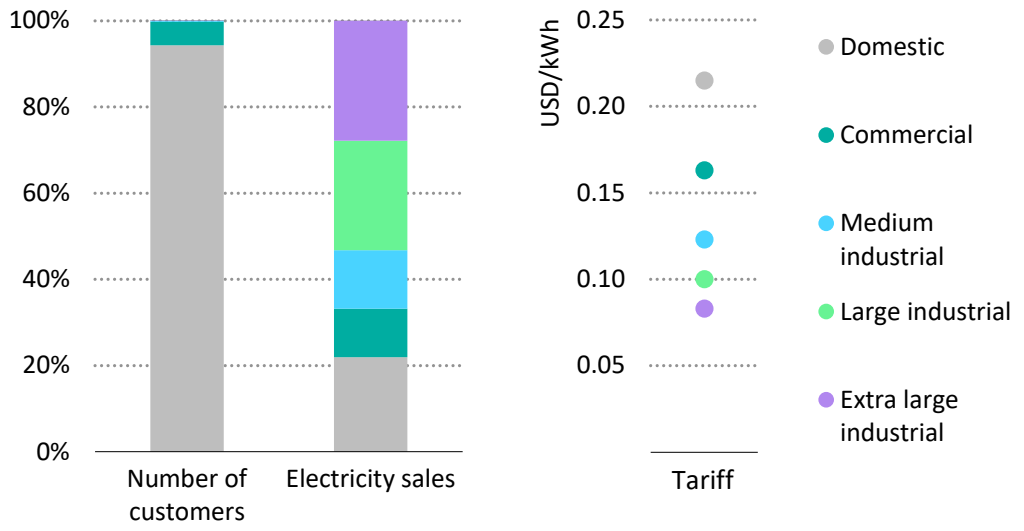
Uganda’s electricity imports were estimated at 28 GWh in 2022, while electricity exports were 425 GWh. Most imports come from Kenya, typically occurring when there are

technical problems with the Bujagali or Nalubaale hydropower stations or their related transmission lines.[6] Most exports in 2022 went to Kenya (303 GWh), followed by Tanzania (113 GWh), Rwanda (7 GWh) and the Democratic Republic of the Congo (2 GWh). Total imports in 2021 reportedly were 24 GWh, whereas exports were 393 GWh.[7] The ERA reports that peak export demand was about 76 MW in December 2022.

Consumption

Sales to customers connected to the national grid were about 4.4 TWh in 2021. As noted in Figure 2.4, which covers Q2 2021, nearly 650 "large" and "extra-large" industrial consumers accounted for well over half of consumption. Households ("domestic"), which accounted for 94% of the number of customers, consumed around 22% of electricity. Over 90% of consumer sales were made by Umeme, the country's largest distribution company. No customers were connected directly to the transmission grid.

Figure 2.6 Categories of customers as a share of total clients and sales, and electricity tariffs, Q2 2021



* Informal conversion using xe.com exchange rate of 18 April 2023.

Notes: Q2 = the second quarter

Source: IEA based on data from ERA (2023).

Peak demand, including exports, grew from 591 MW in 2017 to 656 MW in February 2019, reaching 843 MW in December 2022 (NPA, 2020). The highest domestic peak, i.e. not including export demand, was reported in December 2022 at 785 MW. Export peak during FY2020/21 was about 88 MW.

Taking current generating capacity of 1 347 MW and subtracting a peak domestic and export demand of 843 MW implies a margin of about 504 MW, or 37%. Adding the 600 MW Karuma plant would increase that margin to 1 104 MW, or 57%.

[6] See Monitor (2019c).

[7] https://www.era.go.ug/index.php/transmission/energy-purchases-sales-and-losses

The current annual consumption per capita is under 100 kWh. Demand is constrained by high tariffs and economic factors, even when initial connections are subsidised. The government is currently focusing on ways to reduce the cost of power without subsidising consumption. It is also promoting productive uses of power.

The base case in the UETCL's Grid Development Plan assumes an annual increase in peak and overall demand of 4.1%, based largely on historical trends. This leads to demand estimates of 17.4 TWh by 2030 and 27.9 TWh by 2040, with peak demands of 2 314 MW and 3 536 MW, respectively. According to this scenario, industry is expected to account for around 60% of power consumption in 2030, households 38% and exports a little under 2%. In 2040, these shares are forecasted to be roughly similar (UETCL, 2018).

Tariffs

Uganda's electricity tariffs were heavily subsidised prior to 2012. However, like the case in many developing countries, such subsidies increasingly became a burden on government finances. Important factors causing higher costs at the time included rising fuel prices for Uganda's thermal generation and the depreciation of the Ugandan shilling (UGX).

The government took the politically difficult decision to raise electricity tariffs by over 45% in January 2012 (ERA, 2014). Today, Uganda is one of the few African countries with close to cost-reflective tariffs. End user tariffs currently cover 97% of costs, while the government provides the remaining 3% to partially subsidise standby thermal generation.

The ERA reviews and sets electricity tariffs on a quarterly basis, taking into account changes in inflation, the exchange rate and international fuel prices (ERA, 2014). Figure 2.4 shows the average tariffs per kWh by customer category for Q2 of 2023. (The tariff schedule for commercial and industrial users includes peak and off-peak rates.)[8]

The cheapest tariffs are for the largest industrial users, aimed at promoting economically productive uses of electricity.

All households benefit from a "lifeline" tariff for the first 15 kWh per month (250 UGX/kWh), after which the regular domestic tariff is charged. To promote the use of electric stoves as a substitute for charcoal and wood, a cheaper "cooking tariff" (412 UGX/kWh) applies to consumption between 80 kWh and 150 kWh. (This tariff is automatic and does not require ownership of an electric stove.) After 150 kWh, the regular domestic tariff resumes.

The ERA indicated that its annual tariff review for Umeme resulted in reductions across all consumer categories in 2021 "to assist in recovery from the effects of the Covid-19 pandemic" (ERA, 2021).

Cost reduction

To lower tariffs without resorting to subsidies, the government is committed to finding ways to save costs along the electricity value chain. One of the ways it hopes to achieve this is by not renewing the major, long-term concessions for generation and distribution when they reach their natural ends in 2023 and 2025, respectively. (Ending them before their

[8] The tariff schedule for commercial and all three industrial categories includes both peak and off-peak rates. For large and extra-large Industrial users, there are also two blocks that are averaged here. For the latest (and more detailed) tariff schedule see: https://www.era.go.ug/index.php/tariffs/tariff-schedules.

expiry dates could impose significant costs.) The government notes that doing this will allow it to lower the operator's required return on investment, which, for example, has been 20% in the case of Umeme. It also notes that a state-owned company should be able to negotiate better terms than a private firm when borrowing investment capital on international markets.

While these two assumptions may prove correct, they could be countered at least in part by perceived uncertainty regarding the details of proposed sectoral reforms since uncertainties generally require higher risk premiums. Moreover, if the government hopes to attract private investment to the sector in the future, for example to help with transmission investments, it will be important to maintain a reputation as a reliable partner, including during the transition to the end of the concession contracts. Otherwise, it may be difficult to attract future investors without offering very attractive (i.e. expensive) conditions to compensate for perceived risks.

In the interim period, before the distribution concession runs out, the government also needs to ensure that Umeme has incentives to continue investing sufficiently in power distribution assets, or that the relevant state-owned company takes over this responsibility. Otherwise, the government may need to make significantly larger, remedial investments later.

There is also a risk that uncertainties regarding the transition could lead to an exodus of the most qualified technicians and other staff since the most qualified are also those most likely to have other options. Although there may be savings from offering lower salaries, lower compensation is not likely to retain or attract the most qualified people, and having less qualified staff may increase costs in the medium term due to increased inefficiencies. The recent experience of merging the Rural Electrification Agency into the MEMD may offer lessons regarding staff retention.

To reduce duplication in the administration, as well as better co-ordinate transmission investments with generation, the government has decided to combine the three existing state-owned companies for generation, transmission and distribution into one vertically integrated enterprise. Again, the potential exodus of highly qualified staff (rather than the least qualified) during the transition period, resulting in increased costs later, will need to be considered.

In principle, adding generating capacity with lower investment and running costs to the mix will lower the average cost of power, though generally not until the additional power is matched by increased consumption. Until that demand materialises, additions to capacity, no matter how inexpensive, may still result in higher total costs as long as the government has to pay for significant amounts of unused power.

Transmission bottlenecks can impose constraints on demand. In such cases, investments in grid infrastructure will often be more cost-effective than new generation. In Uganda, transmission bottlenecks appear to be constraining both power supply and demand.

Extending the grid to connect more customers who consume very little could increase overall costs if additional consumption does not cover additional maintenance costs – even if the original cost of grid extension and customer connections is not covered in the rates, e.g. if covered by donors. Connecting a few large "anchor" consumers and promoting connections by those intending to use electricity for economically productive purposes in

addition to connecting households is likely to bring overall costs down more than connecting only households, especially if the latter do not purchase much power once connected.

Electricity trade could be an important way to help lower costs. Even if Uganda's power is more expensive than that of its neighbours, as long as the income received is more than the cost of transmission, such exports could at least offset the cost of deemed energy that the government must pay for anyway.

Importing power will help lower overall costs as long as it replaces more expensive power that is not under a take-or-pay contract or as long as it feeds previously unserved demand at a cost that is at least at or below the average cost of power.

Although promoting energy efficiency is likely to lead to reduced demand for electricity in the short run, the impact of demand-side efficiency for individual consumers will be to lower the perceived cost of power, in turn increasing its attractiveness to more potential customers. Ensuring efficient consumption will also help avoid or delay the need to invest in additional generating capacity in the medium to long term, thus avoiding the need to incorporate the cost of that additional capacity in tariffs.

Nuclear power

Uganda does not have nuclear power, though several policy documents over the past decade have mentioned its future development. For example, the 2023 Energy Policy states that "The government shall promote the sustainable development of nuclear energy for power generation and other peaceful purposes," noting that this is "part of the strategy to diversity the energy mix" (MEMD, 2023a).

Current plans call for Uganda to commission a first nuclear power plant of 1 000 MW in 2031 and a second plant of similar size by 2040 (MEMD, 2023b).

Uganda signed a Country Programme Framework with the IAEA in September 2019 and is following the IAEA's Milestone Approach (Box 2.3). Under the Framework, the IAEA conducted an Integrated Nuclear Infrastructure Review mission in 2021 and is supporting the development of a regulatory infrastructure for nuclear safety. As of mid-2023, Uganda could be considered to be in Phase 2 of the IAEA Milestone Approach.

Box 2.3 IAEA Milestone Approach

The IAEA Milestone Approach enables a sound development process for a nuclear power programme. It is a phased comprehensive method to assist countries considering or planning their first nuclear power plant…The aim is to help member states understand the commitments and obligations associated with developing a nuclear power programme...[It] splits the activities necessary to establish the infrastructure for a nuclear power programme into three progressive phases of development, with the duration of each dependent on the degree of commitment and resources applied in the country. The completion of each phase is marked by a specific "milestone" at which progress can be assessed and a decision can be taken about the readiness to move on to the next phase.

Phase 1: Considerations before a decision to launch a nuclear power programme is taken: A pre-feasibility study helps a country establish a strong national position and answer the key question: why nuclear? This process begins early in Phase 1 after nuclear power is included as an option in the energy strategy.

Milestone 1: Ready to make a knowledgeable commitment to a nuclear power programme.

Phase 2: Preparatory work for the contracting and construction of a nuclear power plant after a policy decision has been taken: In this phase, key organisations, as well as the legal and regulatory frameworks, are established.

Milestone 2: Ready to invite bids/negotiate a contract for the first nuclear power plant.

Phase 3: Activities to contract, licence and construct the first nuclear power plant are undertaken.

Milestone 3: Ready to commission and operate the first nuclear power plant."

Source: IAEA (2023)

The MEMD has carried out a screening process of possible reactor sites, (Figure 2.7), looking at factors such as geology, meteorology, population density and water availability. It has tentatively chosen a site in Buyende District, where it is conducting a number of studies with the help of international consultants (MEMD, 2023b).

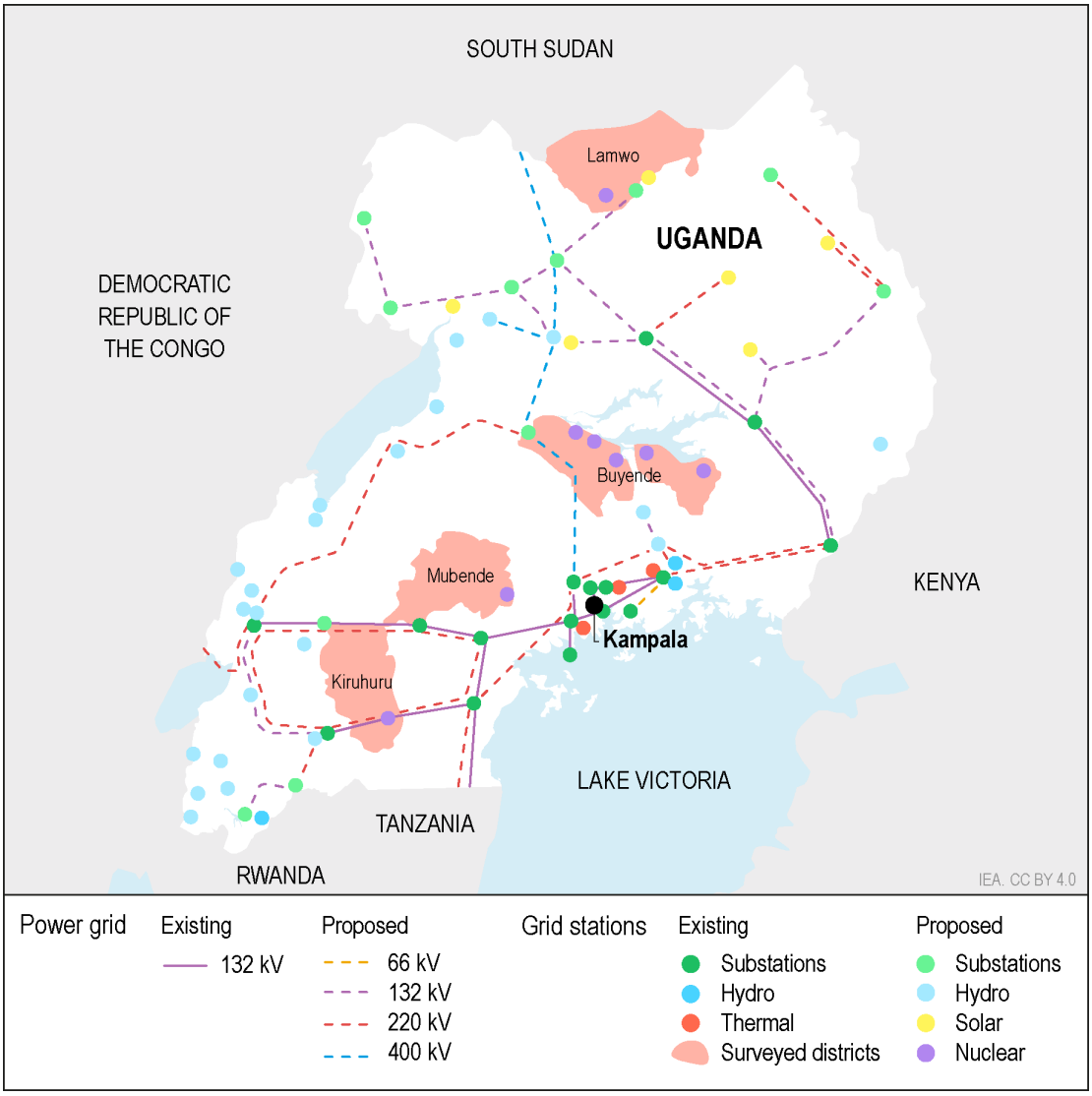
The MEMD reports that it is looking at the following reactor technologies, noting that the choice will depend on the characteristics of the chosen site, which is still being studied (MEMD, 2023b): the VVER-1200 (Russian Federation), the APR-1400 (South Korea), the HPR-1000 (China), the AP-1000 (United States) and the ACR-1000(Canada).

As part of the technology review process, the MEMD has signed non-binding co-operation memoranda of understanding with technology providers in several countries, including Russia's State Atomic Energy Corporation in June 2017 and China's National Nuclear Corporation in May 2018 (MEMD, 2023b). The MEMD notes that the final choice of technology will need to be made at the political level, taking into account the likely long-term nature of the relationship with the eventual technology provider.

The current plan is to enter into a nuclear fuel supply agreement with an international partner for the first reactor but develop a local nuclear fuel cycle for the second reactor based on the country's own uranium deposits, which are so far largely unexplored but thought to be extensive. Ugandan law does not allow the country's uranium resources to be exported.

The Nuclear Power Development Plan started its preparatory phase in 2006 and is currently in the feasibility phase, identifying developers and conducting detailed site evaluation and environmental impact assessments. The commissioning of the first nuclear power plant is planned for 2031 (MEMD, 2023b).

Figure 2.7 Potential sites reviewed for a nuclear power plant in Uganda



Assessment

While electricity production represents only about 2% of Uganda's total energy consumption (due to the large dependence on biomass), almost all power is generated by renewable sources, and the carbon intensity of electricity does not exceed 10 g CO_2/kWh. However, 90% of electricity generating capacity is based on hydropower. The significant reliance on one type of generation has implications for energy security, especially in the context of uncertainties surrounding future climate change impacts on the region's water resources.

Uganda increased generation capacity from about 320 MW in 2002, when the country was in the midst of significant power deficits, to over 1 346 MW today, representing a significant surplus compared to the current peak demand of about 800 MW. The Karuma HPP, which came online in 2023, will add a further 600 MW once fully commissioned.

The increase in generation has not been sufficiently co-ordinated with investment in transmission and distribution, resulting in the inability to use a significant share of the country's generating assets. Since PPAs signed with the UETCL have often included take-or-pay clauses, the government has had to pay for deemed energy that it has not been able to use, adding significantly to the cost of power, that, in turn, has been reflected in tariffs. The government has stopped signing PPAs with the deemed energy clause and has stated that it plans to develop new generation projects with adequate grid infrastructure in place.

Distribution has been dominated by Umeme, which has run the main urban and peri-urban parts of the UEDCL's assets under a 20-year concession. The government has informed Umeme of a firm decision not to renew the concession when it comes to its natural end on 31 March 2025. The 20% rate of return guaranteed in the concession – presumably reflecting perceived risks at the time the contract was signed – has been cited by the government as one of the main reasons tariffs in the country are relatively high and is an important factor in the decision not to renew the concession.

The government is to be congratulated for avoiding the mistake made by many countries of subsidising electricity consumption, since this is only likely to increase sector costs without providing sufficient capital for investments. However, high tariffs have prevented many customers from consuming power once connected. This, in turn, has made it challenging to finance grid extension, operation and maintenance costs, even when initial connections are subsidised. The government is looking at ways to lower the cost of power to encourage consumers to purchase more electricity, not only as a way to finance further expansion but also to improve lives, reduce unsustainable consumption of biomass and encourage productive uses of power that could promote economic development.

The Cabinet recently decided to remerge the UEGCL, UETCL and UEDCL into a new, vertically integrated Uganda National Electricity Company in the context of a more general policy to rationalise government agencies and bodies. In the case of the electricity sector, the government hopes that eliminating private shareholders' requirements for a guaranteed return on investment and the ability of a government-backed company to obtain cheaper credit will help to significantly reduce tariffs. It also cites the potential for closer co-ordination of transmission and generation investments as a benefit.

Some stakeholders, including some investors and development partners, have expressed concerns about uncertainties related to the proposed reforms and their timing. This includes concerns about potential delays in investments needed to maintain the distribution system and expand electricity access during the interim period, especially if issues around staff retention and a clear mapping of responsibilities are not soon addressed. The MEMD is working with international partners, which are helping procure the services of a consultant to advise the government on the reforms.

Reliability of power supply remains a challenge, as outages undermine consumption and are perceived as risks for potential industrial and commercial customers. The ERA sets targets and monitors the quality of electricity supply with indicators such as the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI).

Amendments to the Electricity Act were passed in 2022. Changes include possibilities for net metering and for generators to sell to customers instead of to a single buyer. However, regulations allowing market participants to take advantage of such measures have yet to be implemented.

Electricity trade could help evacuate some of Uganda's excess power and generate additional revenues. It could also take advantage of possibly cheaper power sources elsewhere and even enhance security by diversifying potential sources of electricity supply. Uganda has one 132 kV connection each with Kenya and Tanzania, as well as a 220 kV line to Rwanda. Several more export lines are under consideration, including to the Democratic Republic of the Congo, Kenya, South Sudan and Tanzania. Uganda is also considering further co-operation with the East African Power Pool.

The government is looking at a scenario to develop a 1 000 MW nuclear power plant by 2031 and another 1 000 MW plant by 2040. It is working with the IAEA and has signed non-binding memoranda of understanding with companies in Russia and China to explore options. Since the government is considering investments in nuclear power to enhance energy security and lower the cost of power, it will need to carefully consider dependency relationships that can develop with nuclear technology suppliers and consider life cycle costs, which include decommissioning as well as short- and long-term waste treatment and disposal.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Continuing to address transmission bottlenecks and stimulation of demand for productive uses of electricity as priorities to take greater advantage of existing generation, increase grid stability, lower the cost of power and potentially serve more customers.
- Continuing consultations on power sector reforms and providing clarity to stakeholders on details as soon as practicable. During the transition period, ensure continued investment in and maintenance of the distribution grid.
- Confirming regulation around wheeling agreements to allow generators to take advantage of the end of the single-buyer market.
- Further developing interconnections and power trade with neighbouring countries as a way to export surplus energy, take advantage of possible lower cost electricity elsewhere and enhance energy security by diversifying renewable sources of supply.

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3. Renewable energy

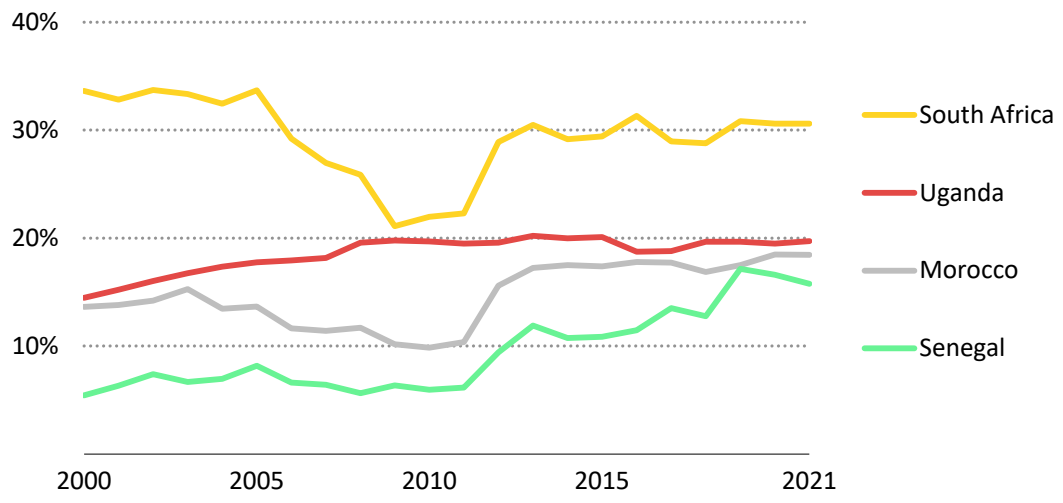
Key data (2021)

Total renewable energy supply: 20 Mtoe or 91% of TES (biomass 19.8 Mtoe, hydro 0.4 Mtoe, solar 0.01 Mtoe)

Overview

While the largest share of energy in Uganda is by far from wood and charcoal, used mostly by households for cooking (see Chapter 5), the present chapter focuses on renewables in electricity production. Although renewable electricity accounts for only around 2% of renewable energy use, almost all electricity was generated from renewables in 2021. Approximately 92% of generating capacity is renewable, of which about 80% (1 073 MW) consists of large hydro, 8% (112 MW) of sugar cane bagasse-fired plants and 4.5% (61 MW) of solar PV plants.

Figure 3.1 Share of modern renewables in total final energy consumption in selected African countries, 2000-2021



Source: IEA (2023).

Uganda introduced PPAs with feed-in tariffs for renewable energy projects under 20 MW in 2007. The GET FiT programme provides an additional per kWh subsidy for projects selected on a competitive basis.

Governance

The **MEMD** is the main government body responsible for policy making related to renewable energy.

Until recently, all grid-connected renewable power producers had to sign PPAs with the system operator, the **UETCL**, which served as the single buyer. The 2022 amendments to the Electricity Act now allow generators to sell directly to customers, although the regulatory framework for this has yet to be developed.

The electricity regulator, the **ERA**, is responsible for licensing renewable energy projects and establishing feed-in tariffs.

The **National Environmental Management Authority** is a semi-autonomous body responsible for issuing certificates of environmental clearance for all energy projects following a review of environmental audits, impact assessments and resettlement action plans.

The **Directorate of Water Resources Management** under the Ministry of Water and Environment issues surface water abstraction and construction permits to developers of hydropower projects.

The **Uganda National Bureau of Standards** under the Ministry of Trade, Industry and Cooperatives formulates and promotes the use of national standards and develops and monitors quality control and assurance systems, including for renewable energy components, such as solar PV systems, and for biofuels.

The Sustainable Energy Development **Programme Working Group** within the overall NDP programme approach is comprised of all ministries, departments and agencies involved in the programme, as well as other stakeholders. It is responsible for inter- and intra-agency planning, priority interventions and resource allocations, delivery of services, and joint monitoring and evaluation of multi-agency activities.

The **National Renewable Energy Platform** was established through a collaborative effort between the MEMD, development partners, the private sector and civil society organisations (CSOs) within the renewable energy subsector as the apex platform/forum linking the government (central and local), the private sector/industry, CSOs and development partners to promote collective action, strengthen co-ordination and harmonisation of activities and sector players for the sustainable development of the subsector.

The platform ensures national representation and harmonisation of the renewable energy subsector through the co-ordination of various stakeholders and players while ensuring central governance, enabling the alignment for strategic actions that solve institutional, technical and regulatory challenges experienced by the ecosystem.

Specifically, in the renewable energy subsector, the national renewable energy platform optimises the co-ordination of players/stakeholders and increases access to wider partnership opportunities in the development and delivery of collective actions to address shared challenges; shapes and develops a harmonised strategic direction; strengthens private sector, industry and institutional capacities; ensures quality assurance of technology implementation; strengthens national and global partnerships to improve access to low-cost finance for renewable energy and energy efficiency; improves access

to, sharing and management of information, including funding opportunities for the renewable energy sector in Uganda and regionally; and conducts scientific and research studies and develops and introduces new technologies.

The **Uganda National Renewable Energy and Energy Efficiency Alliance (UNREEEA)** is an independent, non-profit organisation of business associations and actors dealing with renewable energy and energy efficiency. It was formed in 2015 with the encouragement of the government and its development partners to promote a more co-ordinated approach in the sector. Its mandate is to "represent private sector businesses and actors engaging in renewable energy and energy efficiency to government through advocacy for a conducive business environment". The Alliance's main members are the national business associations in the individual renewable energy and energy efficiency subsectors. These include The Biomass Energy Efficiency Technologies Association, the Hydro Power Association of Uganda, the Wind Power Association of Uganda, the Uganda Solar Energy Association, the Uganda National Biogas Alliance and the Energy Efficiency Association of Uganda.

Policy framework

This main policy documents related to renewable energy in Uganda are the Renewable Energy Policy (2007), the Uganda Green Growth Development Strategy (2017), the Third National Development Plan (2020/21-2024/25) and the Energy Policy for Uganda (2023).

Renewable Energy Policy (2007)

The Cabinet approved the Renewable Energy Policy for Uganda in 2007. It was developed in a context of an unprecedented electricity supply deficit due to low water levels in Lake Victoria following a prolonged drought, in turn leading to the installation of 200 MW of expensive emergency diesel generation (MEMD, 2007). The Renewable Energy Policy notably established a standardised PPA for renewable projects, as well as new, higher feed-in tariffs and a number of financial and fiscal preferences. It also created a Renewable Energy Department at the MEMD.

The Renewable Energy Policy set a target to increase electricity generation capacity from renewable sources to 1 420 MW by 2017, a goal missed by the target date but likely to be achieved during 2023 with the commissioning of the 600 MW Karuma HPP. The policy also aimed to increase the contribution of renewable energy sources other than large hydropower to more than 60% of generated output by 2017 (MEMD, 2007), though this target is unlikely to be achieved anytime soon.

Beyond electricity production, the 2007 Renewable Energy Policy called for blending biofuels with petroleum products (see the biofuels section below), as well as a number of measures related to wood fuel and charcoal (see Chapter 5).

Uganda Green Growth Development Strategy (2017)

The Uganda Green Growth Development Strategy (GGDS) was developed by the National Planning Authority in the context of the 2030 Agenda, the 2015 Paris Climate Agreement and the 2063 Agenda of the African Union (NPA, 2013). Published in 2017, the GGDS has five focus areas, including "energy for green growth". (The other focus areas are: sustainable agriculture, natural capital management, planned urbanisation and sustainable transport).

The energy component of the GGDS notably calls for "increased emphasis on renewable energy investment through biomass energy for electricity and improved technology for enhanced efficiency in using biomass for domestic and industrial uses, enhancing solar power potential for on-grid, exploitation of geothermal energy and reinforcing of environmental, health and economic safeguards for energy generation" (NPA, 2013).

The GGDS provides a number of goals in the area of renewable energy, including:

- increased biomass co-generation by sugar companies
- enhanced solar power potential, "especially for on-grid and local supply", to reach 5 000 MW by 2030
- exploitation of geothermal energy to reach 450 MW by 2030 and 1 500 MW by 2040
- increased utilisation of large and small hydro plants from 50-60% to 80%, and increased evacuation of their generated power to 95% by 2020.

While the use of sugar cane bagasse for power generation has increased since the GGDS was developed and Uganda continues to add solar PV capacity, problems persist regarding the evacuation of power from hydropower plants, and geothermal development is still at an early stage.

Third National Development Plan (2020/21-2024/25)

The government's overall policy document, Vision 2040, is operationalised through five-year NDPs. The Third National Development Plan (NPA, 2020), which covers the period 2020/21-2024/25, has the following goals by mid-2024 under the objective to "Increase adoption and use of clean energy":

- "construct 200 off-grid mini-grids based on renewable energies"
- "promote use of new renewable energy solutions (solar water heating, solar drying, solar cookers, wind water pumping solutions, solar water pumping solutions)"
- "adopt electric transport solutions", e.g. solar power motorcycles, bicycles, tricycles
- "develop a framework for net metering"
- "build local capacity in renewable energy solutions".

The government appears to be making progress in each of these areas, although the construction of mini-grids has been a perennial problem for a number of reasons, including a lack of adequate incentives and regulatory framework for mini-grid developers, uncertainties regarding the timing and compensation for grid arrival, and lack of affordability of cost-covering tariffs. The 2022 amendments to the Electricity Act allow for net metering, but a framework for this has yet to be developed.

Energy Policy for Uganda (2023)

The Cabinet adopted the Energy Policy for Uganda in April 2023 and it was launched in September 2023. Regarding renewable energy, the policy states that "The government shall promote the sustainable development and utilization of all renewable energy resources in a socially and environmentally responsible manner" (MEMD, 2023).

The Energy Policy notes the following "general issues" related to renewable energy:

- "inadequate information and data on available renewable energy resources"
- "limited access to affordable credit and financing for renewable energy projects and technologies"
- "inadequate legal, regulatory & institutional frameworks in place"
- "limited enforcement of quality standards for renewable energy technologies and products"
- "low awareness and appreciation of renewable energy resource(s) and technologies potential, economic benefits, opportunities, and applications"
- "limited technical and institutional capacity to develop, promote, deploy, utilize and manage/maintain renewable energy technologies/solutions".

The 2023 Energy Policy lists a number of "strategies" to address the challenges identified, but it does not go into detail and does not provide any targets or timelines:

- "conduct national renewable energy resource assessments including small hydropower and wind energy resources"
- "foster research and development of renewable energy technologies/solutions"
- "promote technology transfer in the development of renewable energy solutions through regional demonstration centres, exhibition centres, technical training/skills transfer centres and renewable energy centred labs"
- "provide incentives to promote the local production of and use of renewable energy technologies/solutions"
- "establish and/or strengthen information exchange/knowledge-sharing platforms to foster knowledge transfer"
- "develop comprehensive legal, regulatory and institutional frameworks for effective and sustainable renewable energy development and utilization"
- "conduct public awareness campaigns on the environmental, social and economic benefits of renewable energy"
- "develop renewable energy resource investment guidelines and a strategy"
- "strengthen renewable energy subsector/ecosystem co-ordination platforms and mechanisms"
- "strengthen the capacity of the private sector for self-regulation under the relevant umbrella associations"
- "establish and enforce appropriate standards for modern renewable energy technologies"
- "promote land-use planning for large-scale renewable energy projects including solar and wind".

The Energy Policy provides additional lists of challenges and strategies for each renewable energy subsector, some of which are discussed in this chapter.

Feed-in tariffs

As called for in the 2007 Renewable Energy Policy, the ERA introduced the Renewable Energy Feed-in Tariff (REFiT) programme in 2007 to help reduce risks for developers of projects under 20 MW. Offtake and price risks are reduced through the signing of 20-year standardised PPAs with the system operator, the UETCL. This includes guaranteed feed-

in tariffs based in USD and escalation factors for inflation (ERA, 2014). Projects above 20 MW must negotiate a PPA with the UETCL on a case-by-case basis, though the 2022 amendments to the Electricity Act allow the threshold for feed-in tariffs to be raised to 50 MW while also allowing developers to sell to customers directly. However, feed-in tariffs are only available for grid-connected projects that have a PPA with the UETCL.

Tables 3.1 and 3.2 list the feed-in tariffs as of mid-2023. To avoid the difficulties experienced by small hydropower developers with stepped tariffs, a linear tariff structure was developed for hydropower projects between 5 MW and 10 MW.

Table 3.1 REFiT Phase 4 tariffs, O&M %, capacity limits and payment period

Technology	Tariff USDc/kWh	O&M %	Cumulative capacity limits (MW)			Payment period (years)
			2019	2020	2021	
Hydro (10 < X ≤ 20 MW)	7.51	12.9%	30	60	80	20
Hydro (5 < X ≤ 10 MW)	Linear tariff decreasing with capacity 7.51-7.92	13.4%	20	40	50	20
Hydro (500 kW < X ≤ 5 MW)	7.92	13.8%	10	20	30	20
Bagasse	7.93	45.8%	30	50	60	20

Notes: O&M % = operations and maintenance; USDc = United States cent; kWh = kilowatt hour; MW = megawatt.
Source: ERA (2019).

Only hydropower and bagasse-fired thermal plants benefit from guaranteed minimum tariffs. Tariffs for other renewable technologies, including solar PV and wind, are set as maximums, with the idea that project developers must negotiate tariffs bilaterally with the regulator. The ERA notes that “This decision was based on the fact that these technologies are yet to be tested on the national grid” (ERA, 2023).

Table 3.2 Tariff ceiling and return on equity in Uganda

Technology	Maximum return on equity	Tariff ceiling (USDc/kWh)
Biogas	13.5%	11.5
Landfill gas	13.5%	6.6
Waste-to-energy/biomass	13.5%	9.5
Wind power	13.5%	10.4
Solar photovoltaics	10.0%	7.1

Notes: USDc/kWh = United States dollar constant prices per kilowatt hour.
Source: ERA (2019).

GET FiT

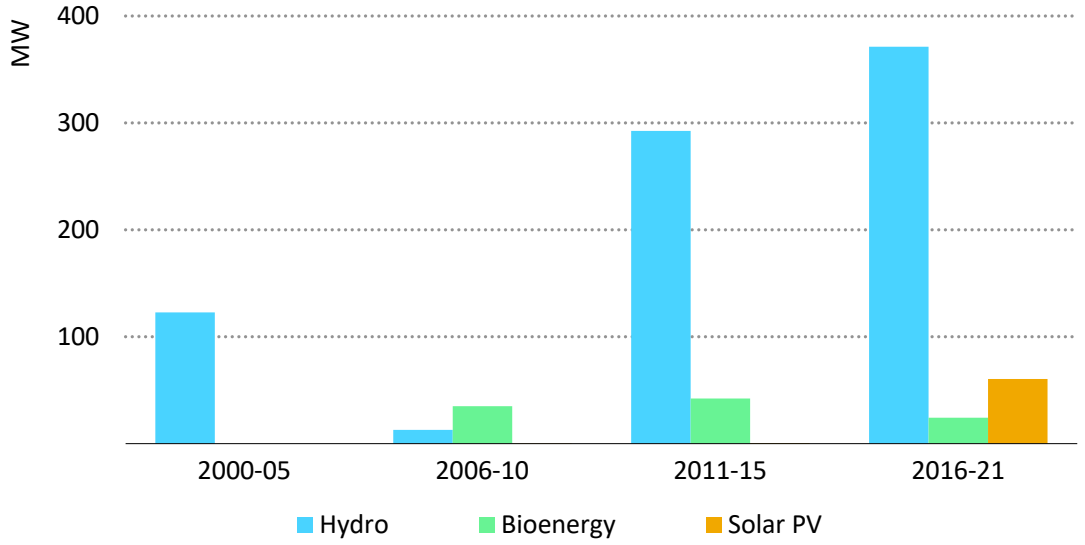
The ERA, in co-operation with KfW, launched the GET FiT (Global Energy Transfer Feed-in-Tariff) programme in 2013. GET FiT, which has also received support from Norway, the

United Kingdom and the European Union, provides an additional 0.50-2.00 USD/kWh on top of the regular REFiT tariffs for selected projects. Developers applied for the subsidy in a competitive process. The programme has helped develop a portfolio of 17 small-scale projects that together provide an installed grid-connected capacity of around 160 MW: 118 MW of hydropower capacity, 20 MW of bagasse co-generation capacity and 20 MW of solar PV capacity, all of which had been commissioned by the end of 2021. This portfolio provided 9% of the country's power generation in 2021. Once relevant transmission capacity is fully in place, it will be able to generate approximately 760 GW annually (KfW, 2021).

Renewable energy capacity and supply

This section provides an overview of Uganda's main renewable energy resources. (Woody biomass is covered in Chapter 5.) Based on a survey of various sources, the total potential for electricity generation from renewables is around 12 000 MW, of which only about 15% has so far been developed. About one-third of potential capacity is large hydropower and over 40% is solar PV.

Figure 3.2 Renewables capacity additions by source in Uganda, 2000-2021



Notes: MW = megawatt; PV = photovoltaics.

Hydro

According to the 2023 Energy Policy, Uganda's potential hydropower capacity is 4 100 MW, around one-quarter of which has already been developed (MEMD, 2023). Most of the potential is along the Victoria and Kyoga Nile.

Hydropower dominates Uganda's current generating capacity, accounting for slightly less than 1 100 MW, or 80% of total installed capacity in 2021. Uganda's largest HPPs are Bujagali (250 MW), Kiira (200 MW), Nalubaale (180 MW) and Isimba (183.2 MW). Only Kiira operates with a reservoir; all others are run-of-river plants.

Once the 600 MW Karuma HPP comes fully online (expected in 2023), the share of hydropower in Uganda's electricity generating capacity will rise to over 85%. Additional

large-scale hydropower projects proposed for development or further study, as mentioned in the NDP III, include Ayago (840 MW), Kiba (330 MW) and Oriang (392 MW) (NPA, 2020).

Around 64 sites for small hydropower development have been identified, mainly in the Mountain Elgon region in the eastern part of the country and in the western districts of Ibanda, Rubiriizi, Buhwju, Kabale, Kisoro, Kabarole and Rukungiri (ERA, 2014). Some 30 of these sites have been developed, most with capacities below 10 MW and a combined total of just under 200 MW. Around half of these (for a total of 118 MW) were developed under the GET FiT programme.

The capacities of Uganda's small HPPs can be significantly diminished during periods of low water levels, such as droughts. As for large hydropower, lack of transmission capacity, largely due to delays in constructing new lines, has prevented a number of small hydropower projects from operating at full capacity while imposing financial costs on the government related to deemed energy under take-or-pay PPAs.

Solar

Uganda's solar global horizontal irradiation potential is between 4.4 kWh/m² and 6.3 kWh/m² per day, with around eight hours per day of sunshine (IRENA, 2021). Vision 2040 calls for 5 000 MW of installed solar PV capacity to be developed by 2040.

There are currently at least five grid-connected solar PV plants with individual capacities of 10 MW or more for a cumulative capacity of over 60 MW, accounting for 4.5% of the country's total grid-connected capacity in 2022. This includes the Soroti and Tororo solar PV plants (10 MW each), which received assistance from the GET FiT programme.

It is estimated that there are more than 30 000 individual solar PV systems installed on households and institutions such as schools and hospitals, with a cumulative installed capacity of 1.25 MW, mostly located in rural regions (IRENA, 2021). According to the Uganda Solar Energy Association, more than 200 companies offer off-grid solar PV systems and products in the country.

In October 2021, the governments of Uganda and Sweden signed a memorandum of understanding (MoU) under which the Swedish development finance agency, Swedfund, is funding a study to assess possibilities for installing floating solar PV technology at a number of hydroelectric dams. Possible advantages include using the existing transmission infrastructure of the dams, avoiding land acquisition difficulties and population displacement, reducing evaporation on reservoirs, and diversifying power supplies. The Swedish engineering company, Sweco, was chosen to conduct the study, which is expected to be completed in 2024.

Wind

Most sources note that wind speeds in Uganda are insufficient for large-scale electricity generation, though they may be adequate for small-scale uses such as water pumping and milling, particularly in the Karamoja Sub-region. However, there is general agreement that data regarding wind speeds are incomplete and that further study may be needed.

A 2003 study of sites in Kabale and Mukono recorded average wind speeds of 3.7 m/s at 20 m (Mekveld and von Eije, 2018). Another source suggests a national average of 2-4

m/s below 10 m (ERA, 2014). The MEMD performed some wind assessments in the Scaling Up Renewable Energy Project in the Districts of Kotido, Napak, Moroto, Nakapirit, Amudat and Kaabong in the Karamoja Sub-region (MEMD, 2020), and there have been some assessments of wind speeds on and near Lake Victoria.

There are so far no wind power plants supplying the national grid, although, in 2020, independent power producer Amea Power signed an agreement to develop a 20 MW pilot project in Karamoja (GIZ, 2022). Additionally, Senok Wind Uganda Limited acquired a generation licence for the Rupa Wind Power Plant currently under construction, with an expected commissioning date in December 2023.

Bagasse, agro- and forestry residues

As noted in Chapter 4, at least five sugar-processing plants, accounting for 112 MW, produce power and heat for their own use by burning sugar cane bagasse, a waste product from their operations. They are able to sell excess power to the national grid, and in 2021, accounted for 6% of the country's electricity generation. This includes Kakira (20 MW), the country's first IPP to be developed under the GET FiT programme.

According to the MEMD (2020), the estimated electricity-generating potential of biomass waste, including bagasse, maize cobs, rice husks, coffee husks and forestry waste, is 1 650 MW. The use of agro- and forestry residues for energy in households is very low, estimated to be below 7.9% and 2.5% in urban and rural areas, respectively (UBOS, 2021). However, they are widely used for commercial and industrial purposes, such as brick making, confectionaries, fish processing and industrial heating. Power production using biomass residues as fuel, e.g. in co-generation power plants, is generally limited in Uganda due to uncertain and often seasonal supply chains.

Geothermal

Geothermal potential in Uganda is estimated to be around 1 500 MW (NPA, 2013). At least 27 potential geothermal sites have been identified, of which 4 are considered to have significant potential for further exploration. All are in or near the Western Branch of the East African Rift System, which is less volcanically active compared to the Eastern Branch through Djibouti, Ethiopia and Kenya. Exploration results suggest that the geothermal activity in these areas is comprised of fault-controlled deep circulation systems rather than magmatically heated systems associated with volcanoes (Bahati and Natukunda, 2020).

Four priority areas, namely Katwe, Buranga, Kibiro and Panyimur, have been earmarked for future development, and surface exploration at these sites is almost complete. Subsurface temperatures of approximately 130-150°C for Katwe, 120-150°C for Buranga, 150-250°C for Kibiro and 110-140°C for Panyimur have been predicted by geothermometry and mixing models. Subsurface exploration has commenced at 2 of these areas (Kibiro and Panyimur) with the drilling of 16 temperature gradient holes to delineate the extent of the reservoir. Temperature gradient hole data will be used to update conceptual models to aid in the selection of drilling targets for deep exploration wells, which is the final stage of exploration (Bahati and Natukunda, 2020).

In addition to electricity production, geothermal direct use in agriculture (greenhouses, aquaculture) and industrial heating processes and tourism could contribute to the country's socio-economic development.

Municipal solid waste

Kampala generates 730 000 tonnes of waste per year, about 70% of which is organic. Most waste currently goes into landfills, which must be located increasingly far from the city centre, imposing rising transportation costs.

Since 2018, the United Nations Development Programme (UNDP) has been implementing the Global Environment Facility (GEF)-funded project, "Nationally Appropriate Mitigation Action on Integrated Waste Management and Biogas in Uganda". The project, which was due to end in August 2023, brings together several Ugandan ministries and local governments in Kampala, Jinja, Mbale, Masaka and Mbarara. In addition to reviewing and amending city waste management plans and ordinances to favour the consideration of waste-based biogas production and electricity generation, it has conducted feasibility studies for several specific projects, with the aim of attracting private investors. In addition to landfills, it has looked at producing biogas at wastewater treatment facilities.

The project aims to attract private investors for a public-private partnership to pilot biogas to electricity technology in the country's key urban areas, starting with the ten cities that generate significant quantities of organic waste that can be sourced for electricity generation using anaerobic digestion. A feasibility study for Kampala already shows that a 4.4 MW waste-to-electricity plant would be viable using only about 500 tonnes of organic waste produced daily by the city's farmers' markets.

Moreover, with the increasing urbanisation at about 5.4%, inorganic waste streams are equally increasing. Thus waste-to-energy facilities such as incinerator systems are seen viable in the cities as well. Kampala Capital City Authority is already working towards demonstration of energy recovery through incineration technology at Dundu landfill, which could also be considered for other growing cities in the country.

Biogas

For the past 20 years, the Netherlands Development Organisation (SNV) has been conducting demonstration projects, training and advisory services that directly or indirectly have led to the installation of over 7 000 biogas digesters in Uganda, typically on farms. It has trained over 100 masons to construct low-tech brick biogas digesters, which allow users to produce methane from cow dung and other agricultural waste. The gas can then be used for cooking, lighting and other purposes. The SNV currently works with Biogas Solutions Uganda, a non-profit that carries out the training and connects farmers to trained biodigester builders.

The government is looking at the possibility of installing biodigesters at large institutions, such as schools, prisons and hospitals, which currently consume large amounts of wood for cooking. A pilot project at one school was able to use pupils' own biowaste to significantly reduce wood consumption. However, a certain amount of consultation and education was reportedly required to overcome cultural sensitivities about using waste for cooking.

Biofuels

The 2018 Biofuels Act calls for blending petroleum products with biofuels, such as ethanol produced from sugar cane, corn, cassava, palm oils or other plant-based materials. The potential advantages of biofuel blending include a reduction in the of petroleum products

imported and greenhouse gas (GHG) emissions. Ethanol additives can also improve engine performance and reduce incomplete combustion. The government has yet to determine the required minimum share of biofuels that petroleum products must contain, but it has indicated that it will be up to 20%. This amount, it has determined, would not require adjustments to most engines in the country's relatively aged vehicle fleet.

The main barrier to introducing biofuel requirements in Uganda is the lack of domestic production capacity. Kakira Sugar Limited installed a distillery in 2016 to manufacture ethanol from molasses, but is currently the country's only producer and its 20 million litre annual capacity is well short of the amount that would likely be needed. For example, replacing 20% of Uganda's annual motor fuel consumption would require some 400 million litres of biofuels. The government plans to gradually increase the blending capacity.

Green hydrogen

The new Energy Policy 2023 states that Uganda is prepared to embrace new alternative energy technologies, such as green hydrogen derived from renewable energy resources. It notes that energy from green hydrogen is one of the cleaner, sustainable alternatives that will provide a link between growing and sustainable renewable electricity generation, as well as tackling the challenge of climate change.

Assessment

Renewable energy currently accounts for nearly all of Uganda's electricity production. However, its heavy reliance on hydropower for its electricity supply presents energy security concerns, particularly in the context of uncertainties regarding the future impacts of climate change on water levels. There are also concerns about the structural integrity of the Nalubaale hydropower project along the Nile, though high water levels currently make it difficult to verify potential problems, let alone conduct any actions to strengthen structures if required.

Uganda aims to increase its non-hydro renewable electricity generating capacity, particularly from solar. The system and grid operator will need to continue monitoring and preparing the transmission system and control functions to integrate such intermittent capacity to be in a position to respond to increased sudden surges and shortfalls in supply.

Individual and institutional solar systems will be important to help the government meet its electrification targets and spur economic development in rural regions. However, the market for solar home systems and components has been significantly undermined in recent years by "faulty installation, importation of substandard systems and poor after-sales service" (MEMD, 2023). This, in turn, has led to scepticism about off-grid solar solutions on the part of potential customers and beneficiaries, contributing to low uptake.

Although standards for solar systems and components exist, these are reportedly rarely enforced, partly due to limited capacity at the Uganda National Bureau of Standards, particularly outside Kampala. Moreover, the UNBS has limited authority to seize substandard items since it usually only has recourse to this when products present a health risk. Almost all solar systems and components are imported, and the UNBS relies on product testing and certification performed by third parties outside the country, notably in China. Unfortunately, this arrangement appears to be ineffective against imports of counterfeit products.

Another major barrier preventing greater uptake of individual solar systems is cost. This has been overcome somewhat by distributors offering the possibility for customers to pay over time, e.g. through pay-as-you-go models employing mobile money applications. However, several distributors have noted that such models are not yet well recognised by the tax authorities, which count the total value of contracts as income received at the time of signature. The Uganda Energy Access Scale-up Project (EASP) financial intermediation component will support the UECCC to scale up and expand the scope of its existing credit facility with grants and guarantees aimed at removing market entry barriers, covering information and communication campaign costs, and addressing affordability constraints for consumers and the high operating costs of serving customers in remote areas (World Bank, 2022).

Import taxes also add to the cost of solar systems. While exemptions exist, it has often been difficult for importers to benefit from them in practice. Part of the problem appears to be the complexity of the rules, which in turn may contribute to inconsistency in their reinforcement. For example, regulations currently allow solar lanterns to be imported tax-free only if the solar panel is attached to the lamp, but not if it is separate and hybridised for grid charging. To help overcome such barriers, UNREEEA, in collaboration with GOGLA, the global off-grid solar energy industry association, produced *The Solar Taxation Handbook*, which is designed to serve as a "reference document and training resource for individuals, firms, officials and organizations involved in the movement, release and clearance of off-grid solar products." The handbook, which covers the East African region, is being updated and the new edition will include an online portal.[1]

Uganda appears to have significant geothermal potential, which could help reduce the power system's dependence on hydro. Given the high upfront cost of exploration and a lower payback compared to oil exploration, however, the main challenge for geothermal development in Uganda is the significant resource uncertainty and geological risk that private investors must bear in the absence of detailed data. Overcoming private investors' perceived risks will likely require the government to invest significantly in pre-feasibility studies.

The main barrier to introducing biofuel requirements in Uganda is the lack of domestic production capacity. If the government wishes to ramp up supplies quickly, it may need to offer substantial incentives to potential producers, including price supports and tax waivers. Alternatively, by initially introducing a low minimum blending requirement, which could be gradually raised over time, it may be able to better target support and monitor their effect on potential investors, as well as potential impacts on food production and GHG emissions. Incorporating green technologies for the planned refinery should also be considered.

Given the high level of organic content in the country's municipal waste, its significantly increasing urban population, and constraints on land available for new dumps and landfills, waste-to-energy projects appear to be a particularly promising way to diversify energy supply while managing increasing amounts of waste. The UNDP GEF-funded project on biogas provides a good base on which to build. Like the development of geothermal resources, however, waste-to-energy projects may require significant public funds initially to help prove the concept and reduce perceived risks for private investors.

[1] For more information on the *Solar Taxation Handbook*, see: https://unreeea.org/updating-of-the-solar-taxation-handbook-for-east-african-region.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Continuing to monitor the potential impacts of climate change on the country's hydropower plants while promoting the diversity of electricity supply, particularly from other renewable sources.
- Assessing how to continue and accelerate network re-enforcement and refurbishment to handle increasing integration of variable, large-scale solar PV and wind capacities.
- Continuing to support the development of waste-to-energy projects, reducing waste while increasing the country's diversification of fuels.
- Updating and increasing enforcement of quality standards for all renewable energy systems, particularly solar PV stand-alone systems and components, including in-country testing, and complementing this with public information campaigns.
- Continuing to promote the use of stand-alone solar systems for economically and socially productive activities, particularly in the agricultural sector. Increase the affordability of such systems by simplifying and reducing import taxes, and continuing to promote the development of small-scale financing mechanisms.
- Reducing the uncertainty and geological risk for potential investors in geothermal energy by investing government funds in pre-feasibility studies for several of the most prospective sites and encouraging synergies between the oil and gas upstream and geothermal sectors.

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4. Access to electricity

Key data (2022)

Access to electricity rate:[1] national 31%, urban 77%, rural 17%

Population with access to electricity: 15 million (urban 10 million, rural 5 million)

Population without access to electricity: 33 million (urban 3 million, rural 30 million)

Electricity consumption per capita: 82 kWh in 2021, +12% from 2015

Overview

According to IEA data,[2] around 30% of Ugandans have access to electricity, but only one in seven does in rural areas (Figure 4.1). An additional 13% of the population has access to pre-electrification through multi-light systems.[3] Although Uganda has one of the largest populations without access to electricity in sub-Saharan Africa and one of the lowest electrification rates, progress has been steady since 2000, when the country reportedly only had 180 000 legally connected grid-based customers. Since 2000, around 4 million people have gained access to electricity. However, population growth is offsetting electrification progress, especially in rural areas, where the number of people without electricity increased from about 23 million in 2000 to around 33 million today. The scattered and sparse settlement patterns of the predominantly rural population further aggravate the cost and complexity of the country's electrification efforts, making it necessary to consider both on- and off-grid solutions.

While most households with access to electricity have been connected to the national power grid, off-grid solutions have started playing a significant role, especially in the past

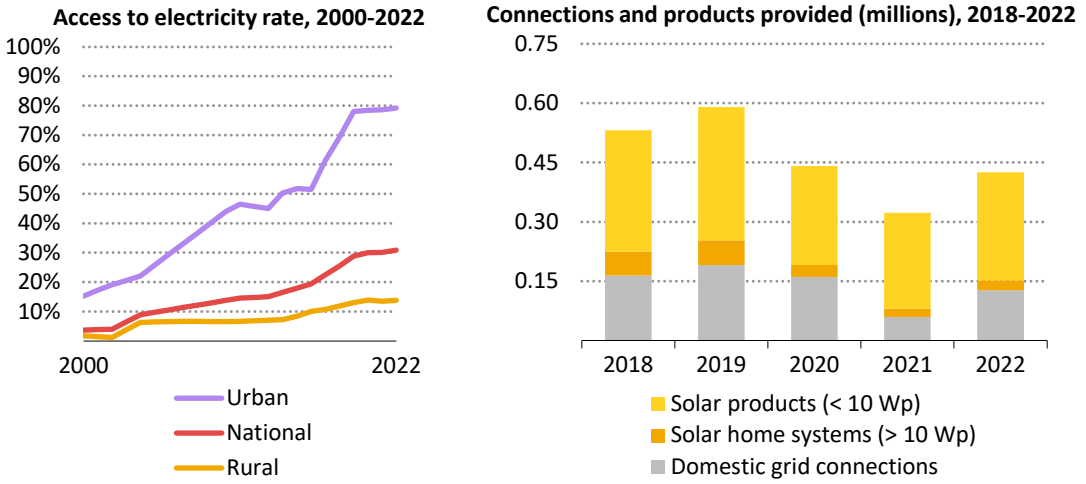
[1] The Ugandan government, in a UBOS 2019 survey, notes that "51% of households in Uganda had access to at least one source of electricity in 2019, including the national grid, solar lighting systems/lanterns, solar home systems, mini-grids and generators". The Uganda Energy Policy (2023) defines energy access according to the Multi-Tier Framework as the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, formal, convenient, healthy and safe for all required energy applications. The Multi-Tier Framework defines six tiers of access, ranging from Tier 0 (no access) to Tier 5 (full access).

[2] The IEA defines access to electricity as a household receiving enough electricity to power at least a minimum level of services that is capable of growing over time. The IEA minimum level of services is defined as the "basic bundle", which includes more than one light, phone charging and a radio, broadly equivalent to a range of 50-75 kWh per household per year, depending on efficiency levels. In the case of Off-Grid Solar (OGS), the IEA considers in the access definition Solar Home Systems (SHS) of 10 Wp and above. See the IEA Guidebook for Improved Electricity Access Statistics.

[3] The IEA excludes Off Grid Systems below 10 Wp, such as solar lanterns (up to 3 Wp) and Multi-Light off-grid Solar systems (MLS) from 3 Wp to 9 Wp, from our above definition for access to electricity. However, MLS provide lighting and sometimes cellular device charging, and are considered as access in the World Bank's definition of electricity access. MLS therefore help fulfil Uganda's 2030 target of universal access, but changing to supply options that enable higher levels of consistent electricity consumption are pursued after this first transitional step.

five years. According to the 2023 National Energy Policy, 27% of the population has an off-grid solution, which could include a solar lantern up to a solar home system. Since 2018, private distributors have sold around 300 000 off-grid electricity systems annually, mostly small lighting systems such as solar lanterns and now increasingly introducing solar systems that can power larger appliances such as fans and TVs. In Uganda, stand-alone solar systems are primarily used by the rural population, but are also sometimes used to address energy gaps in urban settlements or as a backup or complement to grid connections (GOGLA, 2022).

Figure 4.1 Access to electricity rate and connections provided in Uganda (grid connections and off-grid products)



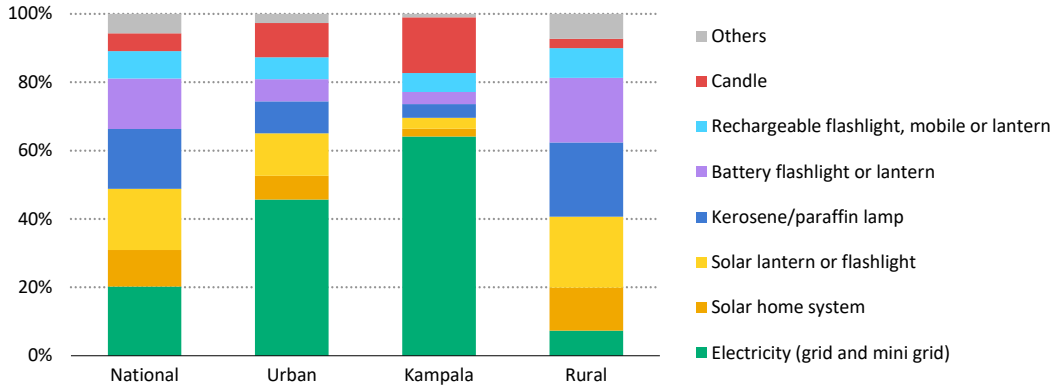
Note: Wp = watt-peak

Sources: Left: IEA (2023), Right: IEA based on data from GOGLA (2018-22).

Recent household surveys[4] highlight the gap between rural and urban populations in terms of lighting sources. While the grid is the main source of lighting for two-thirds of Kampala's population – and for almost half of city dwellers generally – it is the primary source for less than 10% of rural households (Figure 4.2). Rural areas rely on a variety of solutions, including solar lanterns, rechargeable flashlights and solar home systems, but also unclean lighting sources such as kerosene lamps and candles.

[4] UBOS (2021).

Figure 4.2 Distribution of households by main source of energy for lighting in Uganda, 2021



Source: IEA based on data from UBOS (2021).

Several solar or hybrid mini-grid initiatives have been developed, potentially providing electricity for productive use for off-grid households, businesses and community centres.

It is estimated that 50% of the country's health centres and 20% of its schools currently have access to electricity (World Bank, 2022).

Governance

The government of Uganda has established a number of entities to address the electricity access challenge. In 1998, it established the Rural Electrification Board to manage the Rural Electrification Fund (REF). In 2001, it created the Rural Electrification Agency, a semi-autonomous body that served as the Board's secretariat. The REA has been the primary body responsible for operationalising the government's rural electrification plans; in 2021, it was absorbed into the MEMD as the Rural Electrification Department.

The Uganda Energy Credit Capitalization Trust was created in 2009 to pool resources for energy access from the government and its development partners. It has been administered by the UECCC, whose objective is to "provide financial, technical and other support to unlock renewable and/or rural electrification projects for development".

Most on-grid connections have been implemented by Umeme, the private company that since 2005 has had the 20-year concession to run the country's main distribution system, which operates mainly in urban and peri-urban areas. (Umeme's concession is scheduled to run until 2025 and the government has decided not to renew it.)

Policy framework

Access to electricity is mentioned in a number of cross-sector policy documents, including the national Vision 2040 and the Parish Development Model (Box 4.1). In addition, the government has adopted several sector-specific policies, strategies and plans that set targets and specify objectives and measures. Table 4.1 lists some of the main ones.

Table 4.1 Energy-related targets by strategy and plan in Uganda

Policy document	Target	Scope	Period
Vision 2040	National access rate of 80% by 2040	Macroeconomy, all sectors	Adopted in 2013
Revised energy policy 2023	National access rate of 100% by 2040 Rate of grid electricity access of 65% by 2040 Electricity consumption of 578 kWh per capita by 2040	Energy sector	2021-40
Rural Electrification Strategy and Plan (RESP2)[5]	Rural access rate of 26% in 2022, with 1.4 million new customers (1.28 million from grid and 0.14 million off-grid) Rural access rate of 51% by 2030 and 100% in 2040	Electricity in rural areas	2013-22
Electricity Connections Policy	Additional 300 000 new connections annually to reach 3 million new connections by 2027 Electricity demand on the main grid to increase by 500 MW	Electricity	2018-27
National Electrification Strategy	National rate of 60% electricity grid-based access and 33% off-grid based access by 2027 National access rate of 80% by 2040	Electricity	Adopted in 2021

Notes: kWh = kilowatt hour; MW = megawatt.

Box 4.1 The Parish Development Model

"The Parish Development Model (PDM) is the last mile strategy for service delivery by the government of Uganda for improving incomes and welfare of all Ugandans at the household level. It is an extension of the whole-of-government approach to development as envisaged under NDPIII, with the parish as the lowest administrative and operational hub for delivering services closer to the people and hence foster local economic development [… The PDM focuses on] delivering services closer to the people; and measurable results at the parish level in order to ensure transformation of the subsistence households into the money economy. This transformation requires organized, integrated, well-coordinated and results-based efforts."

Source: MOLG (2021).

Electrification efforts

Over the years, the government and its development partners have pursued several policies and programmes to increase electrification rates. Most of these have been co-ordinated by the REA (now RED) and financed through the REF.

[5] MEMD (2013).

Although all programmes have contributed to the progress made, most have fallen significantly short of their targets. Financial challenges are reportedly the main reason for this limited success. Extending and maintaining grids is costly, especially in rural areas, where many settlements are scattered and sometimes isolated by mountains and other difficult terrain and operators can face shortages of materials. In addition, once a household has been electrified, electricity consumption is often very low, making it difficult for distribution companies to cover maintenance costs and posing problems for grid stability on long distribution networks.

Although measures have been designed to improve affordability and foster new connections, several implementation challenges have limited such effects, including long delays and low human capacities. Although there is a connection subsidy programme, with funds made available from the government and development partners, funds have not always been available, and distribution companies often have had to wait a long time to receive the subsidy in the form of a reimbursement, putting a strain on their working capital.

Grid extension

Dedicated plans have aimed to address the electricity deficit in rural areas. After the first Rural Electrification Strategy and Plan (RESP), which ran from 2001 to 2010, the ERA developed a second RESP intending to increase the rural electrification rate to 26% by 2022, up from 7% in 2013. It hoped to achieve this with an integrated strategy combining national grid connections, solar systems and mini-grids (MEMD, 2013).

RESP2 adopted a centralised government-led approach based on proactive planning by the REA and greater centralisation of funding under the REF than in the previous RESP. It also set geographic service territories, which gave private or co-operative concessionaires exclusive rights for on-grid connections while calling for them to work in co-ordination with off-grid service providers.

The Electricity Connections Policy (ECP) 2018-2027, developed under RESP2, currently represents the main government initiative to scale up connections. It aims to increase the number of annual new connections to around 300 000, from an average of around 70 000 in 2018, to reach 3 million new connections by 2027. So far, however, the number of connections has averaged far below this, partly due to complications created by the Covid-19 pandemic. The ECP also aims to contribute to increasing the demand for electricity on the main grid by 500 MW over the same period.

The World Bank-led Energy for Rural Transformation Project is now in its third phase, covering the period 2015-23. Like the earlier phases, the project's development objective is "to increase access to electricity in rural areas of Uganda". It has components covering on-grid energy access, including grid densification, grid extension and new connections. There is another component for off-grid access, including solar PV systems for public institutions in rural areas, provision of related credit facilities and the development of quality standards for component-based solar systems. Originally scheduled to close at the end of 2020, the project was extended through June 2023.

In 2021, the National Electrification Strategy for Uganda provided a least-cost analysis for connecting 10 million new customers with a combination of on- and off-grid approaches. The NES will serve as a base for the successor to the ERT, the new World Bank-administered EASP, which includes the following main components: 1) grid extension and

connectivity (which it notes is “in alignment with the ECP”); 2) financial intermediation for energy access scale-up; and 3) a component focused on Energy Access in Refugee Host Communities (World Bank, 2022).

Solar home systems

Several players are active in the distribution of solar home systems, solar lanterns and the sale of efficient appliances for productive use. GOGLA-affiliated6 companies reportedly distributed over 1.6 million certified solar products in Uganda between 2018 and 2022 (GOGLA, 2022). While most of these sales were for solar lanterns and small-capacity lighting kits (below 10 watt-peaks [Wp]), sales of higher capacity solar systems able to power appliances such as TVs, fans or, increasingly, refrigerators, accounted for close to 200 000 units cumulatively between 2018 and 2022. There have also reportedly been imports and sales of a large number of low-quality and counterfeit solar products. As in many other developing countries, the distribution of solar products in Uganda is not regulated.

The government of Uganda has made efforts to integrate off-grid solutions into national electrification plans and to establish a favourable environment for such technologies by instituting quality standards and fiscal measures, such as value-added tax (VAT) exemptions or import duty waivers on solar PV panels, batteries and agro-processing equipment, etc. In practice, however, companies importing these products report inconsistency and unpredictability in the interpretation of fiscal measures. They also report practical challenges related to the scope of such exemptions. For example, cables; switches; light bulbs; charging cables; and accessories and appliances such as radios, TVs and fans are still subject to taxes. Complex custom procedures drive up costs and ultimately increase prices for end users.

The business environment is reportedly also challenging for the distribution of pay-as-you-go solar products. Bureaucratic procedures hinder low-income households’ access to credit, while customers often default on the reimbursement of credit, potentially due to limited financial literacy. Some companies also report facing unfair market conditions due to a lack of rules enforcement, making them compete with players who have avoided tax obligations or have illegally imported substandard products. Moreover, the large-scale importation of substandard products appears to have significantly dented customers’ confidence in stand-alone solar products generally.

Affordability remains one of the biggest challenges preventing private sector distributors from scaling up services. Several sellers note that, without additional subsidies or facilitated access to low-cost capital for distributors and customers, Uganda will continue to be a market primarily for low-cost, entry-level solar products. Dedicated donor programmes, such as the Beyond the Grid Fund for Africa (BGFA), aim to address some of the financial barriers off-grid service providers face (Box 4.2).

[6] GOGLA is the Global Off-Grid Lighting Association.

Box 4.2 Beyond the Grid Fund for Africa

The Beyond the Grid Fund for Africa (BGFA) is an example of a current donor programme involved in addressing the financing barrier to energy access. Managed by the Nordic Environment Finance Corporation (Nefco), the BGFA operates in Uganda and several other African countries. Six or seven locally owned off-grid service providers in Uganda are expected to receive funding from the first competitive funding round, which took place during 2021-22. A second BGFA funding round for Uganda was announced in early 2023, with an indicative individual contract size of EUR 1-4 million. Denmark and Sweden were the main contributors for the first round. Norway, which joined the BGFA in December 2022, will contribute to the second round.

Source: Beyond the Grid Fund for Africa.

Mini-grids

The regulatory framework enables the establishment of mini-grids, but limited profitability and challenging operations have limited the scope of this sector so far. There were 48 operational mini-grids in Uganda at the end of 2022, over 30 of which were commissioned between 2021 and 2022 (UOMA, 2022). The second round of the BGFA and the envisaged tender of the GET Access programme in 2023 are expected to add significantly to the total number of mini-grids in Uganda.

Most new mini-grids are solar powered, and ownership is generally private or by the beneficiary communities. Financial support for mini-grid project development has been predominantly from private equity and development financing institutions through grants. Access to loan financing has historically been limited due to uncertain business models, although this may change with the tendering of bundled mini-grids.

Key challenges reported for the sector included an uncertain regulatory tariff regime, where developers may not charge cost-reflective tariffs, and relatively short mini-grid concession periods for non-island sites whose risk of grid arrival is higher. A consumer tariff cap may be imposed on specific projects to shield customers from high electricity bills, compared to grid-connected consumers. This obliges many projects to rely on subsidies. Additionally, the processes of acquiring licence exemptions and rights to develop mini-grid sites were reported to be cumbersome. The unpredictable tax regime was also reported to hinder affordability, lowering project viability and energy demand.

In collaboration with development partners and the private sector, the government is working to improve the enabling environment for mini-grid investments. The regulator has developed comprehensive mini-grid regulations and commissioned a review of mini-grid tariffs. Additionally, technical standards and guidelines for mini-grid equipment and their integration when the main grid arrives are currently under development. The current direction for solicited mini-grid project development is to run competitive tenders for bundled clusters of mini-grids, comprising several sites in the same geographical location to a single private developer. This aims to promote economies of scale and thereby increase financial viability.

Demand for electricity and affordability

As in other countries in the region, affordability is one of the main challenges to expanding access to electricity. Various stakeholders have noted that on-grid connection costs are too high for most potential customers, and even when connections are subsidised, the cost of internal wiring and electrical appliances are further barriers (IEA, 2023).

To address these issues, subsidies have been adopted to lower connection costs. To fulfil the ambitions of the ECP, new connections for houses and businesses within 90 metres of an existing low-voltage pole are supposed to be fully subsidised. This programme aims to cover the UGX 98 000 cost for a no-pole connection and the UGX 326 000 cost for a one-pole connection, but applicants are still responsible for their own internal wiring plus the cost of a wiring inspection before the local distribution company can make the free connection.

To help lower the cost of internal wiring, the REA and its partners have developed a number of inexpensive wiring solutions, including ready boards that include a light and several outlets on a single panel. The ECP programme also aims to subsidise the inspection fee, for which the new customer is supposed to only pay UGX 20 000 instead of the usual UGX 41 300 (Monitor, 2019).

In practice, however, the programme has not always been fully funded, so a large backlog of connection requests has developed. The programme reportedly will receive a new injection of funds under the World Bank's EASP, which is set to start in 2023.

The cost of energy is also an important burden for many households in Uganda. While the first 15 kWh is a lifeline social tariff permitting Ugandan households to access basic energy services, most still face financial constraints to access what the IEA considers an essential bundle.

Increasing electricity demand is key to Uganda's power system and is a central objective of the ECP. For this reason, the ECP also aims to provide credit facilities to finance three-phase connections for industrial customers, as well as rebates to customers that invest in infrastructure benefitting other customers. The generally unreliable power supply, characterised by regular grid outages, continues to negatively impact the development of potential demand. Significant investments in transmission and distribution infrastructure will be required to unlock suppressed demand – especially in industries – and to facilitate new demand.

The RED also promotes productive uses of electricity among potential rural consumers, notably for agriculture and agricultural processing, thanks to information campaigns, training, technical assistance and the development of credit facilities. Productive uses, supported by non-energy infrastructure development (e.g. roads), can serve as anchor loads and help increase the profitability of access projects, as well as boost rural economic development, which in turn can further increase household energy demand.

Assessment

Uganda has made progress in increasing access to electricity, and currently around 30% of its population has access as per the IEA definition.[7] As of 2022, around 20% of the population nationally had access to electricity from the national grid, while a further 10% received electricity from solar home systems large enough to provide basic energy services as defined by the IEA. Another 20% benefit from limited access through smaller solar lighting devices such as solar lanterns.

Government support to on- and off-grid solutions deployed by private services providers under the concession schemes and to solar mini-grid operators and distributors of solar home systems is to be commended. The government has developed a comprehensive and clear set of strategies, policies and plans to address crucial issues such as grid connections and rural electrification that provides targets with recommended technologies. Alignment of electricity access plans with the broader vision for socio-economic development, including the Parish Development Model,[8] is critical to ensure cross-sectoral development.

Affordability is the main challenge, as households are financially constrained, both for getting connected to a source of power then acquiring electrical appliances and consuming electricity once connected. This situation hinders the profitability of electrification projects and significantly reduces the interest of private investors, especially in rural and remote areas. Low power demand also undermines the entire power system, thereby contributing further to grid instability and an unreliable supply, which, in turn, further undermines consumption.

A number of well thought-out instruments and mechanisms – such as the social/lifeline electricity tariff and a free connection plan – are in place. However, the level of financial support has not been consistent nor sufficient for most low-income households, while the overall impact of some subsidy schemes has been limited by scarce capacities to implement.

Private companies benefit from several favourable tax regimes and regulations, such as VAT exemptions or import duty waivers on solar PV panels, batteries and agro-processing equipment. However, many of these measures are widely perceived as uneven and inconsistent, while refunds for them take a long time. The scope of tax exemptions also could be larger to reduce additional costs, which otherwise simply get transferred to customers and end users.

[7] The IEA defines access to electricity as a household receiving enough electricity to power at least a minimum level of services that is capable of growing over time. The IEA minimum level of services is defined as the "basic bundle", which includes more than one light, phone charging and a radio, broadly equivalent to a range of 50-75 kWh per household per year, depending on efficiency levels. In the case of Off-Grid Solar (OGS), the IEA considers in the access definition Solar Home Systems (SHS) of 10 Wp and above. See the IEA Guidebook for Improved Electricity Access Statistics.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Pursuing efforts to develop transparent public access to data (including GIS) to help all players identify opportunities to provide electricity services to households, potential productive users and large public institutions.
- Ensuring that access to electricity plans are co-ordinated with other development plans so that new connections can foster economic development and productive energy uses. This should include access to adequate financing schemes.
- Reinforcing policies establishing fair market conditions for private sector interventions aimed at increasing electricity access and consumption for grid and off-grid solutions. This could notably include customs and tax regimes, enforcement of quality standards, and improvement of the financial and digital environment (e.g. mobile phone availability, affordability and coverage) at the end user level.
- With financial development partners, exploring the design of schemes enabling both private service providers for distribution and off-grid companies to provide affordable electricity under sustainable and scalable business models.

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5. Access to clean cooking

Key data

Biomass consumption (2021): 14.6 Mtoe (87% of TFC)

Total access to clean cooking (2022): 5.4% national (urban 11.9%, rural 3.1%)

Overview

In Uganda, less than 6% of the population has access to clean cooking.[1] Around 95% of households rely on either wood or charcoal as their primary energy source for cooking, with the remainder using sources like kerosene and LPG. An additional 10% of households primarily cook with improved cookstoves, which provides transitional access.[2]

Achieving clean cooking goals presents several challenges. The relatively high costs of improved cookstoves and fuels (including electricity), a lack of modern solutions available at scale, insufficient distribution infrastructure for LPG, and cultural and awareness barriers have made it challenging to change cooking habits. In addition, most CSOs and private companies, especially local ones, struggle to access affordable financing to supply clean cooking devices or develop fuel delivery infrastructure.

The high reliance on biomass has led Uganda to have one of the region's highest deforestation rates. Millions of Ugandans, particularly women, are also affected every year by indoor air pollution from cooking with biomass fuels.

Access to clean cooking remains a priority in the main energy policies and strategies, with a recently amended goal of reaching 50% by 2040.

Current policies and projects

The MEMD is the government body responsible for policy making related to clean cooking. The main policies and strategies governing the use of cooking technologies in Uganda, as well as the use of biomass, include:

[1] The IEA and SDG 7 access indicators for clean cooking are defined as households primarily cooking with clean fuels including LPG, electric cooking, ethanol, biogas and improved biomass cookstoves of ISO Tier > 3. However, official SDG7 indicators exclude all solid biofuels (wood, charcoal etc.) from access to clean cooking due to gaps in data gathering on improved biomass cookstoves. Uganda's MEMD has data available on the type of stoves from household surveys and can count improved cook stoves separately. However, ensuring the ISO Tier of these stoves is still challenging with the data available and some of these stoves may not meet the minimum requirements to be classified as access. For this report, the IEA does not consider improved cookstoves in its access rate.

[2] Improved cook stoves (ICS) below ISO Tier 4 are not defined as clean cooking by the IEA but stoves of Tier 3 are considered as transitional solutions. Uncertainties associated with available survey data add challenges in classifying improved cookstoves. Due to these uncertainties, access rates for ICS are reported separately and could include lower-tier stoves for historical data.

- the 2023 National Energy Policy
- Vision 2040 and the National Development Plan (NPD III)
- the Biomass Energy Strategy Uganda (2013).

The 2023 National Energy Policy states that the government shall promote "sustainable biomass energy production and utilization across all sectors… equitable and widespread use of affordable, clean and efficient cooking technologies [and] access to affordable, reliable and clean LPG energy services". The policy aims to increase the proportion of the population using clean cooking fuels and technologies from 15%[3] to 50% by 2040. It recognises the current unsustainable use of biomass, the unreliable supply and high cost of clean cooking fuels and technologies, inadequate institutional co-ordination, a lack of legislation and regulations, and insufficient awareness regarding sustainable biomass use and clean cooking solutions. The policy also acknowledges the need for more gender awareness in the promotion of clean cooking (MEMD, 2023).

The Third National Development Plan aims to decrease the total energy consumption of biomass (which is primarily used for cooking) from 88% in 2018/19 to 50% in 2025 while promoting the uptake of alternative and efficient cooking technologies, such as electric cooking, biogas and LPG, including in rural areas. The NDP III has a target to increase the share of clean cooking from 15% in 2018/19 to 50% by 2025. However, the less ambitious target in the new National Energy Policy apparently overrides this.

In 2013, the government developed the Biomass Energy Strategy in collaboration with the UNDP. The strategy lists several challenges related to unsustainable biomass use, notably including a lack of institutional co-ordination and awareness. The strategy aims to secure a stable biomass energy supply for long-term social and economic development and poverty reduction (MEMD, 2013).

The MEMD is currently developing an Integrated National Clean Cooking Strategy, which will guide the government and its partners in meeting its targets. Other strategies related to clean cooking, including the use of biomass, include:

- the Rural Electrification Strategy and Plan 2013-2022
- updated Nationally Determined Contributions
- the National Electrification Strategy 2021
- the 2021-2025 Sustainable Energy Response Plan for Refugees and Host Communities
- the National Biogas Strategy and Action Plan for Uganda (2023)
- the E-cooking Strategy for Uganda (under development).

Recognising the role of biogas technology as an alternative energy to woody biomass and a potential source of process heat for industry makes it a vital component of Uganda's economic and environmental aspirations.

The National Biogas Strategy and Action Plan was designed to establish a mechanism for the growth and sustainability of the biogas subsector, with the primary goal of increasing the adoption and usage of biogas and its by-products. The proposed interventions respond

[3] As noted earlier, the MEMD considers a household using any clean cooking fuel as having access, even if the primary energy source for cooking is biomass.

to the challenges and issues faced by the biogas industry, including technical capacity, financing, policy and multi-sectoral co-ordination, and awareness.

The strategy is aimed at commercialising, innovatively financing and scaling-up biogas access; promoting biogas market development, innovation and research and development (R&D); enhancing awareness, stakeholder capacity building and skills through education and training; and promoting multi-sectoral co-ordination and a supportive policy and regulatory environment for biogas development.

The government has carried out a number of projects focused on the supply of clean cooking fuels and technologies.

The Uganda Clean Cooking Supply Chain Expansion Project was a USD 2.2 million co-operation between the MEMD and the World Bank that ran between 2015 and 2020. It aimed to reduce both the economic burden on households and the negative impacts on the environment from the inefficient use of biomass fuels for cooking. The project quality tested cookstoves and created partnerships between quality-verified manufacturers and local sellers, including distributors of solar PV equipment whose established micro-credit schemes could also be leveraged for cookstoves. The project avoided the end user subsidies that have been blamed for distorting the improved cookstove market under other programmes, both in Uganda and elsewhere, and instead focused on adapting products to users' needs and researching willingness to pay through consumer trials. More than 58 000 stoves had been distributed by March 2020, exceeding the initial target of 45 000 (World Bank, 2021).

The MEMD's LPG Promotion, Supply and Infrastructure Project plans to distribute 1 million LPG kits (cylinder + stove), targeting vulnerable households as well as large biomass consumers such as schools, by enabling a switch to improved biomass cookstoves. This reportedly could lead to firewood savings of up to 35% per user. As part of this, the government is conducting awareness-raising campaigns to help change the public's misconceptions about clean cooking solutions, for example, that they cannot provide the same cooking service as traditional methods and are too expensive and dangerous. It also has plans to expand LPG infrastructure by increasing the storage capacity in Kampala by an additional 8 kilotonne (kt) and developing six storage units in other parts of the country to reach more households outside Kampala.

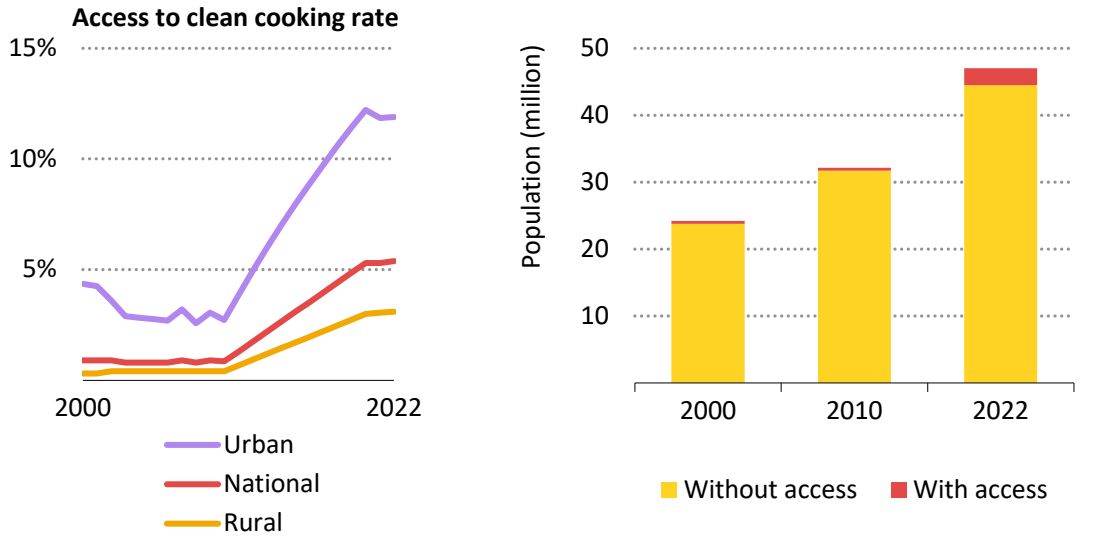
The cooking sector

Over 44 million people (over 94% of the population) do not have access to clean cooking[4] in Uganda; three-quarters of these are in rural areas.

The share of people with access to clean cooking fuels has rapidly increased since 2010, especially in urban areas (Figure 5.1, left side). However, due to the rapid population growth in Uganda, the actual number of people without access has effectively increased, as the clean cooking rate has not kept pace with the population growth (Figure 5.1, right side).

[4] Clean cooking is defined as cooking solutions that release less harmful pollutants, and which are more efficient and environmentally sustainable than traditional cooking options that use solid biomass (e.g. a three-stone fire), coal or kerosene. For more information, see: the IEA website.

Figure 5.1 Access to clean cooking in Uganda, 2000-2022

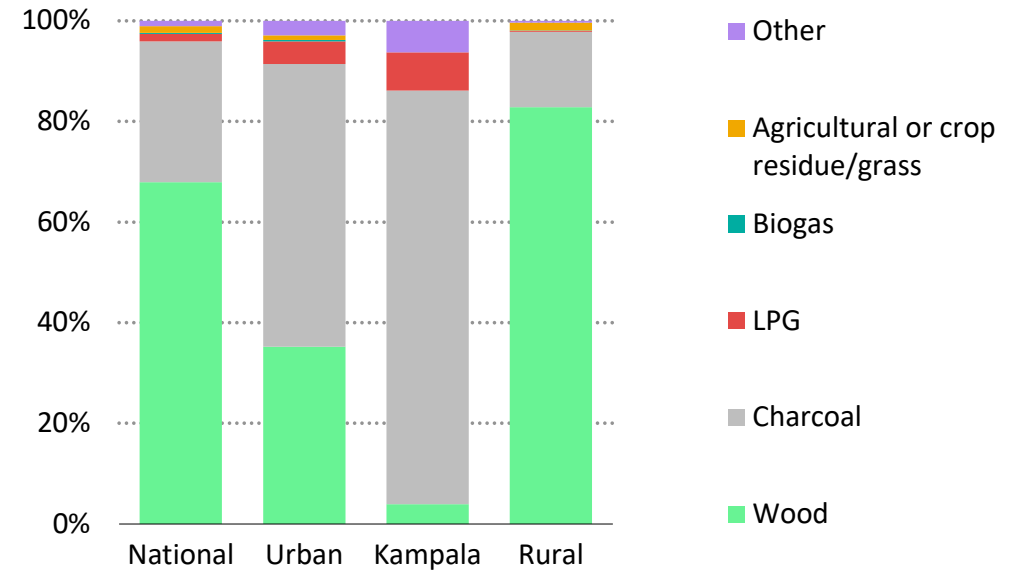


Source: IEA (2023).

A predominance of biomass

Around 68% of Ugandan households use firewood as their main source of cooking fuel; most of the remainder (primarily in urban and peri-urban regions) use charcoal (Figure 5.2). The shares of firewood and charcoal in rural areas are about 85% and 15%, respectively, whereas these shares are 35% and 55% in urban areas. In Kampala, only 4% of households use firewood, while 82% use charcoal. The use of LPG for cooking purposes remains low nationally, at 1.5%, ranging from 0.2% in rural areas to 7.6% in Kampala (UBOS, 2022).

Figure 5.2 Distribution of households by primary cooking fuel in Uganda, 2021



Note: LPG = liquefied petroleum gas.

Source: IEA based on data from UBOS (2022).

The most common type of cookstove in Uganda is the three-stone fire, used by around two-thirds of households, or 76% in rural areas and 32% in urban areas. Solid-fuel cookstoves, both traditional (i.e. non-manufactured) and manufactured, are used by almost all other households, with most users living in urban areas. A very small share of households employs modern cooking solutions such as LPG, with an even smaller share using electricity (UBOS, 2021).

Three-stone fires and other traditional cookstoves that burn firewood, charcoal or other biomass typically have very low efficiencies, at ~20%, requiring large amounts of fuel to meet cooking needs. In comparison, modern biomass cookstoves have an efficiency of ~35%, LPG cookstoves ~56% and electric cookstoves ~85%.

The 2016/17 National Household Survey showed that, out of the 68% of households that use firewood for cooking, 63% collected the firewood from the forest or bush areas, 26% obtained the firewood from their own plantations, and 9% purchased it from the market.

The same household survey also noted that while households mainly rely on collected biomass, especially in rural areas, institutions such as schools, hospitals and hotels mainly rely on purchased fuel since they require it on a greater scale. Some 49% of institutions in Uganda used charcoal as their main fuel for cooking, while 21% used firewood. Institutions consumed a total of 887.3 tonnes of charcoal and 947.6 tonnes of firewood per day. The share of the institutions that used improved cookstoves was 22.7% (14.1% with charcoal and 8.6% with firewood), while 11.9% used LPG (all located in urban areas) and 2.5% used electricity. Regardless of the fuel used, more than 95% of institutions reportedly purchased their fuel (MEMD, 2016).

In its NDC, the government aims to have 50% of schools and other institutions using improved charcoal cookstoves by 2030, compared to the current share of 22.7% (MWE, 2022).

The price of a bag of charcoal in Kampala has reportedly tripled over the last two decades, while the quality of the charcoal has declined with increasing deforestation. Most charcoal is illegally produced in inefficient, traditional kilns in rural areas where wood is still available (Haysom et al., 2021). It is then transported to cities by truck, linking a large share of the recent increase in cost to higher oil prices. Due to deforestation, of which charcoal production is the main cause, the regions supplying the fuel have shifted from the central to the northern parts of the country, making the cost of transportation to Kampala and other cities even higher (New Vision, 2021).

Further regulation of charcoal production across the entire value chain will be fundamental to keeping deforestation under control. The National Forestry and Tree Planting Act of 2003 and subsequent regulations address charcoal issues, but no national law specifically regulates charcoal. The Districts of West Nile, Karamoja and Acholi have all imposed regional bans on charcoal production, although implementation and enforcement have not been successful, and charcoal remains the main source of revenue for many rural communities (Haysom et al., 2021). NEMA recently disclosed that no charcoal dealer in the country had received the required environmental and social certificate. NEMA has asked the authorities to enforce the law by prosecuting illegal dealers (Cooperator, 2023). In May 2023, the Ugandan president announced an executive order banning the cutting of trees for charcoal burning in northern and north-western Uganda.

Challenges related to the use of biomass

Health

Cooking with biomass fuels severely affects indoor air quality, negatively affecting more than 20 million Ugandans per year. There are approximately 23 000 deaths each year due to respiratory infections caused by cooking with biomass, which is also thought to cause 8.3% of all infant deaths in Uganda (UBOS, 2022; MEMD, 2013).

The National Biomass Energy Strategy (2015) aims to increase awareness about indoor pollution and associated health risks. Among other measures, it calls for the MEMD to partner with the Ministry of Health to eliminate indoor pollution-related health hazards through the introduction of improved cookstoves (MEMD, 2013). However, such a partnership has not been established to date.

Gender

Changing to cleaner cooking fuels would lead to positive externalities and equity gains for women in Uganda by alleviating time poverty, expanding labour market opportunities, improving maternal and women's health in general, and helping change social norms (MEMD, 2023). In Uganda, 70% of household members involved in firewood collection are female (both adults and minors) and it is generally females who cook. In sub-Saharan Africa, collecting firewood takes an average of two hours per day per household, affecting female health and safety, as well as taking time that could otherwise be spent on education or paid work (UBOS, 2018). Providing more efficient cooking solutions could therefore help facilitate women's economic empowerment.

Environment

Although Uganda's biomass resources are substantial, biomass is consumed at an unsustainable rate, contributing to a deforestation rate of 1.44%, one of the highest in sub-Saharan Africa (MWE, 2022). According to Global Forest Watch (n.d.), Uganda lost 12% of its tree cover between 2000 and 2021. The use of biomass in 2013 was estimated at 44 million tonnes (Mt), while the sustainable level of supply was only 26 Mt. Deforestation is the primary cause of the decline in forest cover from 24% in 1990 to 10% in 2017 (MWE, 2022).

The traditional use of biomass releases high amounts of GHG emissions during combustion compared to clean cooking alternatives. Cooking a meal with biomass on a traditional stove emits, on average, 1 kilogramme of carbon dioxide equivalent (kg CO_2-eq) emissions in the form of methane (CH_4) and nitrous oxide (N_2O). However, if fuelwood is harvested unsustainably, emissions can be as high as 10 kg CO_2-eq, since the CO_2 emitted also needs to be accounted for. This means that, on average, the traditional use of unsustainably harvested biomass for cooking produces around 60% more GHG emissions than cooking the same meal using LPG and around 40 times more than biogas (IEA, 2022). For this reason, clean cooking projects are eligible for carbon credits, representing a unique opportunity to finance the transition (Box 5.1).

Box 5.1 The role of carbon financing in African countries

Carbon credits are verified metric tonnes of greenhouse gases (GHGs) reduced or removed from the atmosphere. International carbon markets allow countries and companies to generate and trade carbon credits, which can provide economic efficiency and flexibility as to where and when GHG emissions are reduced or removed, and therefore, in theory, reduce the cost of mitigating climate change. Carbon credit markets can also provide host countries and project developers extra revenue streams to derisk the operations of their clean energy investments.

Standards for generating and selling carbon credits include those of international crediting mechanisms of the United Nations Framework Convention for Climate Change (UNFCCC; such as the Clean Development Mechanism, CDM) and those of voluntary carbon markets, which are independent crediting mechanisms, self-regulated and managed by non-governmental entities.

After COP 26, momentum has grown to develop the infrastructure and capacity needed for African countries to tap into the carbon market opportunity, which could help them receive funding to develop projects.

Most African countries had limited opportunities to participate in the CDM due to factors like the slow establishment of institutional and governance frameworks, difficulties with private sector engagement, uncertainty over the investment environment, and reliance on imported technologies (Michaelowa et al., 2021).

Clean cookstoves are the most represented type of project in the voluntary carbon markets. Of the 8 000 projects that have issued credits, 15% are clean cookstove projects. Of these, almost 60% are based in African countries, which have issued around 54 million credits, or 68% of all carbon credits issued for these types of projects globally.

In Uganda, total credits issued in the voluntary carbon market through May 2023 was 16.4 million, representing 7% of all credits issued in Africa. Of these, 60% were issued for clean cookstove projects (9.8 million).

Source: Carbon Credit Quality Initiative (2023).

Clean cooking solutions

Improved biomass cookstoves

Improved biomass cookstoves[5] burn wood or charcoal more efficiently than traditional stoves. They also provide important socio-economic and health benefits while reducing deforestation and GHG emissions. The use of improved biomass cookstoves is generally the cheapest and most practical means of providing clean cooking solutions for households currently using biomass, since it avoids the need to switch fuels and build new supply infrastructures. The introduction of improved cookstoves, therefore, can be

[5] Intermediate and advanced improved biomass cookstoves (ISO tier > 1). Excludes basic improved stoves (ISO tier 0-1).

fundamental for the transition to clean cooking solutions in rural areas where the distribution infrastructure for LPG does not yet exist, though it can also help reduce the use of charcoal in urban households.

The government has implemented a number of incentives to encourage people to switch to improved cookstoves. This includes a tax rate of zero on parts imported for local cookstove assembly as well as a 10% import tax on cookstoves instead of the general import tax rate of 25%.

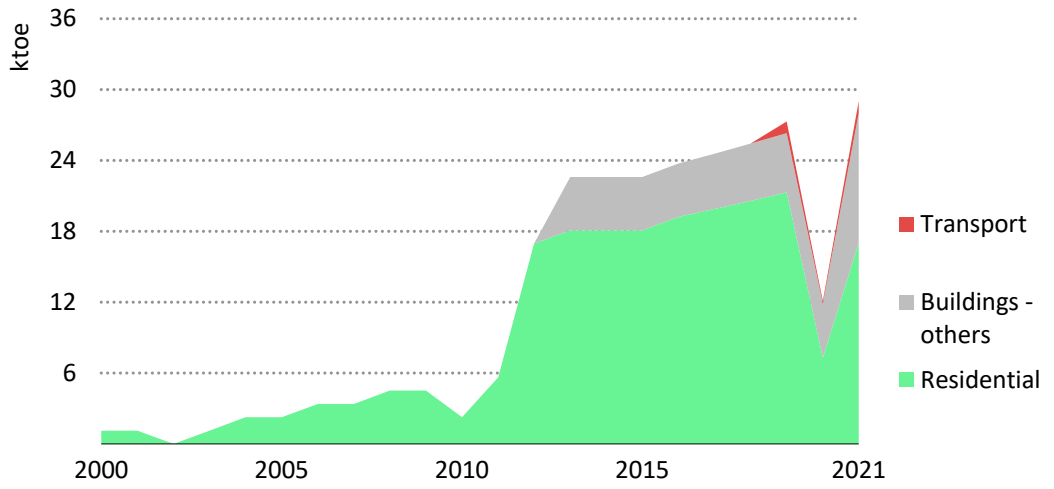
Several companies provide access to affordable financing for the private sector, such as EnerGrow, which offers loans to micro-, small and medium-sized businesses and households for assets or appliances valued between USD 50 and USD 5 000 over a period of six months to three years.

The use of carbon finance can be key to achieving clean cooking goals. Some distributors of improved cookstoves are already leveraging carbon market financing to propose affordable solutions to households. The government is currently working on national regulations for the use of carbon financing for clean cooking projects. This can be an opportunity to unlock more financing for local and smaller companies and ensure that projects have a lasting impact on households. However, the government will need to be careful to avoid adding administrative challenges to companies already benefitting from these sources of finance while also ensuring that lower prices do not distort the market. For more information on carbon credits, see Box 5.1.

Liquefied petroleum gas

Only 1.5% of Ugandan households use LPG for cooking,[6] though this varies by type of household, from 0.2% of rural households to 4.5% of urban households (UBOS, 2022). Around 0.6-1.1 kb/d of LPG is used in Uganda.

Figure 5.3 LPG final consumption by sector in Uganda, 2000-2021



Note: ktoe = kilotonne of oil equivalent.
Source: IEA (2023).

[6] The 1.5% includes both households using LPG as their primary fuel for cooking and as a secondary or supporting fuel.

The main challenge is the high initial cost of buying an LPG stove and gas cylinder, in addition to the cost of the gas itself. LPG is transported and sold pressurised in cylinders and therefore needs a specialised distribution infrastructure and reliable roads. The lack of good roads and refilling stations are major barriers to LPG use, especially in remote areas. Moreover, some households that start using LPG reportedly revert to biomass due to a perceived lack of quality control for the cylinders and the gas, including the level to which cylinders have been filled.

Kampala is currently the only city with a refilling plant, driving up the cost of LPG due to transportation costs to and from the capital. Decentralised refilling plants are, therefore, crucial in transitioning towards easier access to LPG as a cooking fuel.

In 2022, the government of Uganda launched a national LPG programme to disseminate 1 million 13-kg LPG cylinders, burners and other accessories over the next five years, targeting vulnerable communities that normally would be unable to pay the upfront cost of an LPG kit (The Independent, 2022). (A 13-kg gas cylinder can last up to three months for a family of four.) During Covid-19, the government encouraged the use of LPG through subsidised gas-refilling initiatives that allowed LPG distributors to operate during confinement periods.

The planned production of oil from the Tilenga and Kingfisher oil fields in 2025 could provide an additional 3 kb/d of LPG, while the planned refinery may be able to produce a further 1.7 kb/d (see Chapter 6).

Box 5.2 Liquefied petroleum gas subsidies in India and Morocco

In India, nearly half of all households still use biomass for cooking. However, through two LPG subsidy schemes, the government of India has broadened the availability of LPG to reach most Indian dwellings, and more than 200 000 premature deaths are estimated to have been prevented as a result between 2010 and 2019.

The first subsidy scheme, Pradhan Mantri Ujjwala Yojana, provides LPG connections to households living below the poverty line, along with access to an interest-free loan facility for the cost of the stove and first refill.

The second subsidy scheme, Pratyaksh Hanstantrit Labh, allows households already using LPG to continue receiving a subsidy, whereby a customer purchases LPG at market price and the subsidy is subsequently transferred to their bank account.

In Morocco, LPG consumption increased by 50% from 2007 to 2017 due to the Moroccan government's efforts to promote alternatives to biomass to prevent the deforestation and health problems associated with biomass use. In the same period, electricity consumption increased by 67% and the consumption of traditional forms of biomass decreased by 43%. The government continues to subsidise LPG for cooking to keep the price of a cylinder at 40 Moroccan dirhams (USD 3.90).

Sources: IEA (2019; 2021).

Electric

In principle, electric cooking is a clean and efficient option for households and should be part of any set of solutions to move away from biomass. Uganda's current surplus generation capacity (mainly from hydropower) could help enable the transition to electric cooking, while electric cooking could represent an important new market for electricity. However, the country's low electrification rate, especially in rural areas, combined with its unreliable power supply, have made electric cookstoves unattractive for many households in practice. Electric cooking solutions can also be used in off-grid and mini-grid settings, but the capacity needed for the electric stove is often not high enough.

The use of electricity for cooking remains very low in Uganda, where relatively high tariffs often limit household electricity use to lighting for those that are connected. In January 2022, the ERA introduced a cooking tariff (known as the Fumba tariff) to incentivise the use of electricity for cooking. After comparing tariffs in other countries and reviewing the needs of Ugandan households, the MEMD determined that a tariff of 412 UGX/kWh would equate to the monthly costs between cooking with charcoal and electricity. All customers supplied electricity by the main distribution company, Umeme, pay a reduced cooking tariff of 412 UGX/kWh after the first 80 kWh, up to 150 kWh, regardless of whether they have electric cooking facilities. Before and after those thresholds, the normal domestic tariff of 805 UGX/kWh applies, as does a lifeline tariff of UGX 250 for the first 15 kWh.[7]

The government is developing an e-cooking strategy and implementation plan, including a baseline study on e-cooking in Greater Kampala, Mbarara and Mbale.

Box 5.3 Charcoal-to-Power Project

The Electricity Regulatory Authority (ERA) signed an MoU with the Uganda Prisons Service in March 2022 for a project to promote the use of electric stoves in the prisons. The MoU is part of an ERA initiative named the Charcoal-to-Power Project, which aims to convert 50 000 households and 500 institutions (including hospitals, prisons and educational institutions) from using biomass as the primary energy source for cooking or heating. The MoU with the prisons is the second pilot project to be signed under the initiative. The first was a similar project implemented at the children's clinic at Mulago Hospital in Kampala.

Source: ERA (2022).

Biogas

For the past 20 years, the Netherlands Development Organisation has been conducting demonstration projects, training and advisory services that directly or indirectly have led to the installation of over 8 500 biogas digesters in Uganda, typically on farms. It has trained over 100 masons to construct low-tech brick biogas digesters, which allow users to produce methane from cow dung and other agricultural waste. The gas can then be used

[7] For the latest tariff schedule see: https://www.era.go.ug/index.php/tariffs/tariff-schedules.

for cooking, lighting and other purposes. The SNV currently works with Biogas Solutions Uganda, a non-profit that carries out the training and connects farmers to trained biodigester builders.

The government is looking at the possibility of installing biodigesters at large institutions, such as schools, prisons and hospitals, which currently consume large amounts of firewood for cooking. A pilot project at one school was able to use pupils' own biowaste to significantly reduce firewood consumption. However, a certain amount of consultation and education reportedly was required to overcome cultural sensitivities about using waste for cooking.

As an incentive to increase the use of biogas for cooking, there is no tax on biogas tubular digesters.

Ethanol

Ethanol produces minimal fumes and soot and is therefore a much healthier fuel option for cooking than biomass. It is also much more affordable than charcoal. In Uganda, ethanol is produced mainly from cassava, sugar cane, sweet sorghum and municipal waste, making it also a more sustainable fuel than biomass.

The use of ethanol for cooking is still nascent in Uganda, but the government is actively promoting it, reportedly discussing projects with international developers. The strong sugar industry in Uganda provides potential raw material. Studies on cooking with ethanol have been conducted, national standards for denatured ethanol are in place and the government has invested in the Bukona Agro Distillery with a 40 000-litre capacity.

Managing affordability

Despite increasing costs of biomass fuels, the high upfront cost of clean cookstoves, as well the cost of fuel for non-biomass stoves, represent large barriers to switching for most households. This is why policies, measures and programmes to lower such costs will be needed.

On average in Africa, the price of an improved charcoal cookstove is around one-third of the average monthly income. An LPG cookstove costs about half the average monthly income, an electric cookstove around three-quarters, and a biodigester + cookstove as much as six times the average monthly income.

The cooking tariff for households is aimed at promoting cooking with electricity. However, only 20% of Ugandan households were connected to the grid in 2021 and thus able to benefit from this tariff. The number of connected households using over 80 units of electricity is extremely limited. Reportedly, only 10% of Ugandans can afford 100 kWh per day. Significant grid reliability challenges further constrain the use of e-cooking.

Fuel cost also represents an important barrier, especially for households currently relying on virtually free firewood collection. For example, buying and refilling an LPG cylinder can be extremely expensive, and encouraging business models such as PayGo or the partial refilling of cylinders can permit families to use LPG without having to buy large amounts of gas in advance.

Other government measures to help decrease the price of clean cooking fuels include VAT waivers for LPG, VAT and excise duty exemptions for cooking ethanol, a zero-rate tax on tubular biodigesters, an electricity cooking tariff, a reduced (10% instead of 25%) import tax on clean cookstoves, and zero tax for imported parts destined for local manufacturing.

Assessment

Considerable efforts are still needed to ensure universal access to clean cooking in Uganda.

Supporting a diversity of clean cooking solutions, including improved biomass cookstoves, LPG, ethanol, biogas and electric cooking, as well as addressing infrastructure bottlenecks and un/underdeveloped supply chains, especially for LPG, will be essential to establish a reliable and regulated market for clean cooking options that can replace the unsustainable traditional use of biomass.

The rising price of LPG is a significant barrier, leading households to stick with harmful fuels such as charcoal and firewood, which are cheaper and more available options. Affordability concerns are also relevant for most other clean cooking options, such as electric cooking. Without addressing the price barrier, access to clean cooking is likely to remain limited.

The government currently does not have any system to track the type or number of cookstoves sold or disseminated per year. Such a system could provide better insight into how different fuels are used and what types of stoves are purchased and used by different kinds of households.

Since biomass use is primarily a function of poverty and a lack of energy alternatives, biomass policy should ideally be co-ordinated with socio-economic development plans and notably the Parish Development Model.[8]

To ensure the sustainability of biomass use, important issues to address include both upstream processes, such as regulating charcoal production along the whole value chain and ensuring the use of more efficient kilns, as well as downstream issues, such as the availability and affordability of improved biomass cookstoves and other cooking alternatives. Modern use of biomass also offers opportunities for industrial activities such as forest and agricultural waste processing into briquettes and pellets, creating alternative opportunities for economic development.

The main government objectives relative to clean cooking in Uganda are to decrease the share of solid biomass in the energy mix to 50% by 2025 (vs. 88% in 2018/19) and to increase the share of households that own and use clean and modern cooking solutions to 50% by 2040 from around 15% today (even if they continue to also use biomass).

The 2022 LPG programme can help solve the upfront cost barrier, but price incentives and new business models, such as PayGo LPG, should be considered to overcome the barriers of buying and refilling cylinders. While the government of Uganda has implemented a VAT waiver for LPG, the high and increasing cost of LPG internationally will continue to be a barrier for many households. Besides the VAT exemption, no other

[8] The Parish Development Model was developed under the NDP III as an effort to decentralise and place the epicentre of multi-sectoral community development, planning, implementation, supervision and accountability at local (parish) levels. See Box 4.1.

subsidies exist for LPG, making it unlikely that the poorest households will be able to afford LPG cooking. As experienced in other countries, such as India and Morocco, wide adoption of LPG for cooking typically requires significant subsidisation. However, such subsidies must be well designed and targeted to avoid negatively affecting the government budget.

There is a great opportunity for subsidies, business models (e.g. PayGo LPG) and funding from impact investors to lower the price of LPG cylinders. However, the current LPG market in Uganda presents several challenges. There are currently no standards or verification of gas quantities (i.e. the degree to which the cylinder has been filled) and quality. This has led some consumers who can afford LPG cooking to revert to using biomass.

While the cooking tariff is a good tool for demand stimulation, in practice it is focused on wealthier households that can already afford to consume more than 80 kWh of electricity per month at unsubsidised prices.

Displacing the traditional use of biomass can significantly reduce GHG emissions and deforestation, allowing clean cooking projects to access climate finance. Some companies operating in Uganda are already obtaining carbon credits, both under the CDM and voluntary markets. The Ministry of Water and Environment is developing regulations to operationalise the Climate Change Act (2021); one of the aspects considered is the financing arrangements under Article 6 of the Paris Agreement.

The recent executive order banning the production of charcoal in northern and north-eastern Uganda is a step in the right direction for limiting deforestation. However, similar regional efforts have been attempted previously without success. To achieve results on deforestation rates and GHG emissions, it will be important to ensure that the ban is enforced in the short term to calibrate and support efforts toward the development of a sustainable charcoal value chain, similar to programmes adopted by other countries such as Namibia.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Ensuring that the National Clean Cooking Strategy under development covers as many technologies and consumer categories as possible; is integrated with a comprehensive action plan on sustainable biomass use; and employs complementary solutions such as technical assistance, training, research, financial incentives and awareness raising.
- Carefully planning and developing additional LPG refilling stations closer to potential consumption areas in more parts of the country, and standardising cylinders and filling protocols to ensure safe, quality-consistent and easily accessible vending outlets.
- Strengthening campaigns to promote clean cooking alternatives and reduce the consumption of firewood and charcoal, targeting high-use institutions such as schools and hospitals.
- Ensuring that a legal framework is in place nationally for obtaining carbon credits for projects to promote clean cooking. Such efforts should be aligned with international standards, including markets being developed under Article 6 of the Paris Agreement.

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6. Oil and gas

Key data (2021)

Oil and gas reserves: 6.5 billion barrels, of which 1.2 billion barrels recoverable; 7.1 bcm associated gas and 9.5 bcm non-associated gas

Oil production: First oil expected 2025; peak production for current projects to reach ca. 200 kb/d within a few years

Oil product imports: 40 kb/d

Share of oil: 0% of domestic energy production, 9% of TES, 1% of electricity generation, 11% of TFC

Oil product consumption: 40 kb/d (transport 66.2%; residential 1.4%; industry 21.6%; agriculture, forestry and fishing 9.5%; electricity generation 0.7%), +21% since 2017

Share of natural gas: Currently no gas production or consumption

Overview

Uganda's petroleum resources are estimated at 6.5 billion barrels, of which 1.2 billion are considered recoverable, with an additional 0.4 billion barrels of contingent resources.

The country's first commercial oil discovery occurred in 2006 in the Lake Albert basin, also known as Albertine Graben. Commercial production is scheduled to begin in 2025, and peak production from existing projects is currently expected to reach around 200 kb/d by 2028. A consortium of TotalEnergies E&P Uganda B.V., China National Oil Corp and Uganda National Oil Company is pursuing two oil development projects.

The three main upstream investors are developing a crude oil export pipeline in partnership with the Tanzania Petroleum Development Corporation. It will stretch from western Uganda to the Tanzanian coast, providing an outlet for landlocked Ugandan crude to the international market. There are also plans for a refinery to serve the domestic and East African markets.

The government sees oil development as a way to diversify energy supplies, improve energy security by cutting reliance on oil imports (all of which must pass via third countries, given Uganda's landlocked location), provide funds for public infrastructure developments, build technical competencies for other industrial activities, save foreign exchange, and provide revenue for the country's economic and social development. It also hopes oil development will help reduce unsustainable biomass use by providing more LPG for cooking and help develop a petrochemical industry.

Governance

The **Directorate of Petroleum** at the MEMD is responsible for policy setting, licensing and promoting investment in the petroleum sector.

The **Petroleum Authority of Uganda (PAU)** monitors and regulates petroleum exploration, production, refining, transportation and storage.

The **Uganda National Oil Company (UNOC)** is responsible for the state's commercial interests in the sector, including ownership of its shares in a planned oil refinery, crude oil export pipeline and upstream projects. UNOC is also developing oil storage terminals in Jinja and Kampala.

The **Uganda National Bureau of Standards (UNBS),** in collaboration with the MEMD, has developed a number of standards and codes for operation across the entire petroleum value chain through a consultative process with industry and other stakeholders.

The **National Environment Management Authority (NEMA)** provides technical guidance in the area of environmental impact assessments and carries out environmental audits and inspections to ensure compliance with environmental standards and regulations in the petroleum sector.

Policies and legislation

The Constitution of the Republic of Uganda

Article 244 of the Constitution (Minerals and petroleum) provides for government ownership and control of minerals and petroleum in, on or under any land or waters in the country. It also empowers parliament to make laws regulating the exploration and exploitation of minerals and petroleum, as well as the management of accruing revenues and payment of indemnities. Article 245 provides for the protection and preservation of the environment, human health and property.

National Oil and Gas Policy (Petroleum Policy under development)

Uganda's National Oil and Gas Policy 2008 supersedes the petroleum-related sections of the 2002 Energy Policy. Its goal is "to use the country's oil and gas resources to contribute to early achievement of poverty eradication and create lasting value to society." It looks "beyond the oil discovery stage and plan[s] for sustainable oil and gas production, processing and utilisation" (MEMD, 2019).

The National Oil and Gas Policy includes sections on the roles of various sectoral bodies, protecting the environment, health and safety, capacity building, local content, research, and revenue management. This is currently under review to take into account the new developments in the oil and gas industry.

NDP III programme on "Sustainable Development of Petroleum Resources"

The Third National Development Plan, which runs for five years between 2019/20 and 2024/25, includes a programme on "Sustainable Development of Petroleum Resources".

The programme's main objectives are to attain equitable value from petroleum resources and spur economic development in a timely and sustainable manner.

The plan expects a reduction in the volume of imported oil products, increased contribution by oil and gas activities to GDP and tax revenue, and increased employment activities for Ugandans along the petroleum value chain.

While noting that "the necessary policy, legal and institutional framework has been put in place," the NDP III identifies the following challenges in the sector:

- "inadequate infrastructure"
- "un-harmonized legal and regulatory framework"
- "Protracted negotiation for the Final Investment Decision (FID) between government and the international oil companies"
- "Land acquisition issues (high costs, cultural issues)"
- "Limited human and institutional capacity"
- "Unnecessary delays to grant approvals by relevant government agencies ([environmental and social impact assessments] ESIAs, water permits)"
- "Limited private-led investment in the oil and gas industry" (NPA, 2020).

It lists the following objectives to pursue over the period covered by the NDP III, i.e. through 2024/25:

- "Fast track sustainable production and utilisation of the country's oil and gas resources", including infrastructure development, further exploration in the Albertine Graben (Uganda's main oil basin), and a detailed study for establishing a petrochemical industry.
- "Strengthen policy, legal and regulatory frameworks as well as institutional capacity", including reviewing and updating relevant policies, laws and regulations, and completing relevant commercial agreements.
- "Enhance local capacity to participate in the oil and gas industry", including operationalisation of the National Content Policy and the establishment of a fund to enable access to inexpensive credit by local companies.
- "Promote private investment in the oil and gas industry".
- "Enhance quality, health, safety, security and environment (QHSSE)", including the development of a disaster recovery plan (NPA, 2020).

The NDP III also lists the following "core" petroleum-related infrastructure construction projects for the five-year period covered by the plan:

- an oil refinery at Hoima
- the East African Crude Oil Pipeline
- a gas pipeline
- bulk oil storage facilities
- an airport for the Albertine Graben region (NPA, 2020).

The government has made progress in most of these areas. In particular, exploration and infrastructure development has continued in the Albertine Graben; the National Content Policy has been operationalised; and progress is being made on developing the oil refinery

and oil export pipeline, although the export pipeline has been the target of protests by a number of international and regional CSOs (see below).

Key oil and gas-related legislation

Uganda's main oil and gas-related legislation includes:

- Article 244 of the Constitution (Minerals and petroleum)
- the Petroleum (Exploration, Development and Production) Act 2013 ("2013 Petroleum Act"), which replaces the 1985 Petroleum (Exploration and Production) Act
- the Petroleum (Refining, Conversion, Transmission and Midstream Storage) Act 2013
- seven sets of regulations introduced in 2016 to operationalise the two petroleum Acts, addressing technical; health, safety and environmental; national content; and metering issues
- the Public Finance Management Act 2015, which, among other things, governs the management of petroleum revenues
- the East African Crude Oil Export (EACOP) Act
- the National Environment Act, 2019 and associated regulations, including the Petroleum Waste Management Regulations 2019 and the Oil Spill Regulations 2020
- Climate Change Act 2021.

The Model Production Sharing Agreement (PSA) provides a basis for negotiating PSAs. It is reviewed occasionally to take into account new policies, the changing business environment in Uganda's petroleum industry and global dynamics.

Oil reserves

Article 244 of Uganda's Constitution vests ownership and control of all minerals and petroleum resources in the government on behalf of the people. The PAU estimates Uganda's petroleum resources at 6.5 billion barrels, of which 1.2 billion are considered recoverable under current market conditions, with an additional 0.4 billion barrels of contingent resources. At a projected peak production rate of around 200 kb/d from the existing projects, the PAU estimates that current discovered resources will be able to last 20-30 years (PAU, 2023).

So far, all reserves have been found in the Albertine Graben, which is part of the East African Rift System that runs along Uganda's western border with the Democratic Republic of Congo. The Albertine Graben is approximately 500 km long with an average width of 45 km, for a total area of about 23 000 km^2. Most petroleum deposits to date have been found at depths of 290-3 000 m.

There are at least five other sedimentary basins in Uganda, including Hoima, Lake Kyoga, Moroto-Kadam, Lake Wamala and Lake Victoria. Geological, geochemical and geophysical surveys are currently being undertaken in the Moroto-Kadam basin.

Uganda has had an agreement with the Democratic Republic of the Congo since 1990 on sharing any resources that straddle their common border, though so far, no finds reportedly have been located on the border.

Crude oil from the Albertine Graben is generally medium to heavy, sweet, waxy and viscous, with an API range of 17-33 degrees. It has a pour point of 40°C, which means it solidifies at room temperature (PAU, 2023).

Exploration

Oil exploration first took place in Uganda in the 1920s. One deep exploration well was drilled (Waki-1) in Butiaba in 1938 before activities ceased during World War II. Exploration resumed in the 1980s, and Hardman Petroleum struck Uganda's first commercial oil deposit in January 2006 at its Mputa-1 well in Exploration Area 3 (now part of the Kingfisher project). Hardman was purchased by Tullow Oil later that year, and in 2012, Tullow sold part of the ownership rights in its licences to Total E&P Uganda and China National Offshore Oil Corporation (CNOOC).

According to the PAU, 33 seismic surveys have been carried out so far in the Albertine Graben, and some 121 exploration wells have been drilled. This has resulted in 21 discoveries, most of which are oil and 17 of which have been fully appraised. Approximately 60% of the province has yet to be explored, and 85% is currently not under any licence.

Nine production licences have been issued in the Albertine Graben so far, covering 14 of the 21 discovered fields. Eight of these are now operated by TotalEnergies E&P Uganda B.V. (five of which were originally operated by Tullow), and the remaining one is operated by CNOOC Uganda Limited (CNOOC). The Lake Albert integrated development project includes the Tilenga and Kingfisher oil project (production capacity 230 kb/d, TotalEnergies 57%, CNOOC 28%, UNOC 15%) and EACOP midstream project (a 1 443 km underground pipeline from Uganda to Tanzania's coast).

Tilenga project

The Tilenga project, which was licensed in 2016, is operated by TotalEnergies on behalf of joint venture partners CNOOC and UNOC. (Tullow sold its remaining shares in the project to TotalEnergies in 2020.) Tilenga consists of six production licences covering the following fields: Jobi-Rii, Gunya, Ngiri, Kasamene-Wahrindi, Kigogole-Ngara, Nsoga and Ngege, located in the Buliisa and Nwoya Districts. It is an onshore development with a northern section partly located in the Murchison Falls National Park.

The project includes a central processing facility (located outside the park) in Buliisa with a capacity to handle 204 kb/d of oil, i.e. sufficient for an expected peak production of about 190 kb/day of oil (TotalEnergies, 2023) and 700 kb/d of total liquid. The plan is to use three rigs to drill 426 wells from 31 well pads over about 10 years (CNOOC, 2018). These will be connected by 180 km of underground flow lines and a 95-km, 24-inch buried feeder pipeline to the export hub and refinery to be built in Kabaale in Hoima District. About half of the wells will be used to inject water to pressurise the reservoir and maintain flow. This will include recycled water separated from the produced oil and additional water abstracted from Lake Albert (MEMD, 2023a).

The central processing facility will include an LPG recovery plant that will be able to supply the local market.

TotalEnergies submitted an ESIA report to NEMA in 2018, after which the PAU organised a number of public hearings. Among the issues initially raised at the hearings was a "lack

of an environmental and social management plan". TotalEnergies subsequently updated and resubmitted the ESIA to NEMA, which issued a conditional ESIA certificate in April 2019, valid for ten years (PAU, 2023).[1]

TotalEnergies notes that it is taking "stringent measures" to minimise the project's impact on the Murchison Falls National Park and is contributing to conservation measures such as supporting the development of local economic activities, increasing the number of park rangers by 50%, and restoring the Victoria Nile Delta wetlands and forests on the eastern shore of Lake Albert (TotalEnergies, 2023).

Kingfisher project

The Kingfisher project is operated by China's CNOOC Uganda Limited on behalf of joint venture partners TotalEnergies E&P Uganda B.V. and UNOC. The Kingfisher Development Area covers the Kingfisher field in the Kikuube District, with future plans to tie in the Mputa-Nzizi-Waraga fields in Hoima District.

The development plan includes drilling 31 wells (including 11 for water injection) from 4 well pads. Kingfisher's central processing facility in Buhuka will have a capacity of 40 kb/day of oil, the expected peak level of production. This will be connected to the fields via 19 km of flow lines and to the future refinery and export hub in Kabaale via a 46-km, 12-inch pipeline.

CNOOC submitted an ESIA to NEMA in 2018, after which the PAU conducted two public hearings. Key issues raised were the "need for clear livelihood restoration programmes, local content development, and management and impact on the lake and other protected areas". CNOOC revised and submitted its ESIA report, and NEMA issued an ESIA certificate in March 2020 (PAU, 2023).

Competitive licensing rounds

Section 58 of the Petroleum Act 2013 requires competitive bidding for licences issued after that date. The first licensing round was held between 2015 and 2017 for six blocks with a total acreage of 2 674 km^2 in the Albertine Graben. Out of 19 applicants at the request-for-qualification stage, 16 were invited to submit proposals; 4 made it to the negotiation stage. This resulted in the award of three new exploration licences: one issued to Armour Energy Limited (Australia) for the Kanywataba Contract Area andtwo issued to Oranto Petroleum Limited (Nigeria) for the Ngassa Shallow and Ngassa Deep Plays.

The second competitive licensing round was announced in May 2019 for five blocks in the Albertine Graben. Out of the six potential applicants that were registered and issued request-for-qualification documents, two were considered successful bidders and issued exploration licences:

- IDGR Global Limited (Australia) obtained a licence for the Turaco block in January 2023
- UNOC obtained a licence for the Kasuruban block in January 2023.

[1] The conditional status of the ESIA was related to the expectation that certain parameters of the project could change in the coming years, depending upon early results; the ESIA would then need to be reviewed if those parameters changed.

A third licensing round was announced for 2023, and there are plans to hold additional rounds every four to five years.

First oil

President Museveni officially launched the country's first commercial drilling campaign at Kingfisher on 24 January 2023. The country's first commercial oil is currently scheduled to flow from this project in 2025, and Tilenga is expected to begin producing later in the same year.

The time between the first commercial discovery in 2006 and expected first production in 2025 has been longer than the government originally expected for several reasons. These include the delays to the sanctioning of the export pipeline and the government's desire to ensure a robust legal and institutional framework. Since Uganda's first commercial oil discovery, pledges made by many countries in the context of climate change to reduce reliance on fossil fuels, as well as an increased reluctance by many international banks to finance projects related to fossil fuels, may challenge Uganda's ability to monetise some of its hydrocarbon resources.

According to an evaluation carried out in 2022 using the PAU's Upstream Economic Model, the total cost of developing and producing a barrel of crude oil in Uganda is about USD 17.73, excluding oil pipeline tariffs, which could be expected to add another USD 12.77/bbl (MEMD, PAU and UNOC, 2023).

Investment conditions

According to the Ministry of Energy and Mineral Development, the Model Production Sharing Agreement 2015 includes the following "key provisions":

- royalty payments based on gross production, with rates ranging from 5.5% to 21%
- state participation of not more than 20%
- cost recovery limit set at 65%
- production sharing
- signature bonus, along with research and training fees and annual acreage rental fees paid into the Uganda Petroleum Fund
- a performance guarantee equal to 50% of the minimum exploration expenditure for the first exploration period
- various taxes in accordance with Ugandan laws
- requirements to train and employ suitably qualified Ugandan citizens.

The first Extractive Industries Transparency Initiative (EITI) report for Uganda points out that, although the model PSA is publicly available, including on the PAU's website, the actual PSAs signed by the companies are not publicly available.

It is believed that the PSAs signed with investors in the country's two main projects include clauses shielding the companies from tax increases for 20 years (IEA, 2022). Nevertheless, the World Bank comments that "The numerous revisions to oil-related sections of the Income Tax Act have created a sentiment of a government that wants to squeeze too much from the private participants in the oil sector" (World Bank, 2021).

Since 2015, the government has waived the 18% VAT rate for investments in capital equipment related to petroleum exploration and development.

Local content

According to the PAU, Ugandan companies obtained an average of 28% of the value of contracts for goods and services in the petroleum sector during Uganda's "exploration phase". The government aims to increase this share during the "development phase" of oil production (PAU, 2023).

The government estimates that oil companies will spend USD 15-20 billion during the development phase. It approved a local content policy for the petroleum industry in 2017 to ensure that much of that money is directed to Ugandan companies and citizens.

The Local Content Policy identifies 25 "critical industries" with a high potential for national content and reserves 15 categories of goods and services exclusively for Ugandan suppliers (PAU, 2023). According to the MEMD, Ugandan companies received about 17.5% of the approximately USD 3 billion invested in the sector in 2022 (MEMD, PAU and UNOC, 2023).

The PAU estimates the number of Ugandans employed directly by the oil and gas sector was 3 400 in 2019. According to the MEMD, in November 2022, licensed oil companies were directly employing 506 people, 70% of whom were Ugandans, and their subcontractors were employing another 5 647, 97% of whom were Ugandan (MEMD, PAU and UNOC, 2023). The NDP III notes that the goal is to have 200 000 Ugandans employed in the sector by mid-2025.

According to TotalEnergies, the country's two main production projects, together with EACOP pipeline (see below), are expected to create 20 000 direct and 60 000 indirect local jobs during construction, with some USD 2 billion spent on local contractors. During the operations phase, it expects some 1 200 direct and 3 000 indirect local jobs, with about USD 100 million spent annually on local contractors (TotalEnergies, 2023).

TotalEnergies and other international companies in the sector have helped finance a number of technical training programmes through local universities while also sending a number of Ugandan students for training abroad.

According to the PAU's website, efforts to ensure that more of the invested money in the sector is earned by Ugandans include the following:

- "regulating in-flow of expatriates"
- "supporting national enterprises to acquire contracts"
- "emphasizing capacity building"
- "dissemination of information on the oil and gas industry requirements"
- "putting in place an Enterprise Enhancement Center to raise the standards of business and entrepreneurs"
- "development of a National Suppliers' Database and a National Oil and Gas Talent Register"
- "development of standards for goods and services reserved for Ugandans".

The PAU established the National Oil and Gas Talent Register in February 2019, and by the end of 2022 it had registered 7 695 qualified persons and 117 employers and had facilitated postings for 373 jobs. The PAU established the National Supplier Database in 2017 to help monitor the use of Ugandan goods and services by licensees and their contractors. As of the end of 2022, there reportedly were 1 320 qualified suppliers registered on the platform, of which 1 827 were Ugandan entities. The MEMD notes that it is working with the Ministry of Finance, Planning and Economic Development to create a Local Content Development Fund that will "provide affordable financing to Ugandan companies to participate in the oil and gas sector" (MEMD, PAU and UNOC, 2023).

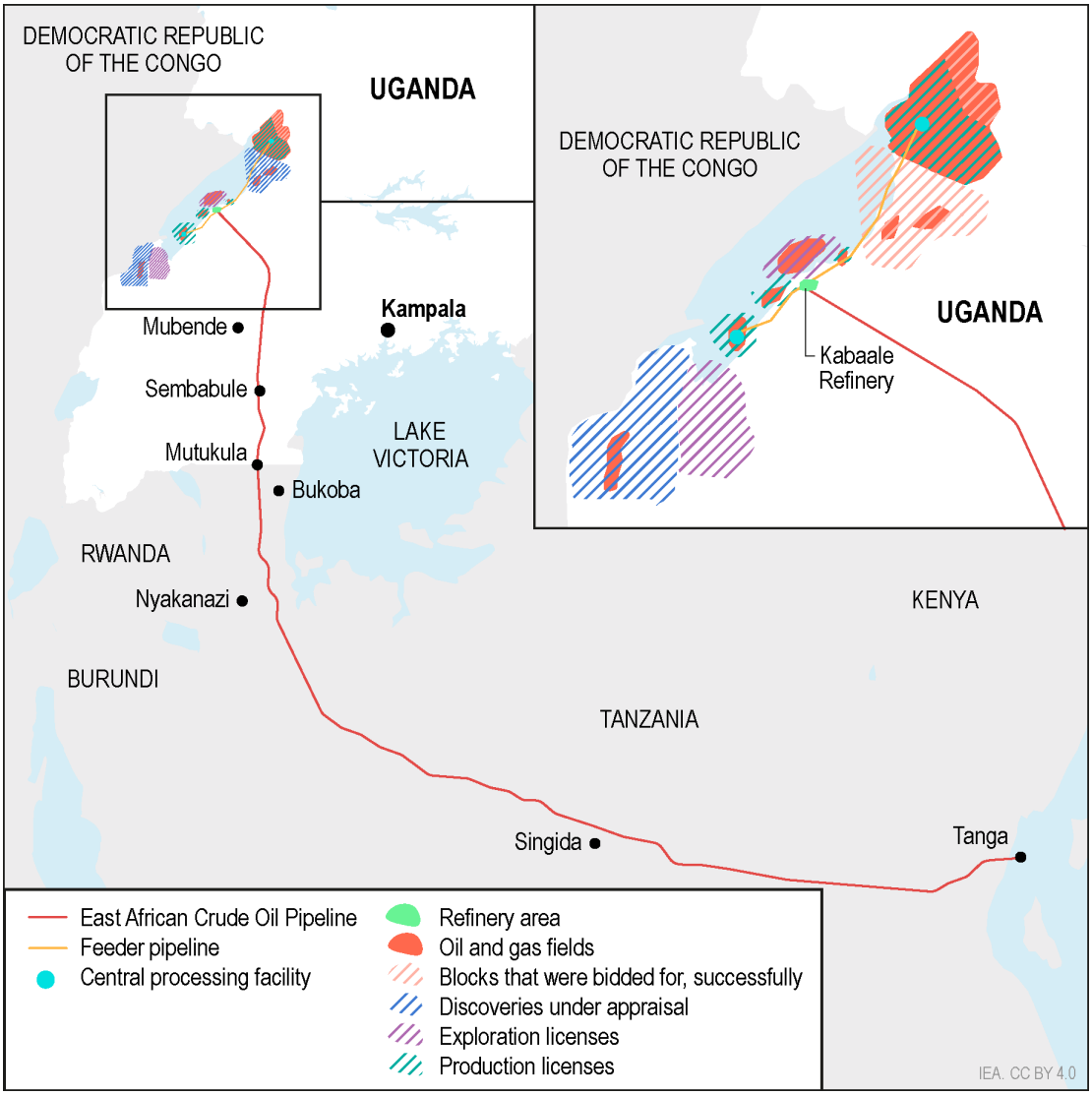
Oil pipeline

TotalEnergies is the lead partner in a consortium to build a pipeline to bring crude oil from landlocked Uganda to Africa's east coast. The original planned route was eastward through Kenya, but later changed to run south-eastward through Tanzania. In the view of some, the project is part of a programme to develop closer economic relations between Uganda and Tanzania (GIZ, 2022). The government believes that the pipeline, by ensuring a route to international markets, will increase international oil companies' confidence and willingness to invest in Uganda's upstream sector.

According to current plans, EACOP will stretch 1 443 km from Kabaale, in Hoima District, to Chongoleani, a peninsula near Tanga, Tanzania, including 296 km in Uganda (Figure 6.1). The 24-inch buried and heated pipeline will include six pumping stations, two of which will be located in Uganda. The design flow rate of the pipeline will enable it to transport 216 kb/d. The project will include a tanker-loading jetty that can accommodate Aframax and Suezmax tankers and a 2 million barrel marine storage terminal (TotalEnergies, 2023).

The pipeline partners carried out detailed routing studies between 2016 and 2018, with a reported emphasis on minimising the displacement of people and protecting natural habitats. The steel pipeline is to be buried 0.8-1 m underground along a right of way 30 m in width. It will be thermally insulated with polyurethane foam, and an electrical heat-tracing element will be in physical contact with the pipeline along its entire length to maintain or raise the oil temperature as needed. EACOP's plans include restoring the landscape above the buried pipeline to allow grazing and farming. Buried electrical and fibre optic lines will follow the same route (Katungi, 2023).

Figure 6.1 East African Crude Oil Pipeline



Uganda and Tanzania signed an intergovernmental agreement on the pipeline between in May 2017 and was followed by a negotiation of host government agreements. A shareholders' agreement and a transportation and tariff agreement were signed at a ceremony in April 2021. TotalEnergies is the largest shareholder in EACOP, with 62%. The CNOOC has 8%, UNOC 15% and Tanzania Petroleum Development Corporation 15%.

TotalEnergies contracted Gulf Interstate Engineering of Houston, Texas, to undertake the front-end engineering and design study, which was completed in 2018, and awarded an engineering, procurement and construction management contract to Worley Parsons (now Worley Limited) (PAU, 2023). The required investment is estimated at USD 4 billion. TotalEnergies announced an investment decision on 1 February 2022 and received a licence for the construction of the portion of the pipeline in Uganda in January 2023 and for the Tanzanian portion in February 2023. Civil works on the Ugandan side are expected to start in 2023 (MEMD, PAU and UNOC, 2023).

EACOP has attracted opposition from several international and East African environmental and civil society organisations, in particular for its routing through sensitive habitats, as well as alleged problems with land acquisition and compensation schemes. On 14 September 2022, a cross-party group in the European Parliament introduced a "Joint motion for a resolution on violations of human rights in Uganda and Tanzania linked to investments in fossil fuel projects" (European Parliament, 2022). This outlined the groups' main criticisms of the oil projects, including alleged harassment of its civil society opponents.

While there have also been protests against Uganda's upstream projects, EACOP seems to have attracted the most attention, as pipelines often have done in other countries. The government feels that international non-governmental organisations are using Uganda's pipeline unfairly as a proxy for worldwide oil development, with insufficient recognition of the work it has put into developing the sector's environmental and social regulatory framework, or of the local energy security and development contexts. In particular, the government points out that its oil production is aimed at helping the country diversify energy supplies and improve energy security by cutting reliance on oil imports via third countries, and that generated revenue is intended to help finance the country's economic and social development.

Refinery

The development of a refinery has long been a goal of the government, both to add value along the petroleum supply chain and reduce reliance on imported oil products. Security of supply is a particular concern since Uganda is landlocked and must rely on imports via Kenya and Tanzania.

The government points to a 2008 East African Community Refinery Strategy, which recommended that a second refinery for the region be developed in Uganda.[2] In 2010, the government hired Foster Wheeler Energy Ltd (United Kingdom) to carry out a feasibility study, which provided recommendations regarding size, configuration, location, markets and financing. This led to plans for a 60 kb/d refinery at Kabaale, in Hoima District, near the main expected production areas of the Albertine Graben.

A contract with the original chosen developer was cancelled in 2014. The government signed an agreement in 2018 with the Albertine Graben Energy Consortium.[3] The Albertine Graben Energy Consortium will be the majority shareholder with 60% of the shares, while the Uganda Refinery Holding Company Ltd, a subsidiary of UNOC, will hold 40% on behalf of the government.

Current plans call for a 60 kb/d refinery with a residual fluid catalytic cracker configuration to produce LPG, diesel, petrol, kerosene, jet fuel and heavy fuel oil.

The project is expected to cost around USD 4 billion and include a 211 km multi-products pipeline from Kabaale to Namwambula in Wakiso. A final investment decision is expected in 2023, and the government aims to have the refinery running in 2027. The government

[2] The only existing refinery in the region, located in Mombassa, Kenya, subsequently closed in 2013, but reopened in 2018 to begin processing Kenyan oil from Kenya's Turkana field.

[3] The consortium includes YAATRA Africa, Nuovo Pignone International, Lion Works Group Ltd and Saipem p.A (Katungi, 2023).

has invited other East African Community member states to take stakes in the venture, which it hopes eventually will be able to serve a regional market.

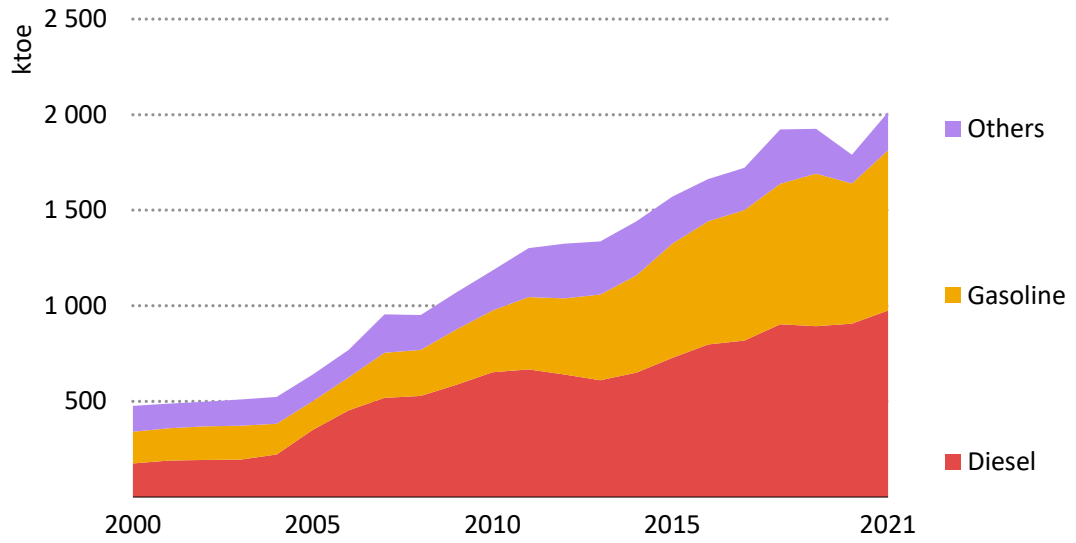
The Albertine Graben Energy Consortium has completed some of the key milestones set out in the Project Framework Agreement, including completion of the front-end engineering and design and ESIA studies. The government has already undertaken a Resettlement Action Plan and acquired 29 km² around the site at Kabaale, in Hoima District, which is also slated to host an international airport, petrochemical industries, and crude and oil product storage terminals.

According to an MoU signed in 2014 between the government of Uganda and the major upstream developers, once the refinery is built, it will have the first call on crude oil produced in Uganda; the rest will be transported through EACOP (MEMD, PAU and UNOC, 2023).

Consumption and oil product market

All oil products sold in Uganda are imported. Domestic sales in 2021 consisted of a little over 18 kb/d each of petrol and diesel, as well as much smaller amounts of jet fuel and kerosene. Kerosene is consumed primarily by households for lighting, while some 80% of petrol and 60% of diesel are consumed by the transport sector. The agricultural sector, which primarily consists of subsistence farming, consumes relatively small amounts of oil products. (For LPG, see next section.)

Figure 6.2 Uganda's oil product imports, 2000-2021

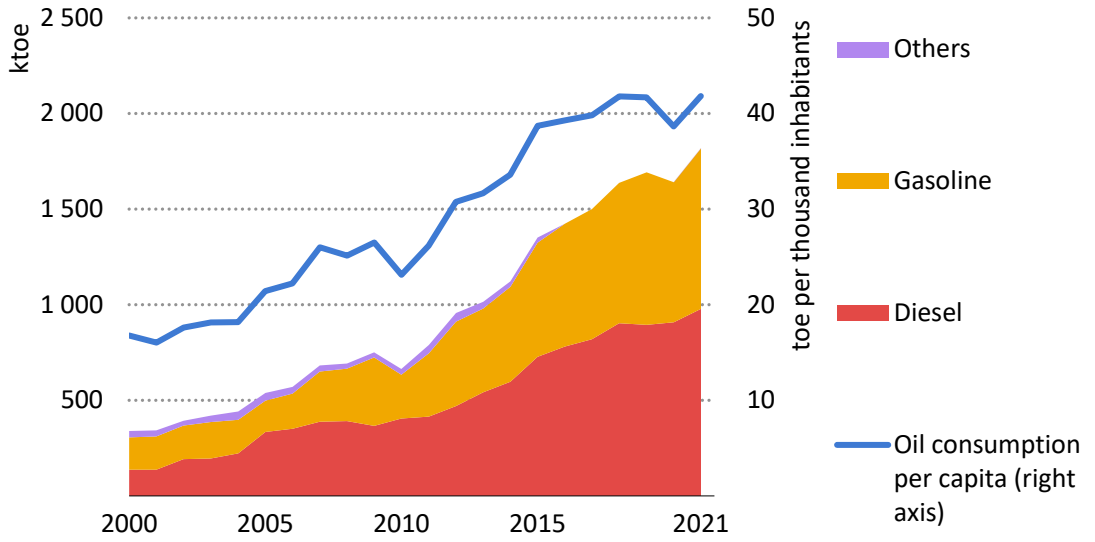


Note: ktoe = kilotonne of oil equivalent.
Source: IEA based on data from MEMD (2021).

The Petroleum Supply Act 2003 is aimed at "ensuring adequate, reliable and affordable supply of quality petroleum products for all sectors of the economy at internationally competitive and fair prices within appropriate health, safety and environmental standards" (questionnaire). The government does not subsidise or regulate fuel prices. Since April 2021, when world crude price rises led to sharp increases at the pump in Uganda, there have been public calls for the government to regulate fuel prices, as is currently the

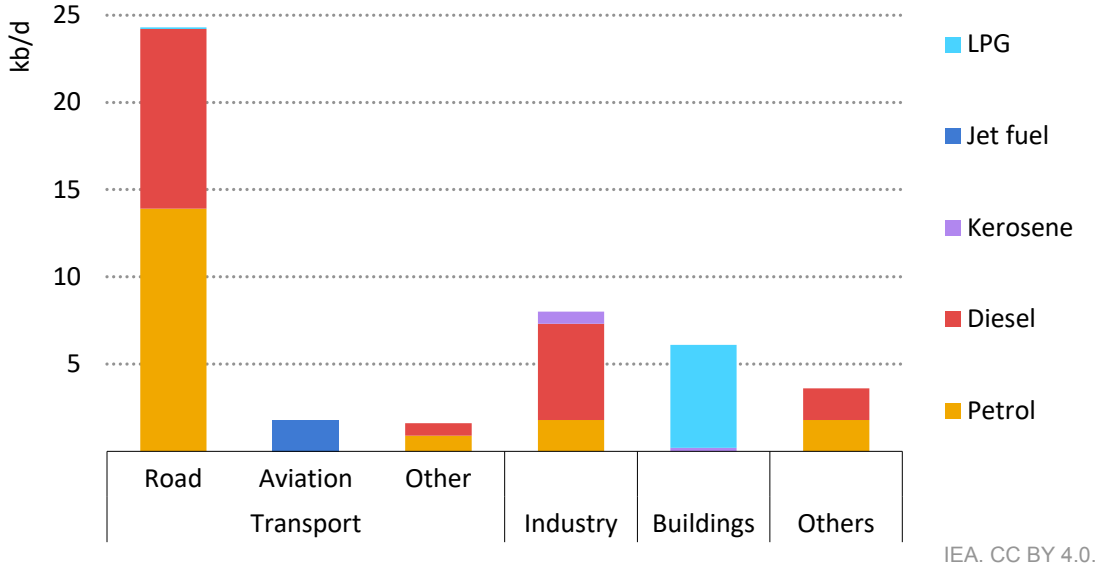
practice in neighbouring Kenya, Rwanda and Tanzania (IEA, 2022). There are around 75 oil product marketing companies active in Uganda, though only around 10 with market shares above 2%. The largest are Vivo Energy Uganda Ltd and TotalEnergies Uganda Ltd, which had market shares of 16.9% and 15.3%, respectively, in 2021; the third-largest oil product company had a market share of only 5.6% (MEMD, 2023b).

Figure 6.3 Oil products consumption in Uganda, 2000-2021



Notes: ktoe = kilotonne of oil equivalent; toe = tonne of oil equivalent.
Source: IEA (2023).

Figure 6.4 Oil products consumption by sector and product in Uganda, 2021



Notes: kb/d = thousand barrels per day; LPG = liquefied petroleum gas.
Source: IEA based on data from MEMD (2021).

The 2018 Biofuels Act calls for blending petroleum products with biofuels. The government has yet to determine the required minimum share of biofuels that petroleum products must contain but has indicated that it will be up to 20% and depend on the availability of locally

produced ethanol. As noted in Chapter 3, the main barrier to introducing biofuel requirements in Uganda is the lack of domestic biofuel production capacity.

Liquefied petroleum gas

Current LPG consumption is about 0.6-1.1 kb/d, representing less than 1% of Uganda's energy consumption. Most of this is consumed by urban households for cooking. Uganda does not produce any LPG, so all LPG must be imported via Kenya or Tanzania.

According to TotalEnergies, the Tilenga project expects to produce around 2.5 kb/d of LPG from its central processing unit. About half of this reportedly will be butane suitable for cooking and half will be propane for industrial uses.[4] The company intends to provide LPG for sale within the country to help reduce the current reliance on wood and charcoal for cooking. (See Chapter 5 for a discussion of the LPG market.) The Kingfisher project plans to produce about 0.5 kb/d of LPG from its central processing unit. Current plans call for the refinery to produce an additional 1.7 kb/d of LPG (MEMD, PAU and UNOC, 2023).

Oil storage

Retail companies are required by law to hold ten days of working stocks of oil products. UNOC also owns and manages 190 kb of government oil product tanks in Jinja, equivalent to a further five days of average national consumption. However, during a fuel shortage in 2022 (due to high international oil prices), the national petroleum product stocks were depleted, highlighting the challenges of inventory volume and usage policies.

The NDP III set a goal to increase national storage for refined petroleum products from 620 kb in 2019 to 940 kb by 2024/25. UNOC is in the process of constructing 2 million barrels of storage in Kampala that will be connected by a product pipeline to the future refinery in Hoima. Once completed, the combined capacity of government storage will be equivalent to more than 50 days' of 2020 consumption.

Gas

There is currently no production or consumption of gas in Uganda, though estimated gas resources include 7.1 bcm of associated gas and 9.5 bcm of non-associated gas (MEMD, 2023a).

Both the Tilenga and Kingfisher projects are expected to produce gas associated with their oil output. Originally, Tilenga planned to use all of its associated gas to generate electricity for the project. Since there are now plans to extend the power grid to the project region, only half of Tilenga's associated gas will now be used for this purpose; the rest will be used to produce LPG (see above). The new emphasis on the use of grid electricity, which in Uganda is generated almost exclusively from renewable energy, is part of the project's strategy to reduce GHG emissions, as well as to help replace the use of unsustainable biomass for cooking with LPG. The Kingfisher project similarly plans to use its associated gas for both electricity generation and LPG production.

[4] LPG use in hot climates generally requires a high butane content, whereas propane is generally used in Europe and North America.

According to the MEMD, there are discussions about building a gas pipeline to Uganda from neighbouring Tanzania, which began producing gas in 2006. To the extent possible, the pipeline would follow the right of way of the EACOP oil pipeline.

The government of Uganda, through the National Planning Authority, carried out a Gas Demand Study in 2018, which recommended the development of such a pipeline to support the iron and steel industry. The gas would be used as a reducing agent in the processing of iron ore, a project included in the NDP III.

The governments of Uganda and Tanzania signed an MoU in 2018 for the development of a natural gas pipeline to Uganda that would also help supply remote areas of Tanzania. They are currently undertaking a feasibility study and developing the necessary bilateral arrangements. The plan developed by the Joint Technical Committee for the project is to commission the pipeline as early as 2027/28.

Revenue management

The National Oil and Gas Policy for Uganda recognises that "if the country's petroleum resources and revenues are not well managed, the subsector has the potential to have the most negative impact on society" (MEMD, 2019). Through its stakeholders, the government has focused on developing a "robust policy, legal, regulatory and institutional framework that addresses the potential negative environmental, social and economic impacts of petroleum exploration and production" (PAU, 2023).

The Oil and Gas Revenue Management Policy was developed in 2012, and the Public Financial Management Act was amended in 2015 with provisions for oil revenues (World Bank, 2021). The Oil and Gas Revenue Management Policy lists measures to monitor oil companies' recoverable costs and promote the transparency of revenue flows. It also emphasises the need for petroleum revenues to be used for developing infrastructure and other productive economic sectors. The Public Financial Management Act provides for revenue sharing (6%) with local governments (Public Financial Management Act 2015, Sections 58-75). All oil-related revenues will go into a Petroleum Fund, which is meant to benefit future generations, while current expenditures from the Fund are limited to infrastructure investments, including such things as roads and power plants.

Uganda became a member country of the EITI in 2020. The country's local EITI committee prepared its first report in May 2022, the validation of which was scheduled to begin in April 2023 (DT Global, 2022). According to the EITI report, total revenues received by the government from the extractives sector during FY 2019/20 were UGX 436 353 million, of which UGX 61 414 million were from the oil industry (about USD 119 million at an exchange rate of 3 677 UGX/USD), while most came from mining. However, payments from petroleum activities are expected to increase exponentially once commercial oil production begins, then continue rising as the companies recoup their investments, allowing more oil to be shared with the government. The government expects to eventually receive around USD 2 billion annually from oil-related revenues (Dahir, 2023). The EITI report makes a number of recommendations, including making the details of licences and signed PSAs easily accessible (DT Global, 2022).

Assessment

Oil accounted for less than 10% of Uganda's total energy supply in 2020 and is currently primarily used in road transport. The country's first two domestic oil development projects, Tilenga and Kingfisher, are expected to begin production in 2025.

As a landlocked country, Uganda faces the energy security challenge of importing via third countries, with about 80% coming through Kenya and the rest via Tanzania. A consortium that includes the main upstream developers is planning to build a crude oil pipeline to the port of Tanga in Tanzania. The government also plans to build a 60 kb/d refinery at Hoima that would supply national and regional markets. While the economic merits of the refinery investment are still being assessed, both projects could contribute to Uganda's energy mix and security.

Oil stocks can also play an important role in energy security. (For reference, all IEA countries are required to keep 90 days of net imports.) Even if a refinery is in place, supply can be interrupted due to maintenance or accidents. However, Uganda currently has neither regulations determining how much oil should be stored in its government tanks nor rules on how to use these reserves.

Output of LPG from the main oil production projects' central processing units is expected to be around 3 kb/d, which is more than current domestic consumption, all of which is currently imported. The producers plan to provide the LPG to the domestic market, and the government envisions additional significant output of LPG from a planned refinery. By maximising LPG production for cooking, oil development could play a role in helping the country transition from the current unsustainable use of biomass.

Some international and local groups have raised environmental and social concerns about oil projects in Uganda, with a particular focus on the EACOP pipeline. This includes a 2022 resolution in the European Parliament calling for Uganda to reconsider the pipeline route. The government has condemned such criticism as ill-informed, countering that laws, regulations and company policies related to health, safety and the environment have been carefully developed over more than a decade to help minimise potential negative impacts from Uganda's oil development and pipeline projects. The government emphasises that it sees oil production as a way to help diversify its energy supplies, improve energy security by cutting reliance on oil imports via third countries, and provide revenue for the country's economic and social development.

All tax and non-tax revenues for the government from oil are received by the Uganda Revenue Authority on behalf of the government and deposited in the Petroleum Fund, which was established by the Public Finance Management Act 2015. The Fund is designed to ensure that the revenues from petroleum resources are well managed and allocated for the benefit of current and future generations of Ugandans, with an emphasis on infrastructure development.

While upstream oil projects can play a significant role in a country's economic and social development, the experience of many resource-rich countries has shown that there are significant potential challenges to overcome to ensure that such benefits materialise. As the National Oil and Gas Policy for Uganda recognises, "if the country's petroleum resources and revenues are not well managed, the subsector has the potential to have the most negative impact on society." The government of Uganda has made efforts to benchmark the experience of other oil-producing countries and is to be commended for

joining the EITI, to which it was admitted in August 2020. EITI participation is important for assuring stakeholders that the government is credibly managing its revenues from petroleum and mining projects.

If the world starts to successfully transition towards net zero emissions by 2050, the demand for fossil fuels will decrease globally. Investments in new projects with long lead times risk not finding returns on their investments, especially if they are export oriented. Governments and companies ultimately will make the decisions on which investments to make.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Ensuring that oil projects, including pipelines, are consistent with the aims of Uganda's planned energy mix and future Energy Transition Plan, in addition to strictly complying with all environmental, social and other regulations and commitments, taking into account the concerns of local communities.
- Continuing to work with the Extractive Industries Transparency Initiative and other partners regarding best practice for oil revenue transparency, management and investment, including the use of its Petroleum Fund, to ensure that oil revenues help Uganda achieve its economic, social and Sustainable Development Goals.
- Developing a policy for maintaining and managing oil stocks to strengthen oil supply security.
- Optimising the integration of oil and gas facilities with other low-carbon energy sources to minimise the oil projects' carbon intensity.

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7. Critical minerals

Key data

There is currently no production of critical minerals but initial exploration has revealed several potential deposits.

Overview

Mining in Uganda began in the early 1900s with a focus on gold. Commercial production of copper started in the 1950s, and by the 1960s, mining accounted for 30% of Uganda's exports. The country's mining industry declined after the Kilembe copper mine ceased operations in the 1980s (MEMD, 2021b).

Deposits of critical minerals were discovered following initial nationwide exploration in the 2000s. While foreign direct investment and mining activities have increased over the past 20 years, mining's contribution to GDP remains minimal (1-2%). The government has developed new mining policies and laws in recent years. Although most mining today is artisanal, and there is not yet any production of critical minerals in Uganda beyond two small pre-feasibility projects for rare earths and graphite, there are growing expectations within the country that mining will be able to create employment and increase government revenues.

Critical minerals have become a fundamental part of the energy landscape. As highlighted in the IEA's *World Energy Outlook 2022*, demand for critical minerals for clean energy technologies could rise fourfold by 2030 because of the expanding demand for and deployment of renewable energy technologies, electric vehicles (EVs), battery storage and expanded electricity networks (Box 7.1) (IEA, 2022b). Both the extraction and processing of critical minerals are now highly concentrated geographically. Unless the current lack of diversity in supply chains is addressed, there is a risk that the supply of critical minerals could become a bottleneck for clean energy development.

The expected growth in demand for critical minerals provides African countries with a major economic opportunity, thanks to vast mineral resources. However, there has been a downward trend in investment for exploration across the continent since the 2010s (IEA, 2022a). If Uganda can become a supplier of critical minerals, it will help the world to advance the global energy transition.

Box 7.1 The role of critical minerals in clean energy transitions

Building solar photovoltaic plants, wind farms and EVs generally requires more minerals than their fossil fuel-based counterparts. A typical electric car requires six times the mineral inputs of a conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired power plant. Since 2010, the average amount of minerals needed for a new unit of power generation capacity has increased by 50% as the share of renewables has risen.

Among the minerals that have been found in Uganda, nickel, cobalt and graphite are crucial to battery performance, longevity and energy density. Rare earth elements are essential for permanent magnets that are vital for wind turbines and EV motors. And electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity-related technologies.

The shift to a clean energy system is set to drive a huge increase in the requirements for these minerals, meaning that the energy sector is emerging as a major force in mineral markets.

Source: IEA (2021).

Institutional governance for critical minerals

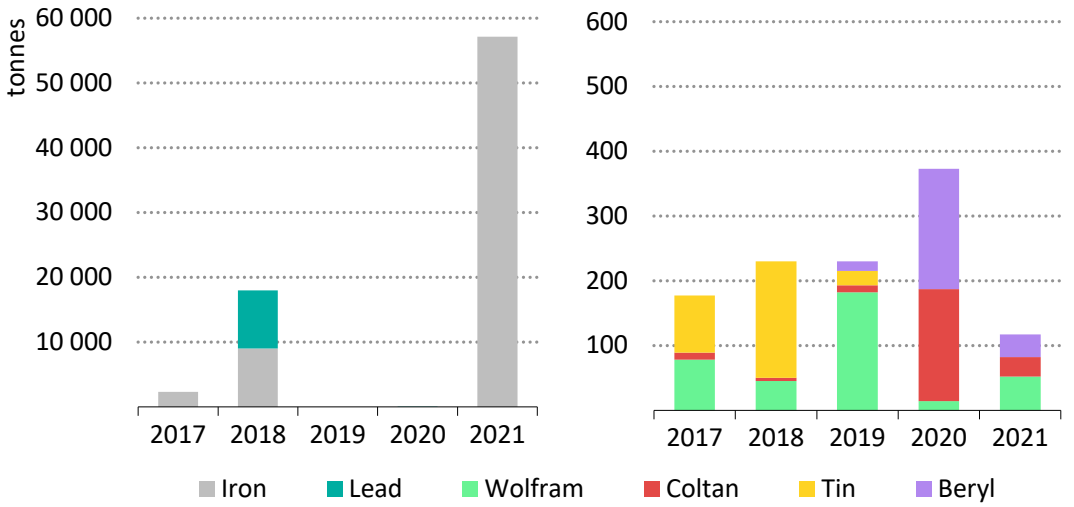
The **MEMD's Directorate of Geological Survey and Mines** has jurisdiction over the mining sector in Uganda. It is mandated to establish, promote, strategically manage and safeguard the rational and sustainable exploitation and utilisation of mineral resources for social and economic development. The Directorate comprises the Mines Department, the Geology Survey Department and the Geothermal Department. The Mines Department oversees the process of granting licences and regulating mining operations. The Geology Survey Department is responsible for establishing mineral potential through geological surveys and providing data to potential investors and the public. The Geothermal Department is in charge of geothermal energy development (for more on geothermal, see Chapter 3).

The Mining and Minerals Act 2022 calls for the establishment of a state-owned mining company – the **Uganda National Mining Company** – which would hold a 15% interest in all medium- and large-scale mines at no cost, with the option of purchasing an additional 20%. The National Mining Company had not yet been established at the time of writing.

Production and prospects

Uganda has discovered deposits of minerals critical for the worldwide transition to cleaner energy systems, including copper, cobalt, graphite and rare earth elements. However, there is currently no production of critical minerals in Uganda. Limestone, pozzolana and vermiculite are the main minerals produced, along with a small amount of gold.

Figure 7.1 Selected mineral production in Uganda, 2017-2021



Source: IEA based on data from MEMD (2023a).

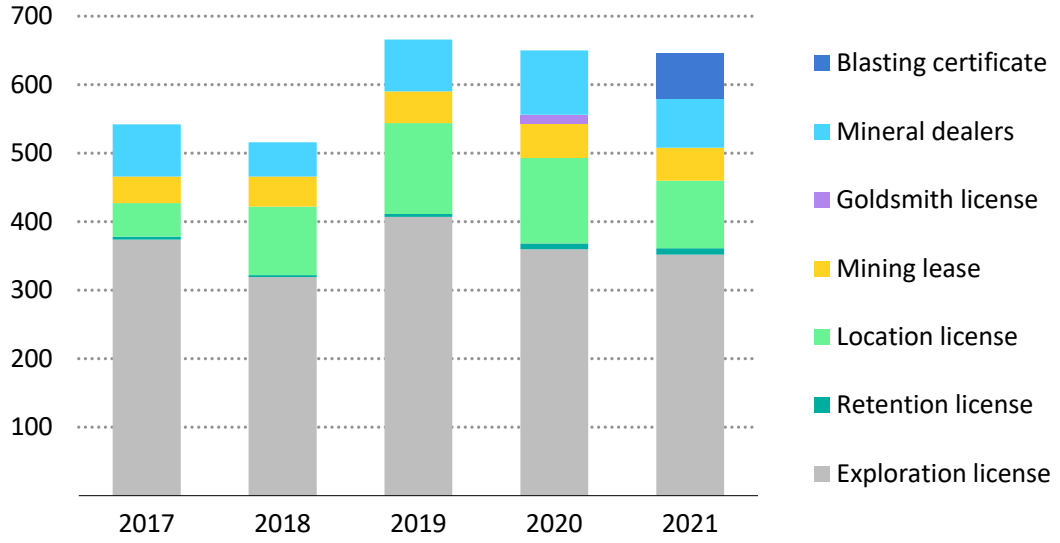
The MEMD conducted airborne geophysical surveys over 80% of the country between 2004 and 2012 under the Sustainable Management of Mineral Resources Project, which was funded by the World Bank, the Nordic Development Bank and the government of Uganda. The remaining part of the country, the Karamoja Region, was surveyed during 2021 and 2022 with support from Spain. These projects confirmed the presence of a number of different minerals, including gold, iron ore, zinc, niobium-tantalum, tin (cassiterite), copper, cobalt, lead, beryllium, wolfram, bismuth, chromium, lithium, titanium, phosphates, uranium, platinum-group minerals, nickel, diamonds and rare earth elements (NPA, 2020). However, most occurrences require further investigation regarding their quality and quantity.

The NDP III, which covers the period 2020/21-2024/25, prioritises the development of rare earth elements, cobalt and copper. According to the NDP III, Kilembe still contains 4.5 Mt of copper with a 1.77% grade and 4.5 Mt of cobalt. Copper occurrences are also reported at Boboong in Kotido District, Kitaka in Bushenyi District and Kampono in Mbarara District. Rare earth elements in Sukulu are estimated at 73.6 Mt with a grade of 0.32% of La2O5. Aluminous clays in Makuutu are enriched in scandium, gallium, yttrium and other rare earth elements.

Figure 7.2 Map of minerals and related infrastructures in Uganda

As of 2021, there were 794 licences related to minerals (Figure 7.3). Most were exploration licences (44%), followed by prospecting licences (19%); only 6% were mining leases.

Figure 7.3 Number of registered mineral licences in Uganda, 2017-2021

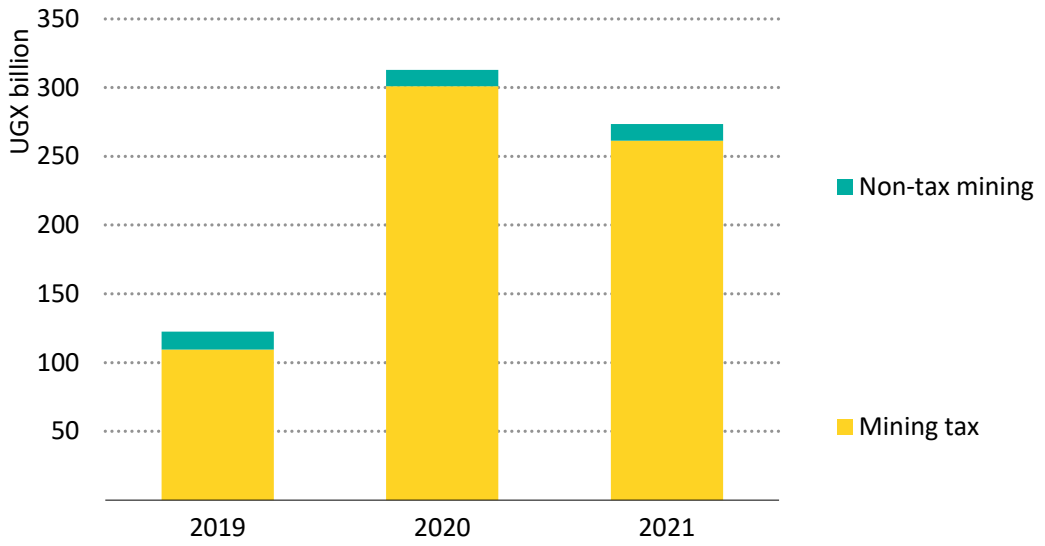


Source: IEA based on data from MEMD (2023a).

National revenue collected from the mining and quarrying industry by the Uganda Revenue Authority was only 1.18% of total government revenue in 2021/22. The Uganda Revenue Authority expected to increase revenue from gold exports by UGX 30 billion in 2021/22 after the Mining Act 2021 imposed a 5% tax on the value of processed gold and a 10% tax on unprocessed gold. However, most of this levy reportedly was not collected due to a lack of clear procedures for customs officials on handling the importation and exportation of precious minerals. As a result, the export tax on gold only brought in UGX 2.25 billion in revenue that year.

Non-tax revenue from minerals collected by the MEMD, such as royalties and licence fees, showed an annual increase of more than 20% between 2016 and 2018 but a two-year decline during 2019 and 2020. Although non-tax revenue recovered slightly in 2021, it was still below the level in 2019. This decline was mainly due to the government's ban on raw mineral exports (MEMD, 2023b). The government expects revenues to rise as more minerals become available for export in some form in the future. The primary source of the non-tax revenue was mineral dealers' royalty payments.

Figure 7.4 Revenue collected from mining tax and non-tax mining in Uganda, 2019-2021



Sources: IEA based on data from MEMD (2023a); URA (2022).

Artisanal and small-scale mining accounts for 80% of Uganda's mining activity (NPA, 2020). Developing large-scale mining will require attracting larger companies that can bring experience, technology and capital. The NDP III highlights the challenge of inadequate infrastructure for mine operations and processing.

Several critical mineral exploration projects involve foreign investors. For example, a UK company acquired 100% of the Orom-Cross Graphite Project in 2020. The project reported 24.5 Mt of resource deposits with a 6% graphite content and is currently undertaking feasibility studies. The foreign company plans to take a final investment decision in 2024, with the goal of beginning production in 2025 (MEMD, 2023a). Another example is an Australian company that is buying into a Ugandan firm that holds rights to the Makuutu Rare Earth Project. This deposit is estimated to contain 532 Mt of 640-ppm (parts per million) rare earth oxide. The foreign company is preparing the mining licence application and expects the final investment decision in 2023.[1]

The Kilembe cobalt/copper mine and related copper smelting plant in Jinja was previously the largest mining operation in Uganda but halted production in 1982 in the wake of a decline in global copper prices. In 2013, the government signed a concession agreement with a Chinese company to rehabilitate the mine but terminated the agreement in 2017 after determining that the company was not complying with the contract. The government is currently looking for new investors for Kilembe.

Policies

Uganda has no policies specific to critical minerals. The Mining and Mineral Policy for Uganda 2018 aims to develop the general mining industry through increased investment,

[1] https://ionicre.com.au/wp-content/uploads/02628205.pdf (accessed on 26 April 2023)

value added, national participation and revenue generation, with the goal of having mining contribute significantly to socio-economic transformation and poverty eradication.

The Mining and Mineral Policy identifies 18 mineral deposits prioritised for exploration and development. Among these, eight have been identified as containing critical minerals (Table 7.1).

Table 7.1 Critical mineral areas prioritised for exploration and development in Uganda

Name of deposit	Potential minerals present
Iganga gabbro intrusion	Nickel, platinum-group elements
Moroto area	Chromite, platinum-group elements, marble, gold
Naigobya geophysical anomaly	Nickel, chromium, copper, cobalt, rare earth elements
Bukusu carbonatite	Limestone, phosphates, iron ore, titanium, vermiculite, rare earth elements
Masindi-Karuma Falls area	Nickel, chromium, platinum-group elements, iron
Kitaka-Buhweju area	Gold, base metals
Kafunzo area	Nickel, platinum-group elements
Makuutu area	Rare earth elements, aluminium, uranium

Source: MEMD (2018).

The government's main economic development policy document, Vision 2040, calls for the mineral industry to become a major driver for employment creation and GDP growth that mainly provides materials for domestic manufacturing, infrastructure development, agriculture, and the information and communication technology sectors (NPA, 2013). It points to the importance of securing added value from mineral resources and returning benefits to local communities. Vision 2040 also highlights the need to strengthen infrastructure, human resources in the science and technology fields, and good governance. Regarding infrastructure, it calls for railway lines to be developed in areas where significant mineral resources have been confirmed and electricity to be supplied to mineral processing plants.

The government uses the five-year NDPs to implement Vision 2040. While noting some progress in the development of iron and fertiliser processing, the NDP III lists several reasons for the limited development of most mineral resources so far, including:

- rudimentary mining methods and informality in the mining sector
- inadequate human and institutional capacity to carry out exploration, quantification and characterisation activities
- inadequate supporting physical and R&D infrastructure

- limited investment in industries that utilise available minerals.

The NDP III sets several new goals, including:

- increasing the volume of copper produced from 0 to 2 000 metric tonnes
- increasing the value of investment in the exploration and processing of selected minerals from USD 0.8 billion to USD 2 billion
- increasing the contribution of processed minerals to total manufactured exports from 5% to 7.1%.

The NDP III determined five prioritised minerals: iron ore, gold, copper, phosphates and development minerals (such as marble and limestone).[2] It also called for more surveys to study the qualities and quantities of the existing occurrences.

The Mining and Minerals Act was amended in 2022 (and previously in 2003), incorporating national policies such as Vision 2040 and international initiatives to prevent illegal natural resource exploitation. It envisions establishing a state-owned company that will hold a 15% interest in medium- and large-scale mines and encourages miners to prioritise local content. The Mining and Mineral Act of 2022 incorporates initiatives adopted by the International Conference on the Great Lakes Region to prevent illegal mining. It allows miners and traders to access the international market through a certification scheme designed to avoid mineral smuggling and illegal exploitation. The Act introduced a bidding process for exploration licences and medium- and large-scale mining licences while ensuring a "first-come, first-serve" principle for applications for exploration licences.

The Mining (Licensing) Regulations were revised in 2019 and are being reviewed again in the context of the 2022 amendments to the Mining and Minerals Act. Among other things, the current regulations allow miners to apply for mining licences online. The online Mining Cadastre and Registry System is a self-service licensing system used to apply for, follow the review process of and manage granted licences.

One of the most significant challenges for potential investors wishing to develop critical minerals for the world market is the current export restriction on raw materials. The Ugandan government banned the export of unprocessed minerals in 2015 to encourage local value added before export. Box 7.2 provides a discussion of whether export bans contribute to downstream industries. The government aims to make Uganda a regional processing hub, though the details are still under consideration, including which minerals to target.

[2] According to the Development Minerals Programme of the European Union; UNDP; and the African, Carribbean and Pacific Group of States, development minerals "are minerals and materials that are mined, processed, manufactured and used domestically in industries such as construction, manufacturing, infrastructure and agriculture. Development minerals have a high degree of economic linkage and utilization close to the location where the commodity is mined…" (www.developmentminerals.org).

Box 7.2 Do export bans contribute to downstream industries?

Gabon introduced an export tax on manganese in 1999, South Africa introduced an export licensing scheme for lead in 2008, and Zambia and Zimbabwe imposed export tariffs and bans on copper and chromite, respectively. A study examined the effectiveness of eight export restrictions in these four African countries using revealed comparative advantage indicators. The researchers found that the comparative advantage of ores and concentrates had declined due to the three types of export restrictions but that the advantage of these processed products was not brought about by those policies. The study found that the other five policies did not bring benefits to the country. In conclusion, the investigated export control policies did not promote downstream value added and, in some cases, had a negative impact on the industry.

Source: Fliess, Idsardi and Rossouw, (2017).

Assessment

After decades of stagnation in mining activity in Uganda, renewed initial exploration began in 2000 and has now covered the whole country. New policies and legislation have also been introduced. However, there is still limited investment in large-scale mineral production. The government understands that it needs to take the lead in continued exploration to provide potential investors with the information they require to invest in further exploration and development and is already seeking funds for this purpose.

Besides normal exploration risk, possible uncertainties for investors in Uganda's mineral sector include the planned revision of licensing regulations and the role of the new state-owned mining company. The current policy banning the export of unprocessed minerals is another factor that could hinder the development of the industry.

The European Union is considering enhancing bilateral and regional economic co-operation through economic partnership agreements and a strategic partnership on critical raw materials with Uganda. A recently renewed EU-Great Lakes strategy calls for the European Union to work with the International Conference on the Great Lakes Region to help develop sustainable value chains for minerals. This includes conflict minerals such as tin, tantalum, tungsten (3T) and gold, as well as critical raw materials, such as cobalt and lithium, which are important for developing sustainable local value chains and for the global energy transition (European Council, 2023). The European Union may add other minerals, including cobalt and lithium, to its conflict minerals list, strengthening procurement due diligence. Uganda's 2022 legislation to address illegal mining is an important step for addressing supply chain due diligence. Still, it will be necessary to keep updating this law, taking into consideration the OECD Due Diligence Guidance for Responsible Mineral Supply Chains for Conflict-Affected and High-Risk Areas (OECD, 2016).

Maintaining an efficient transport infrastructure is essential for connecting Uganda with international markets, especially since the country is landlocked. A stable power supply is also important, since the mining industry is highly energy-intensive. The production of critical minerals generally requires significantly more energy than that of metals such as

iron since the ore for critical minerals is usually less concentrated and hence requires more processing. This also means that the production of critical minerals typically emits more GHGs (IEA, 2021).

Many mining companies aim to reduce Scope-1 and Scope-2 CO_2 emissions, an indication that investors and mineral users are seeking minerals that have a low-carbon footprint. Most CO_2 emissions from mineral production come from electricity consumption and fuel use. For refined copper production, using renewable energy instead of fossil fuels can reduce carbon intensity by two-thirds. Using electricity instead of fossil fuels can reduce carbon intensity by 80% from the more typical production methods, though this depends on the source of electricity (IEA, 2021). Uganda's abundant hydropower and renewable energy could help make the country a relatively low-carbon source of critical minerals, giving it a market edge over other suppliers.

The mining sector may be able to learn lessons from the investment experience of the country's petroleum sector, where two upstream oil projects have already reached the final investment decision stage. This includes the development of sector legislation, local capacity building, and the creation and management of a national resource company.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Taking the lead in exploring and identifying promising areas to attract investment in mineral production, in particular by financing the further exploration of several of the 18 mineral deposits already identified, prioritising the critical minerals necessary for the worldwide transition to renewable energies.
- Developing a road map for infrastructure development, such as rail extensions, so that investors can better plan the development of resources in anticipation of demand.
- Continuing to explore the potential for moving up the mining value chain through the development of processing capabilities and related activities.
- Assessing the energy needs of mining operations through enhanced data collection and exploring opportunities for low-carbon power supply for mineral processing.

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8. Energy efficiency

Key data (2021)

Total final consumption (TFC): 17 Mtoe, 665 PJ (bioenergy 87%, oil products 11%, electricity 2%), +22% since 2015

Consumption by sector: residential 61%, industry 22%, commercial and public services 9%, transport 7%, agriculture and forestry 1%

Energy consumption (TFC) per capita: 0.37 toe/capita (IEA average: 2.9), -0.5% since 2015

Energy intensity (TFC/GDP): 155 toe/USD million PPP (IEA average: 75 toe/USD million PPP), -4% since 2015

Overview

Even relative to its East African neighbours, Uganda has a high level of energy intensity. This is partly driven by heavy reliance on biomass for cooking in the residential/buildings sector, which accounts for the lion's share of energy consumption in the country. Affordability issues, combined with low levels of access to clean energy, present important challenges for policy makers. The removal of subsidies for electricity in 2012, for example, has had little impact to push households to invest in energy efficiency since most homes are not connected to the grid and/or cannot afford more efficient technologies. Similarly, a lack of access to capital in businesses and industries hinders investments in energy efficiency in response to higher electricity tariffs.

Uganda's population and economy are expected to grow significantly over the coming decades, increasing energy consumption. Available data suggest there is significant potential for increasing energy efficiency. The government is working to finalise the legal, regulatory and enforcement framework for efficiency, while voluntary standards are already in place for several technologies.

Uganda is at a relatively early stage of developing policies and programmes related to energy efficiency. The government has an opportunity to put in place a cross-cutting and comprehensive framework of regulations, information measures and incentives aligned with global best practices and supported by the deployment of digital tools across sectors and technologies.

Dedicated financial instruments can play a significant role in making energy efficiency more affordable, while effective monitoring and enforcement will be an important counterpart to preserve public budgets and ensure the optimal impact of policies. Several non-state actors are actively collaborating with the government on a variety of energy efficiency programmes.

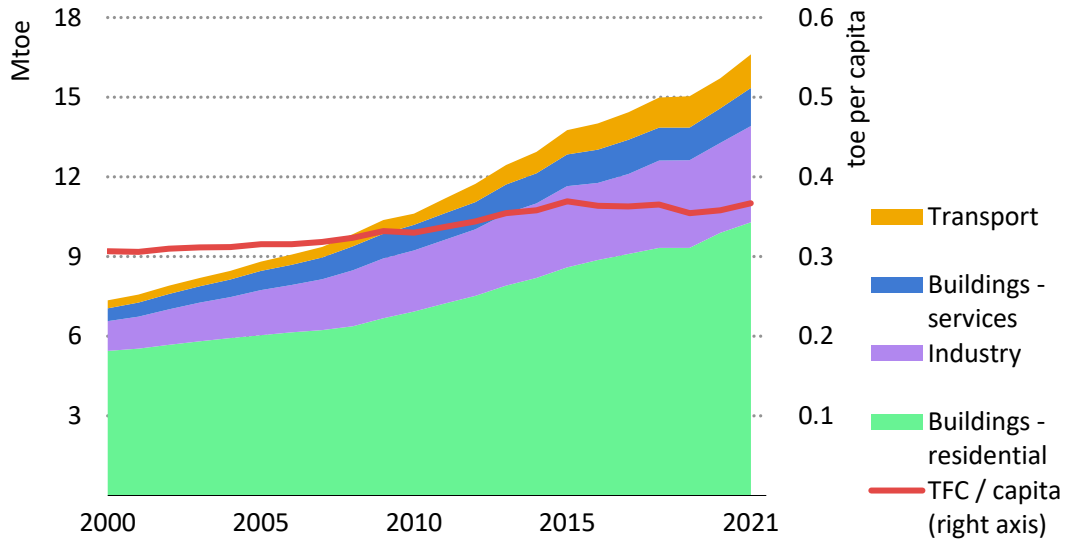
Energy end use data in Uganda are limited, and improving data collection stands out as an important consideration for policy makers.

Energy consumption

While data on energy efficiency and end use consumption in Uganda are limited, available indicators, such as energy intensity, suggest a significant potential for improving energy efficiency. According to the 2017 *Energy Efficiency Roadmap for Uganda*, the technical potential for energy efficiency gains in electricity consumption across all sectors is estimated to be over 2 200 GWh from projected power consumption in 2030, or just over 340 MW of expected peak demand (i.e. significantly greater than the output of the Bujagali power station). Some 90% of these savings reportedly would be cost-effective at a 7% discount rate (Power Africa, 2017).

Economic and population growth are key drivers for energy consumption. Annual GDP growth of nearly 10% is expected in Uganda in the coming decade, and the current population of approximately 45 million could more than double by 2060 (World Bank, 2021). Uganda is in the global top 15 for population growth, and demographic trends reflect regional trends in the Horn of Africa, where the population grew by 75% between 2000 and 2020.

Figure 8.1 Final energy consumption in Uganda, 2000-2021



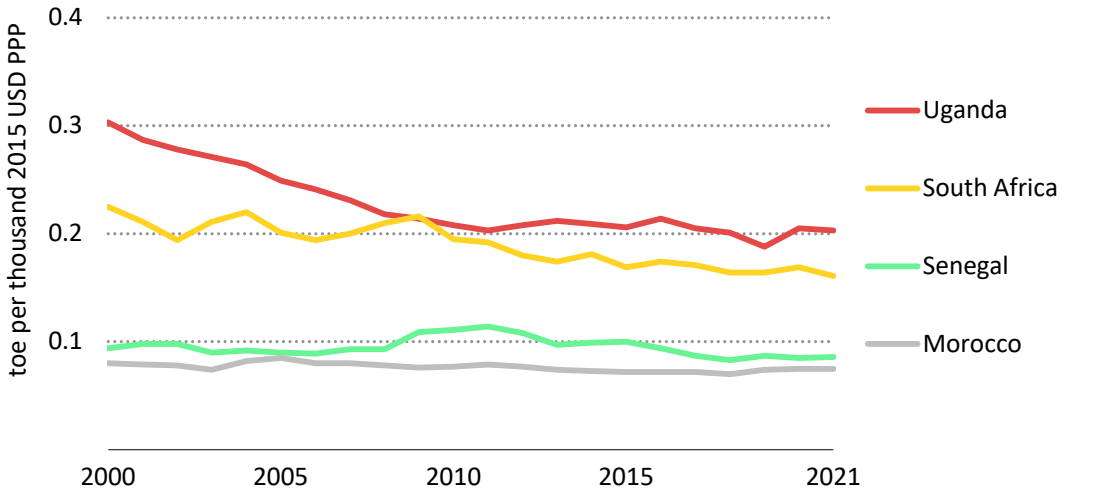
Notes: Mtoe = million tonnes of oil equivalent; toe = tonne of oil equivalent; TFC = total final consumption.
Source: IEA (2023).

Energy intensity

Uganda's primary energy intensity has declined by nearly 35% over the past two decades, from 0.30 toe per thousand USD (2015 USD PPP) in 2000 to 0.20 toe per thousand USD in 2019 (Figure 8.2). Despite this improvement, Uganda continues to be characterised by a relatively high energy intensity, partly due to the heavy reliance on biomass, notably for cooking, including in most rural and urban homes; hotels; restaurants; and institutional kitchens such as schools, hospitals and prisons. Uganda had the 11th-highest energy

intensity out of 195 countries in 2019, with levels more than twice the world average of 4.7 MJ/USD 2017 PPP GDP. It also had the second-highest energy intensity among the seven countries of the East African Community.

Figure 8.2 Energy intensity in Uganda and selected countries, 2000-2021



Notes: toe = tonne of oil equivalent. Energy intensity is calculated as total energy.
Source: IEA (2023).

Supply per unit of GDP end use sector consumption

While total final energy consumption in the buildings sector increased by over 45% between 1990 and 2020, the sector's share of TFC compared with other end use sectors decreased from nearly 90% to less than 70% over the same period. This is due to a notable increase in industry sector TFC and, by comparison, a smaller yet significant increase in transport sector TFC. In 2020, industry sector TFC was over 20% of the total, compared to less than 10% in 1990. Transport sector TFC increased nearly sixfold over the same period.

Policies and measures

The first policy efforts on demand-side energy efficiency in Uganda began in the period following the energy crisis of 2009-12, which saw significant power outages in the country. Subsidies for electricity were removed in 2012 as part of wider efforts to promote a more rational use of energy and to stabilise the power system. In parallel, policy makers began drafting strategies and bills; piloting measures such as standards and labelling regimes; implementing age restrictions on imported vehicles to reduce transport sector emissions and energy use; and working with market actors and donor partners to promote energy efficiency initiatives, such as lighting and energy audits in industry.

Despite these efforts, progress to date on energy efficiency in Uganda has been complicated by several important challenges and barriers, including a lack of access to electricity and clean cooking solutions. Uganda's population and most businesses rely on biomass (wood fuel and charcoal) for cooking, with limited or no use of grid-connected lighting, refrigerators, televisions or other devices, particularly in rural areas. This situation limits the impact of subsidy removal, a widely used and recommended policy pillar for

promoting energy efficiency. Meanwhile, policy development and implementation have been complicated by the lack of a regulatory framework and enforcement regime, as well as gaps in data on end use sectors and other energy efficiency indicators.

Due to these and other challenges addressed in this chapter, Uganda is at an early stage of developing a policy framework and enabling environment for energy efficiency. Given its growing population, high energy intensity and ambitions for increasing access to, and demand for, grid-based electricity, the government continues to explore how energy efficiency can support Uganda's wider energy and economic development objectives while aligning with the country's commitments under the Paris Agreement. In 2023, the government is expected to put in place Uganda's first legal framework for energy efficiency, with important new powers for ministries and implementing bodies to develop and deploy measures. In this context, Uganda has a unique opportunity to lay the foundations for an energy efficiency framework that is aligned with global best practices as defined in the IEA's Policy Packages Toolkit for Energy Efficiency, which provides ten strategic principles as well as sector-specific policy packages (IEA, 2022a). Clear targets and strategies, along with regulations, information and incentives, are core elements in all policy packages and across all sectors. In parallel, early deployment of digital technologies across end use sectors can "future-proof" technologies and systems, particularly as Uganda's electricity grid expands and access to electricity increases.

Institutional framework

The MEMD is the main policy-making body for energy efficiency. Its **Energy Efficiency and Conservation Department**, created in 2015, is responsible for developing energy efficiency strategies and programmes. The department has a staff of ten officials.

The **Uganda National Bureau of Standards(UNBS)** is responsible for developing energy-related standards, including MEPS.

The **Department for Works and Transport** has responsibility for standards in new construction and works with the **National Building Review Board (NBRB)** to develop building standards.

Several non-state actors are involved in energy efficiency policy dialogue, training and programmes. These include the **Energy Efficiency Association of Uganda**, a membership group for energy efficiency professionals that offers certification for energy auditors and managers. The **Private Sector Foundation of Uganda** has helped raise awareness about energy efficiency and promotes energy audits among its industry members. The **Uganda Manufacturing Association** similarly has helped raise awareness and has organised training for energy managers. The **Centre for Research in Energy and Energy Conservation (CREEC) at Makerere University** conducts research on energy efficiency. CREEC also organised training programmes for energy managers under the third phase of the World Bank-led Energy for Rural Transformation programme, while academic institutions, including **Makerere University and Kyambogo University, among others,** conduct energy management courses.

Development partners that have been particularly involved in energy efficiency activities in Uganda include Germany (GIZ and KfW), France (French Development Agency), the World Bank, the European Union, Sweden (Sida) and Norway.

Policies

In April 2023, the government adopted a new National Energy Policy, which replaced the previous policy from 2002. The new policy sets a target to cut Uganda's energy intensity by more than half, from 9.97 MJ per 2017 USD GDP to 3.70 MJ per 2017 by 2040. In addition to this target, the policy includes objectives to "enhance utilisation of energy-efficient practices and technologies" and "promote adoption of energy efficiency and conservation practices", framing energy efficiency within wider objectives of "ending energy poverty and securing access to affordable, reliable, sustainable, and modern energy" (MEMD, 2023).

The new National Energy Policy commits the government to putting in place a cross-cutting and enabling framework to promote energy efficiency in all sectors. It notes that it will do this through standards and regulations, awareness raising and capacity building, research, targeted incentives for clean cooking, energy audits and certification schemes, and the promotion of efficient cooling, among others. In the transport sector, for example, it calls for the provision of a legal framework for electric mobility, standards development and enforcement, the introduction of fuel economy labels, and the facilitation of charging networks and other clean transport infrastructures. For agriculture, it cites the promotion of energy-efficient technologies and related financial incentives. The policy does not contain details on the kind of incentives to be deployed.

While there is no dedicated budget line solely for energy efficiency in the policy, it estimates the financing needs for promoting efficiency and conserving energy supply and utilisation at nearly USD 36 million. Financing needs for on-grid access and clean cooking are estimated at nearly USD 2.5 billion and just over USD 2 million, respectively (MEMD, 2023).

The policy also outlines data collection efforts across all sectors. This includes annual surveys on energy consumption per floor area in commercial buildings, the number of registered energy efficiency professionals and energy services companies (ESCOs), total energy consumption and cooking energy consumption in households and institutions, and energy consumption per unit of production by industry category, along with annual transport and agriculture energy consumption surveys.

The adoption of the National Energy Policy paves the way for the adoption of the draft Energy Efficiency and Conservation Bill, which would create the first legal framework for energy efficiency policy making, regulation and enforcement in Uganda. First tabled in 2014, the draft bill contains new powers and responsibilities for the MEMD, including:

- approving the National Energy Efficiency and Conservation Strategy and Plan, which is due to be finalised following the adoption of the draft Energy Efficiency and Conservation Bill
- regulating the manufacture and import of appliances and energy-using equipment, and licensing importers of certain energy efficiency technologies
- issuing regulations on energy performance, e.g. MEPS
- prescribing qualification requirements for energy auditors and managers
- designating energy consumers subject to mandatory energy audits and employment of energy management systems

- recommending fiscal incentives and other measures to the Minister of Finance and developing innovative financing mechanisms.

The draft bill also requires the MEMD to appoint a commissioner for energy efficiency. The official holding this new role will be responsible for overseeing the implementation of a work plan containing measures such as regular reporting on expected mandatory energy audits by designated energy consumers. Co-operation with the UNBS is also part of the new commissioner's brief, as is providing recommendations to the minister based on the collection, monitoring and analysis of energy consumption data across sectors. The draft bill would further empower key agencies such as the UNBS to enforce efficiency standards and laws and the Department for Works and Transport to enforce efficiency standards for commercial building development.

The draft bill contains few specific provisions for the buildings sector. However, efforts are underway to develop building codes and standards for new construction and major retrofits in collaboration with the UNBS, and to deploy and enforce these codes and standards through implementing measures once the legal framework for energy efficiency is in place.

For industry, the draft Energy Efficiency and Conservation Bill mandates energy audits for industries and commercial facilities consuming above certain energy thresholds. Such thresholds are still being discussed as part of the finalisation of the draft bill. This measure would enhance existing voluntary efforts in this area.

The draft bill also requires the MEMD to develop annual strategies and plans on energy efficiency, import bans on inefficient appliances, and to update and expand MEPS to cover additional product categories, accompanied by product registries and testing regimes. The last item would build on existing voluntary MEPS for lighting, refrigeration, electric motors and air conditioners. The text also includes provisions for financing mechanisms and measures to improve capacity and awareness across sectors.

In transport, the draft bill does not propose fuel economy standards, such as Euro 4 or 5. However, fuel economy targets are in place to achieve average passenger vehicle efficiency of 7.2 litres per 100 km by 2025 and 4.1 litres per 100 km by 2030, compared with current averages of 13.9 litres per 100 km for all vehicle types.

The government is either still elaborating specific targets and incentives for most sectors or will define them once the draft Energy Efficiency and Conservation Bill has been adopted. As a result, important elements of Uganda's energy efficiency framework are still to be confirmed (Table 8.1).

Table 8.1 Overview of select targets, regulations, information measures and incentives in Uganda's emerging energy efficiency framework

Sector	Targets	Regulations	Information measures	Incentives
Cross-cutting	Reduce energy intensity by over 50% by 2040	National Energy Policy Energy Efficiency and Conservation Bill (draft)	Annual Energy Week Annual surveys on energy services companies	Multiple (tbc)
Buildings	tbc	New building codes (tbc)	Annual surveys on commercial building floor area	tbc

Sector	Targets	Regulations	Information measures	Incentives
Appliances and lighting	tbc	New mandatory MEPS (tbc)	Labelling regimes (tbc)	tbc
Industry	tbc	Mandatory audits for large consumers (tbc)	Training programmes for auditors	tbc
Transport	Triple average vehicle fuel efficiency by 2030	Bans on imports of older vehicles (15 years, moving to 8 years in the future; tbc)	Fuel economy labels (tbc) Annual consumption surveys	tbc
Agriculture	tbc	tbc	Awareness campaigns (tbc) Annual consumption surveys	Technology-specific incentives (tbc)

Note: tbc = to be confirmed.

The draft Energy Efficiency and Conservation Bill is being developed in tandem with the Energy Transition Plan and the Integrated Energy and Resources Master Plan, as well as Uganda's decarbonisation commitments under the Paris Agreement. Uganda's NDP III contains an objective to "Promote utilization of energy efficiency practices and technologies", with specific goals to:

- promote the uptake of alternative and efficient cooking technologies (electric cooking, domestic and institutional biogas and LPG)
- promote the use of energy-efficient equipment for both industrial and residential consumers
- introduce minimum performance standards for selected electrical appliances (NPA, 2020).

The concurrent development in 2023 of the Energy Transition Plan and the Integrated Energy and Resources Master Plan presents an opportunity to ensure that measures contained in the draft Energy Efficiency and Conservation Bill align with Uganda's wider energy sector objectives and programmes. These include growth in generation capacity and electricity access, utility sector reform, and deployment of off-grid energy supply and end use technologies, all of which can be enabled by energy efficiency and/or have important implications for energy consumption and intensity.

Barriers and challenges

An important barrier to energy efficiency in Uganda has been the lack of a legal framework to support it. Delays in adopting the National Energy Policy and the Energy Efficiency and Conservation Bill and competing priorities such as the expansion of energy access have had a knock-on impact on the development of energy efficiency laws and their enforcement. For example, the MEMD's attempts to deploy a MEPS labelling regime for appliances have been unsuccessful due to the lack of a legal framework for energy efficiency.

In addition, due to low income levels, many consumers in Uganda cannot afford to connect to existing grids and pay for electricity, limiting the role of energy efficiency measures in improving the performance of grid-connected devices. Similarly, most Ugandans cannot

afford higher upfront costs for more energy-efficient technologies without subsidies or other financial support. As noted above, in contrast to the situation in IEA countries, these access and affordability challenges make it difficult for higher tariffs to stimulate energy efficiency.

Lack of data and insufficient administrative resources to collect them are further important barriers. While a code of practice on official statistics exists, and the MEMD and the UNBS have some data on industry and household energy use, there is a general lack of disaggregated data for energy use across sectors. Data collection is vital for monitoring the effectiveness of new standards, subsidies and other measures targeted to end use sectors, such as buildings, appliances, lighting, industry, transport and agriculture. Insufficient and/or poor quality data and indicators complicate analyses of trends in energy use. This can negatively affect baseline and target setting and monitoring to track the impact of policies.

There is also a significant need to raise awareness and build capacity, not only for the general population, but for policy makers and other technical actors. An uncertain investment environment and lack of access to capital for potential energy efficiency service providers create additional challenges.

The Energy Efficiency Roadmap for Uganda notes that the main barriers to energy efficiency in Uganda are "a lack of access to affordable capital and financing, a lack of confidence about energy efficiency investments, a lack of enabling policies, a lack of enforcement of regulations, and a lack of technical expertise" (Power Africa, 2017). The road map's priority recommendations are to:

- enact the Energy Efficiency and Conservation Bill (needed as a basis for enforcing standards)
- include energy efficiency in integrated resource planning so that it can be considered as an equal alternative to investments in additional generating capacity
- develop regulations for energy audits and management for large users
- enforce the existing standards and labelling programme (Power Africa, 2017).

Programmes

While challenges for energy efficiency remain significant, and the policy framework to promote it is still under development, notable energy efficiency programmes have already been, or are being, deployed in Uganda. Many of these efforts have been informed at least in part by the 2007 Energy Efficiency Roadmap for Uganda, developed in collaboration with USAID, and include the participation of an active ecosystem of non-state actors. Several of these programmes are detailed in the end sector trends section, as well as in the following examples.

Different government and non-government bodies, such as the Private Sector Foundation and the Uganda Manufacturing Association, have carried out awareness-raising campaigns. The annual Energy Week has also served as an important awareness-raising event, offering companies involved in energy efficiency the opportunity to demonstrate their products.

Uganda is also a member of the East African Centre of Excellence for Renewable Energy and Energy Efficiency (EACREEE), along with Burundi, Kenya, Rwanda and South Sudan.

Policy makers in the MEMD are engaged with their counterparts in other EACREEE member countries to align on standards for energy-using technologies, among other activities.

There is notable start-up market activity within the energy efficiency sector, particularly in the area of electric mobility. Many sector stakeholders are eagerly awaiting the adoption of a legal framework to improve the business environment for energy efficiency and point to significant potential for energy efficiency service providers to contribute to Uganda's economic growth.

LED street lighting is being installed in urban settings, and there is a new donor-supported pilot programme to develop a market for ESCOs, as discussed further in the industry and services section.

Box 8.1 Seizing the opportunity of digitalisation through energy efficiency

As Uganda's power grids expand and more Ugandans gain access to electricity, more and more buildings, appliances and electric vehicle chargers, among many other energy-using devices and systems, will be connected to the power grid. With its emerging framework for energy efficiency, the government has a unique opportunity to ensure that these devices and systems are energy efficient. Efficiency will promote a more rational use of energy. It will also make electricity more affordable for Ugandans.

Uganda's emerging framework for energy efficiency also presents a unique opportunity to mandate the deployment of digital technologies across end use sectors, systems and devices. This can ensure that power grids are able to manage two-way power flows from distributed and intermittent renewable energy systems or that they can "communicate" with energy-using devices to reduce power demand at peak times. Energy efficiency policies and measures, notably regulatory mandates supported by financial incentives, can act as key enablers, ensuring such technologies are integrated from the beginning and avoiding costly retrofitting later.

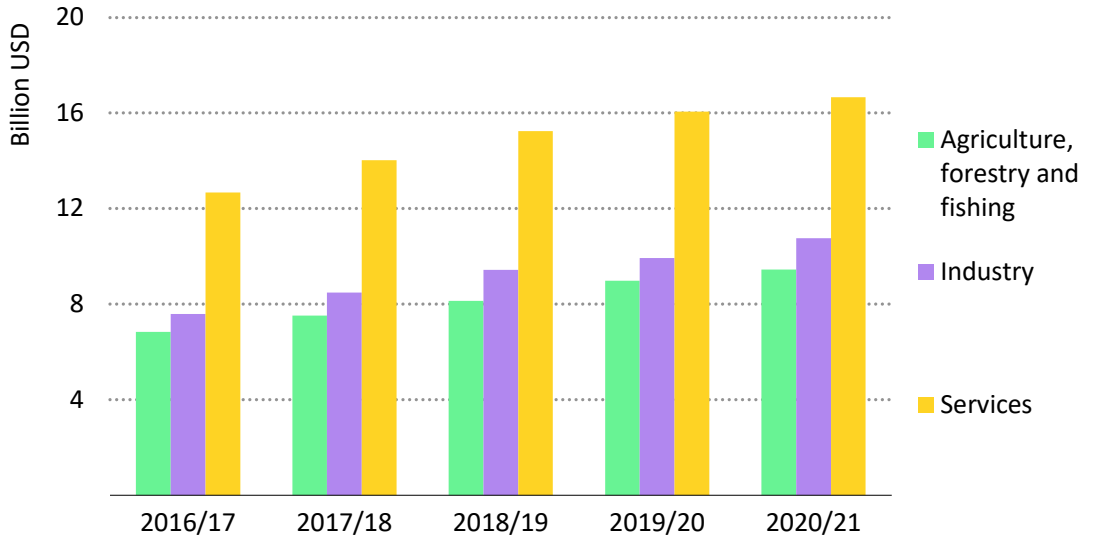
For example:

- In the buildings sector, codes for new buildings and major retrofits could include bidirectional meters and inverters to facilitate rooftop solar photovoltaic integration, smart meters, smart lighting systems, building management systems (in commercial facilities) and networking devices, as well as battery storage and electric vehicle charging capability.
- Minimum energy performance standards for energy-using devices and appliances such as air conditioners and refrigerators could include requirements for "smart" capabilities, notably Wi-Fi and networking technologies to enable remote control, automation and scheduling, consumption reporting, and integration with other devices.
- In industry, a variety of digital tools exist to optimise efficiencies, improve processes and enable grid interaction. These include energy management systems, advanced metering and control systems. In addition to requiring regular audits, policy makers could mandate the deployment – or at least the consideration – of these and other devices during the construction or major retrofit of industrial facilities.

Sector trends

The services sector is the highest contributor to GDP in Uganda, accounting for 42% of GDP in 2019/20 (Figure 8.3). Industry (primarily manufacturing) contributed 27% to Uganda's GDP in 2019/20, agriculture (including forestry and fishing) contributed 24%. Annual growth in GDP reflects demographic and economic trends.

Figure 8.3 Sector contribution to Uganda's gross domestic product, 2016/17-2020/21



Source: IEA based on data from UNBS (2020).

Buildings

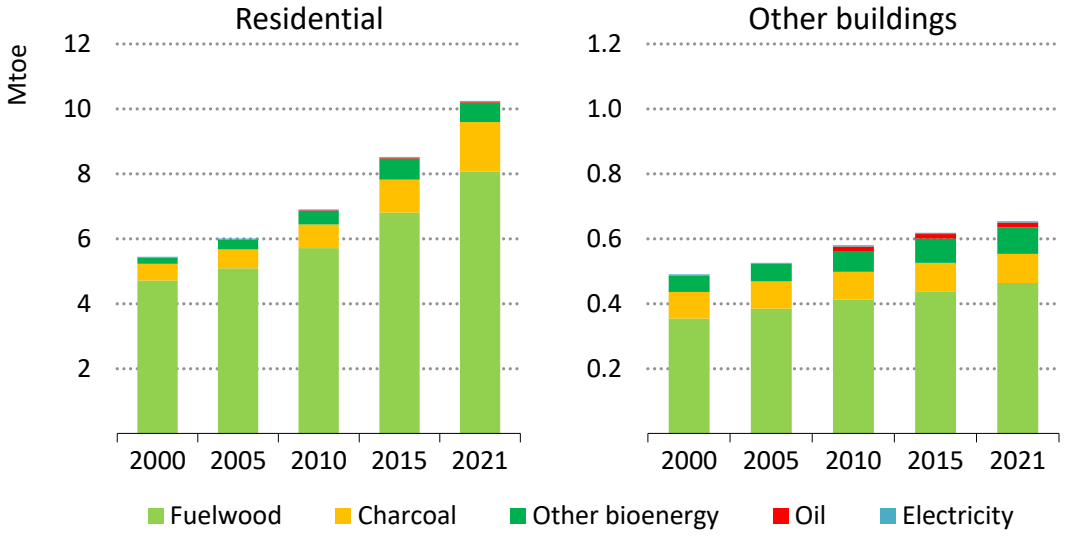
Based on TFC in the residential and services sectors, the buildings sector is the largest energy consumer in Uganda, with significant historical consumption growth linked to its increasing population, urbanisation rate and GDP. This reflects regional trends in the Horn of Africa, where consumption in the buildings sector reportedly increased by 65% between 2000 and 2020 and where the sector accounts for the largest share (around 80%) of final energy consumption. Heavy reliance on biomass, particularly for cooking, is a common feature of the entire Horn of Africa region, with significant implications for energy intensity in the buildings sector.

The buildings sector in Uganda is largely unregulated: only 22% of buildings in Uganda reportedly have construction or building permits (GBCUG, 2023). Among other disadvantages, this complicates efforts to assess the country's buildings footprint since permits are often used in other countries as important sources of data on things such as floor area.

Most buildings in Uganda are not connected to the grid, reflecting low electricity access levels across the country. This is one reason why both households and businesses such as hotels, offices and hospitality facilities rely on biomass for cooking. However, once households and institutions are connected to the grid, significant use of biomass often continues, including for reasons of cost. Uganda has a clean cooking access rate of less

than 1%, while the rate in urban areas is slightly above. A heavy dependence on biomass as the primary energy source in buildings contributes to Uganda's relatively high levels of overall energy intensity.

Figure 8.4 Final energy consumption in buildings in Uganda, 2000-2021



Note: Mtoe = million tonnes of oil equivalent.
Source: IEA (2023).

Uganda's existing National Building Code contains requirements for energy efficiency, though these are generally not implemented for several reasons, including a lack of awareness about specific requirements among officials and developers, the absence of a comprehensive inspections regime, and the lack of funding instruments to deploy more efficient building systems and technologies that have higher upfront costs compared to less efficient alternatives.

With significant population and energy demand growth projected for Uganda, the prospect of significant new construction in the coming decades presents a risk of "locking in" inefficient buildings. This could result in higher future costs for energy efficiency renovations, creating an important barrier for future policy initiatives, particularly energy efficiency requirements and/or targets for existing buildings.

The NBRB is expected to complete a review by mid-2023 of the National Buildings Act, which establishes the National Building Code. Once the review of this Act has been completed, the NBRB will conduct an ongoing revision of energy efficiency requirements in the Code. This effort is being implemented under the auspices of the Department for Works and Transport with the support of non-state actors such as the Global Green Growth Institute and the Green Building Council of Uganda. These organisations carried out a gap analysis of the existing code and submitted recommendations on "greening" the code to the NBRB.

Appliances and lighting

In 2007, the MEMD procured 800 000 compact fluorescent lightbulbs for Umeme to distribute to its customers. Each customer received up to three free compact fluorescent

lightbulbs in exchange for three ordinary incandescent bulbs. As a result of this programme, electricity demand reportedly fell by around 32 MW, while participating consumers saw significant reductions in their electricity bills (Power Africa, 2017). The programme was expanded to LEDs in 2015.

In 2011 and 2012, the MEMD and the UNBS issued voluntary MEPS for lighting, refrigerators, freezers, motors and air conditioners. However, until the draft Energy Efficiency and Conservation Bill is passed, the UNBS will not have the authority to enforce such standards. Another challenge is the lack of testing equipment and facilities. In the meantime, the MEMD plans to introduce MEPS for additional product categories and update those in place for existing technologies. These efforts are part of regional collaboration through the EACREEE, under which a regional framework for compliance and trade is being developed in collaboration with member countries' customs authorities and standards bodies, notably with respect to domestic appliances and lighting. Much like in other parts of the region and Africa as a whole, the "dumping" of older and inefficient appliances is an important concern for policy makers in Uganda, who are seeking ways to address this issue with counterparts in the region.

In terms of verification, such as conformity of products to applicable MEPS, there has been progress for lighting, with testing regimes in place and available data showing conformity levels of 80% for LEDs. Labelling schemes have been piloted for refrigerators and freezers, though the MEMD indicates challenges in scaling this programme. Policy makers explored the use of star labels (such as the Energy Star system used in the United States) as well as numeric and hybrid labels, though these have not been implemented due to the lack of a legal framework for enforcement as well as low consumer awareness.

While voluntary MEPS for air conditioners are in place, policy makers acknowledge that more concerted efforts are required to improve energy efficiency for cooling. Increases in global average temperatures, rising incomes, urbanisation and other drivers are pushing up demand for cooling services in sub-Saharan Africa and many other regions. According to IEA scenarios, demand for cooling is likely to be one of the strongest drivers of household electricity demand in Africa, with many countries already seeing increasing pressures on their energy systems as a result. In Burkina Faso, for example, increased use of air conditioners has led to load shedding to avoid wider power system outages. As part of efforts to address this issue, policy makers in Burkina Faso are combining MEPS for air conditioners with public awareness campaigns to encourage users to switch off air conditioners 30 minutes before leaving rooms, reducing consumption without significantly compromising comfort (IEA, 2022c).

Industry and services

Between 2007 and 2011, energy audits were performed on several publicly owned facilities, and the MEMD helped finance many of the recommended energy efficiency investments. In 2014 and 2015, the GIZ led Promotion of Renewable Energy and Energy Efficiency Programme and the MEMD commissioned energy audits for 26 high energy-consuming industries. Over 120 energy audits have reportedly been carried out to date in Uganda, along with the certification of 60 energy auditors. However, many of the recommended measures from these audits reportedly have never been implemented by the industry owners. This is due to a lack of binding regulations, incentives and available finance, as well as a lack of confidence by the owners in the efficacy of such investments (Power Africa, 2017).

The Promotion of Renewable Energy and Energy Efficiency Programme has conducted several trainings for energy managers in high energy-consuming companies since 2015. The programme has also trained trainers to conduct similar programmes, and GIZ has worked with the MEMD to develop a certification programme for energy auditors and managers (Power Africa, 2017).

MEPS are in place for industrial motors. Similar to the situation for appliances, however, these are generally not enforced or monitored.

As part of wider reform efforts, the MEMD is planning to make energy audits mandatory for designated consumers every three years, accompanied by licensing regimes and periodic reporting. This effort is being developed alongside a new database to collect industrial energy efficiency indicators. Up to now, efforts to collect energy efficiency data on companies have been limited to a once-per-decade business survey of financial statements.

The MEMD is collaborating with the SNV and other partners, with funding provided by the Swedish government, to promote the development of ESCOs in Uganda through pilots in the agribusiness sector, including for maize, dairy, coffee, sugar cane, tea, oil milling and tobacco, with the eventual goal of developing ESCO services in other industries. The programme offers a financial derisking facility covering 50% of the initial technology investment, a results-based financing mechanism and technical assistance. Applications to develop pilots in tea plantations have been received from a small number of companies, including from neighbouring Kenya, where agribusiness-focused ESCOs are already operating.

Transport

Uganda's fleet of predominantly older and imported vehicles is inefficient compared to global averages. For example, light-duty vehicles (which include passenger cars) consume over 25% more fuel than the average for light-duty vehicles globally (GFEI, 2020) (Table 8.2).

Table 8.2 Vehicle average fuel efficiency and CO_2 emissions – Uganda and global

Category	Heavy-duty vehicles	Medium-duty vehicles	Light-duty vehicles	All vehicles
Diesel fuel efficiency (L/100 km)	25.5	11.7	10.6	15.9
Petrol fuel efficiency (L/100 km)	15	8.8	8.9	10.9
Average efficiency diesel and petrol (L/100 km)	20.25	10.25	9.75	13.4
CO_2 emissions based on averages (g CO_2/km)	348.7	204	207.5	253.4

Notes: L/100 km = litres per 100 kilometres; g CO_2/km = grammes of carbon dioxide per kilometre.

Source: MEMD (2023).

Addressing the age, inefficiency and carbon intensity of Uganda's largely imported vehicle fleet is a priority for the MEMD, which has put in place an import ban on vehicles more

than 15 years old, with plans to move to an 8-year limit. At the beginning of 2023, most vehicles in Uganda were more than 15 years old, while in neighbouring Kenya, the average vehicle age was 8 years.

E-mobility initiatives for two- and four-wheel vehicles are being deployed with the support of international donors. The government has set a target to electrify 30% of the motorcycle fleet by 2030 since motorcycles, commonly referred to as “boda bodas”, dominate the taxi market.

Uganda’s Makerere University, together with Kira Motors Corporation, piloted the first solar-powered electric bus in 2018. In June 2022, the government of Uganda, with support from GIZ, launched four electric mobility charging stations for motorcycles along one of the main roads outside of Kampala. Battery-swapping pilots are also being tested for two-wheelers (PREO, 2022).

Agriculture

Little data are available on end use energy consumption in Uganda’s agriculture sector, which contributes nearly one-quarter of Uganda’s GDP. As part of its energy and emerging energy efficiency policy framework, the government is seeking to address the use of inefficient equipment and machinery and the limited conversion of agricultural waste to energy. It is promoting increased mechanisation and energy efficiency gains for key technologies such as pumps. The government plans to deploy financial incentives to encourage the uptake of more efficient technologies and improve the energy efficiency of agricultural practices.

Financing

Financing is noted in the National Energy Policy and Draft Energy Efficiency and Conservation Bill as an important component of Uganda’s future policy framework for energy efficiency. The National Energy Policy calls for earmarked budgets for energy efficiency, though these funds are also to be used to support wider priorities, including supply-side efficiency. The need for dedicated financing instruments for energy efficiency in Uganda is acknowledged in policy documents and by stakeholders as a critical issue for addressing several objectives related to energy efficiency, including improving access to electricity, reducing energy intensity, improving the efficiency of end use devices, and growing a market for energy efficiency services and technologies.

In addition to dedicated financing instruments to overcome consumer affordability challenges, there is a need for instruments to improve access to capital, which is an important concern for energy efficiency services companies, investors and end users. While numerous energy audits have been carried out at industrial sites, follow-up on implemented technology projects and/or energy management systems has been limited despite relatively high electricity tariffs. Both service providers and potential customers lack access to dedicated financing for energy efficiency measures identified in audits while the risks of such investments are often perceived as high. As a result, the market for ESCOs and other providers of energy efficiency services is nascent in Uganda, though new pilot projects that include financial and other derisking mechanisms are reportedly being designed to help stimulate market activity.

Assessment

Efforts are underway to develop Uganda's first legal, regulatory and enforcement framework for energy efficiency following the adoption of the 2023 National Energy Policy. The historical absence of a legal framework for energy efficiency has stalled or delayed important measures, such as the development and enforcement of new building codes and labelling regimes, and the enforcement of existing MEPS. Draft texts demonstrate that the government is keen to accelerate progress. A comprehensive set of measures is being discussed as part of the draft Energy Efficiency and Conservation Bill, which is expected to be adopted in 2023.

Affordability issues combined with low levels of access to clean energy present important challenges for energy efficiency policy makers and stakeholders in Uganda. The removal of subsidies for electricity in 2012, for example, has had little impact to push households to invest in energy efficiency since most homes are not connected to the grid and/or cannot afford more efficient technologies. In businesses and industries, a lack of access to capital hinders investments in energy efficiency in response to higher electricity tariffs.

The need for financing instruments, such as grants, preferential loans and tax incentives for the uptake of efficient appliances, vehicles, industrial machines and agricultural equipment, for example, is cited both in the National Energy Policy and the draft Energy Efficiency and Conservation Bill. However, the government is still discussing the details on how these instruments will be developed and funded. Current budget allocations for energy efficiency, as cited in the National Energy Policy, are small compared to allocations for other energy sector priorities.

Alongside funding instruments, the enforcement of existing and the development of new MEPS will be fundamental for promoting energy efficiency in Uganda, particularly in the context of economic and demographic growth. The government has developed five MEPS and five others are in the pipeline, but the implementation and lack of testing facilities and equipment remain a challenge. Without well-enforced MEPS, increased electricity consumption would embed inefficient technologies and systems into Uganda's economy over the medium to long term, increasing the cost of future investments to improve efficiencies. This is notably the case for the buildings sector, where significant expansion of the built environment is anticipated in line with population growth. While the government is revising existing building codes to address this issue, substantial efforts will be required to develop an adequate enforcement regime since new construction in Uganda is largely unregulated, particularly in terms energy efficiency requirements. Building plans in the future reportedly will be required to include a certificate of compliance.

Heavy reliance on biomass, particularly for cooking, is a common feature of the entire Horn of Africa region, with significant implications for energy intensity in the buildings sector. The government is addressing this through programmes to promote clean cooking, including by working with Makerere University's CREEC to develop a framework for clean cooking and testing clean cooking technologies. Given the low penetration rate of clean cooking, significant work remains to be done in this area.

Once adopted, the draft Energy Efficiency and Conservation Bill will mandate audits for larger industrial energy consumers. Follow up on existing voluntary audits in the form of energy efficiency investments has been limited, however, due to a lack of access to capital as well as a lack of awareness and capacity, both within the services and technologies

supply chain as well as among industrial plant operators. The MEMD's efforts to address the lack of capacity through the promotion of training are to be commended; as of 2022, there were 55 certified energy auditors.

In transport, efforts have been made to improve average vehicle fuel efficiency through limits on the age of imported vehicles, and the government is planning further restrictions. Fuel economy standards are currently not envisioned for Uganda, although these could be an important policy consideration for achieving the government's target of cutting average vehicle consumption by more than a third by 2030. E-mobility initiatives for two- and four-wheel vehicles are being deployed with the support of international donors, and the government has set a target to electrify 30% of the motorcycle fleet by 2030.

In agriculture, given the food demands of a growing population, providing affordable access to efficient irrigation pumps, dryers and other equipment in rural settings is a government priority. Policy makers are considering ways to improve efficiencies in processes and technologies while providing dedicated financing instruments for the sector, with details being discussed as part of the finalisation of the legal framework for energy efficiency.

Policy makers and stakeholders working on energy efficiency in Uganda face numerous challenges and barriers, many of which are not unique to energy efficiency. These include a lack of granular data; low levels of economic development, awareness and capacity among the general population and within ministries and agencies; and a lack of enforcement of existing rules, regulations and standards. A lack of co-ordination and funding across sector organisations and associations undermines their ability to advise and support the government on energy efficiency policy making. Despite these challenges, the MEMD is collaborating with civil society, sector associations, the private sector, donor organisations and other non-state actors to advance energy efficiency. Regional collaboration efforts are also underway, with Ugandan policy makers working with counterparts in Kenya, Rwanda and Tanzania on regional standards for appliances, among other areas.

Energy efficiency can not only mitigate growth in energy intensity; it can enable sustainable energy demand growth, help increase energy access and system resilience, create jobs, and help mitigate against economic shocks. As part of its efforts to expand affordable electricity access while growing demand for productive energy services, the government has an opportunity to lay the foundations for energy efficiency while avoiding a "lock-in" of inefficiencies across energy-using, GDP-contributing sectors of the economy. A robust regime for energy efficiency, supported by digital technologies, can ensure that both current and future energy consumers benefit from technologies and systems that are affordable, reliable and high-performing. While higher upfront costs for efficient technologies will require dedicated funding in the short term, investing in energy efficiency now will ensure greater cost-effectiveness and affordability in the medium and long terms.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Finalising the policy and legal framework for energy efficiency, and in particular adopting the draft Energy Efficiency and Conservation Bill, so that key instruments such as mandatory minimum energy performance standards, building codes and energy audits can be implemented and enforced.
- Leveraging the potential of energy efficiency as an enabler of affordable and sustainable energy access and demand growth in both rural and urban settings through incentives and dedicated funding instruments for the purchase of energy-efficient equipment by end users.
- Ensuring that relevant agencies have sufficient means and capacity to effectively implement, enforce and monitor new regulations and standards.
- Continuing efforts to increase awareness of the benefits of and opportunities for energy efficiency, especially within industry.
- Exploring opportunities to promote energy efficiency by employing digitalisation in buildings, appliances, industry and other end use sectors, through regulations and mandates supported by targeted incentives.
- Supporting growth in e-mobility solutions, notably for two-wheelers, through measures such as targeted incentives to overcome higher upfront purchase costs, improvements in charging infrastructure and awareness raising for consumers.

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9. Energy, climate change and the environment

Key data (2021)

CO_2 emissions from fuel combustion: 5.7 Mt CO_2

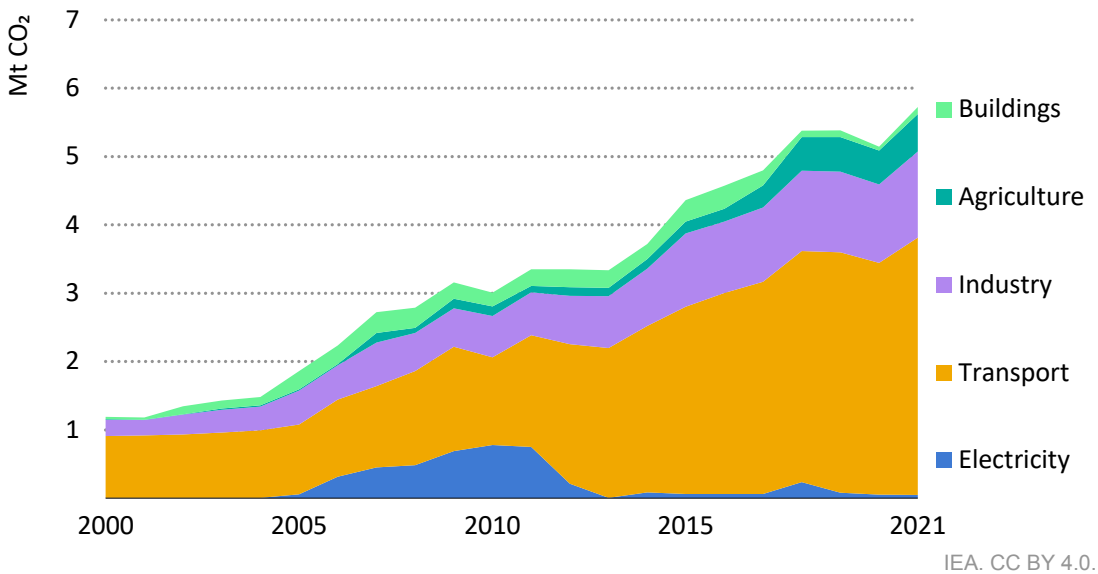
CO_2 emissions from fuel combustion by sector: transport 66%; industry 22%; agriculture, forestry and fishing 10%; buildings 2%; electricity 1%

Overview

Important environmental issues in Uganda's energy sector include deforestation, land degradation and indoor air pollution related to the use of biomass in residential cooking; the vulnerability of the country's large hydropower-generating capacity to climate change; and the future impact of oil and gas operations on land, water and air resources.

Uganda has signed and ratified the Paris Agreement on Climate Change, which requires parties to develop climate change policies, strategies and plans that promote adaptation and mitigation. The Uganda Vision 2040 and the NDP III 2020/21-2024/25 call for appropriate adaptation and mitigation strategies to ensure that Uganda is cushioned from the adverse impacts of climate change while at the same time promoting low-carbon intensive pathways for the country's economic development.

Figure 9.1 Emissions from fuel combustion by sector in Uganda, 2000-2021



Note: Mt CO_2 = million tonnes of carbon dioxide.

Source: IEA (2023).

Institutional framework

The main government body responsible for environmental and climate policy making in Uganda is the **Ministry of Water and Environment**, including its Climate Change Department, which is directly supervised by the permanent secretary. The Ministry of Water and Environment is responsible for co-ordinating government action regarding climate change, including ensuring that the country meets its responsibilities and commitments under the UNFCCC and the Paris Agreement.

The management of internationally received climate finance through the GEF and the Green Climate Fund (GCF) is the responsibility of the **Ministry of Finance, Planning and Economic Development**, which is also Uganda's National Designated Authority *vis-à-vis* the UNFCCC and the GCF.

The **National Environmental Management Authority** is a semi-autonomous body created in 1995 under the National Environment Act and is responsible for issuing environmental clearance certificates for energy projects. NEMA is also responsible for enforcing regulations regarding waste; approving environmental and social impact assessments for waste management facilities; and issuing a licence to all private businesses dealing with collecting, transporting, storing, treating or disposing of waste.

The **Policy Committee on Environment** advises the Ministry of Water and Environment and other government bodies on the implementation of the National Climate Change Act (2021), while the **National Climate Change Advisory Committee** provides independent technical advice to the Policy Committee on Environment and to the Minister of Water and Environment (MWE, 2022a).

Strategic framework

The government sets out the policy directions, measures and initiatives related to climate change and the environment in several strategic documents that have been developed and updated over the past decade.

The latest five-year **National Development Plan**, which aims to help accomplish Vision 2040, has a programme entitled "Climate Change, Natural Resources, Environment, and Water Management". This programme aims primarily at protecting natural resources, both from the consequences of climate change and human activity. However, it does not mention specific impacts from activities in the energy sector (NPA, 2020).

The **National Climate Change Policy (2015)** was developed "to guide efforts towards achieving Vision 2040 and moving towards low-carbon development". The policy emphasises adaptation, "given that the country's GHG emissions are still relatively very low", while the country remains vulnerable to many climate change risks and impacts (MWE, 2022a).

The **National Energy Policy (2023)** notes several issues and proposes policies related to the energy sector's impact on the environment and natural resources, including indoor and outdoor air pollution, and the impact of energy projects on biodiversity and ecosystems. The policy states it was "developed in line with the government of Uganda's commitment to regional and international obligations on energy transition towards a zero-carbon economy through strategies on new energy trends such as adoption of smart grids, clean energy for transportation (e-mobility) and smart appliances". The Policy recognises that

the energy sector has greater environmental impacts than most other economic sectors and that energy policies should include efforts to mitigate these impacts.

The Policy lists 14 outcomes, one of which is "improved environmental conservation". Proposed strategies include public awareness campaigns on the costs and benefits of different types of energy sources and strategic environmental assessments of energy plans, programmes, projects and policies.

The **National Climate Change Act (2021)** provides a domestic legal underpinning for the UNFCCC and the Paris Agreement. Among other things, it provides for mechanisms such as emissions trading, protocols for measuring emissions reductions, and the development of climate change financing and incentives for those implementing mitigation and adaptation response measures.

Additional government policies and strategies related to the environment and/or climate change include the:

- National Forestry Policy (2001)
- National Renewable Energy Policy (2007)
- National Disaster Preparedness and Management Act (2010)
- National Land Policy (2013)
- Forest Investment Plan (2017)
- Strategic Programme for Climate Resilience (2017)
- Uganda Green Growth Development Strategy (2017/18-2030/31)
- Climate Change Strategy and Action Plan for the Energy, Minerals and Petroleum Programmes (2023/24-2028/29)
- Ten Year Plan of Action for Restoration of the Environment and Natural Resources in Uganda (2021-2031).

Targets and objectives

Uganda signed the Paris Agreement in October 2015 and ratified it in September 2016. In accordance with this Agreement, it submitted its Intended NDC in 2015; this became its NDC after entry into force of the Paris Agreement in 2016. Uganda submitted an updated NDC in September 2022, which provides information on social and economic trends; the policy, legal and institutional framework related to climate change; climate change risks and vulnerabilities; and GHG emissions trends, sources and projections through 2030.

In the updated NDC, Uganda plans to implement policies and measures in the energy; waste; transport; industry; and agriculture, forestry and other land use (AFOLU) sectors that would result in a 24.7% reduction of national GHG emissions below the business-as-usual trajectory in 2030, i.e. a reduction of 36.76 Mt CO_2-eq. Almost 6% (5.9%) of this target is unconditional, while the remaining 18.8% is subject to the availability of international support, such as financial resources, capacity building and technology transfer.

The unconditional target of a 5.9% business-as-usual emissions reduction by 2030 will be facilitated by domestic resources. Uganda has committed to mobilising USD 4.1 billion (equivalent to 15% of the total cost of the NDC) of domestic resources to cover the unconditional actions. To reach its unconditional target, Uganda has also requested

USD 23.9 million in international financing. Of this, USD 8.7 million is allocated for mitigation and USD 15.2 million for adaptation.

The AFOLU sector is projected to account for 82.7% of the total (unconditional + conditional) mitigation impact and 7.56%, 6.36%, 3% and 0.4% from the transport, energy, waste, and industrial processes and product use sectors, respectively. The 24.7% target is a progression from the original 22% target communicated in Uganda's first NDC.

Uganda is developing its Energy Transition Plan, which is expected to consider several scenarios, according to which targets will be set.

Climate change mitigation

Uganda's GHG emissions increased from 53.4 Mt CO_2-eq in 2005 to 90.1 Mt CO_2-eq in 2015. The energy sector[1] contributed 10.7% of total emissions in 2015, while land use, land-use change and forestry[2] accounted for 59.5% and agriculture a further 26.9% (MWE, 2022a).

The Greenhouse Gas Inventory for Uganda's Third National Communication covers the period 1995-2017 and was prepared in accordance with the 2006 IPCC Guidelines for national GHG Inventories. It notes that the transport sector accounted for about 66% of Uganda's energy sector GHG emissions in 2017 but that biomass combustion was the main source of precursor gases, particularly CO_2 (MWE, 2022b). Uganda's GHG inventory was previously updated in its 2019 Biennial Update Report to the UNFCCC.

Uganda's overall emissions profile is projected to grow from 90.1 Mt CO_2-eq in 2015 to 148.8 Mt CO_2-eq in 2030 and 235.7 Mt CO_2-eq by 2050 under the business-as-usual scenario. By far, the largest portion of this growth is expected to come from the agriculture and forestry sectors (MWE, 2022a). Although the updated NDC contains an elaboration on the country's long-term climate strategy, Uganda has not yet communicated a long-term low-emission development strategy to the UNFCCC, as encouraged by Article 4.19 of the Paris Agreement.

Some 82.7% of the combined conditional and unconditional reduction from business-as-usual emissions is projected to come from the AFOLU sector. The transport sector accounts for the next highest share of the reduction at 7.56%, and the energy sector the third highest at 6.36% (MWE, 2022a).

The main proposed mitigation actions for the stationary energy sector are:

- renewable energy generation (lists plants expected to come online through 2030, most of which are hydropower, though including 20 MW of solar and 20 MW of wind)
- reduction in transmission and distribution losses
- improved efficiency of charcoal production
- industrial energy efficiency (10% reduction from business-as-usual by 2025)
- industrial fuel switching (to more use of "sustainable biomass")
- improved cookstove efficiency for commercial/institutional use (50% of institutions to be using improved charcoal cookstoves by 2030, 15% to be using LPG stoves and 35% electric stoves)
- increased electricity access for households (100% by 2030)

[1] In UNFCCC terminology, "energy sector" usually refers to sources of fuel combustion, including by consumers.
[2] Land use, land-use change and forestry is a subset of AFOLU.

- lighting energy efficiency in households
- household cooking mitigation measures, including energy efficiency and fuel switching.

Additional mitigation measures include promoting the establishment of ESCOs, energy management standards and energy efficiency in buildings (MWE, 2022a).

The NDC points out that about 96% of freight and passenger traffic in 2018/19 was by road, and that road transport accounted for 84% of energy consumption in the transport sector, mostly in the form of petrol and diesel. It notes that the average age of vehicles in Uganda is currently more than 15 years and that much of Uganda's fleet (1 355 090 vehicles in total) has been imported, used or reconditioned from Japan (MWE, 2022a). Important energy-related mitigation measures in the transport sector include:

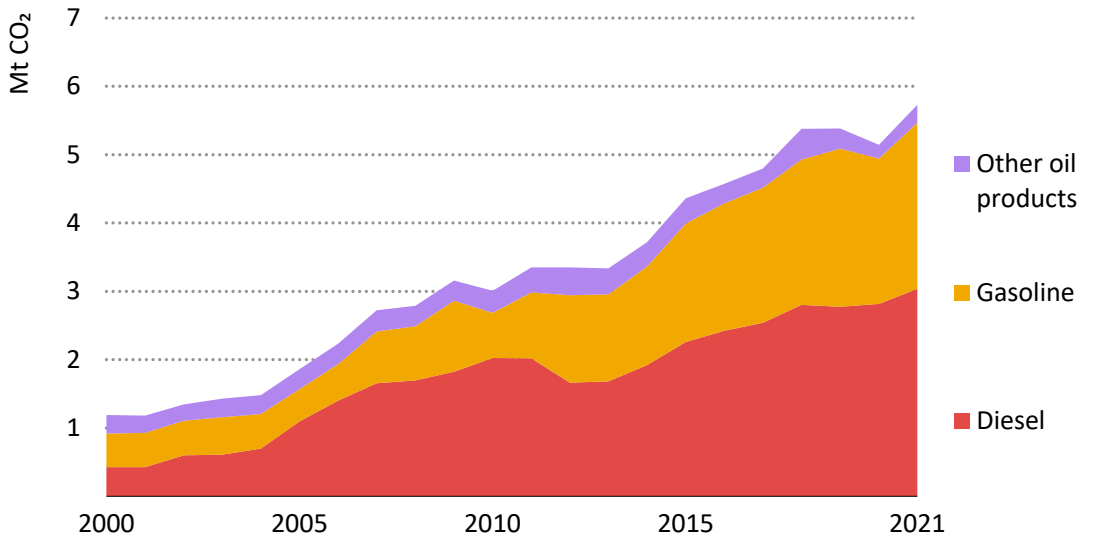
- road transport fuel efficiency (improved fuel standards and regulations for imported vehicles)
- further development of public transport (including railway rehabilitation and bus rapid transit
- fuel switching (including the use of EVs)
- construction of an oil products pipeline (replacing road transport of oil).

Energy-related mitigation actions in the AFOLU sector listed in the updated NDC include:

- commercial smallholder and community bioenergy woodlots
- improved charcoal kilns linked to bioenergy woodlot
- commercial transmission pole and timber plantations
- energy-efficient fuelwood and charcoal stoves.

Energy-related CO_2 emissions

Figure 9.2 Emissions from fuel combustion by fuel in Uganda, 2000-2021



Note: Mt CO_2 = million tonnes of carbon dioxide.
Source: IEA (2023).

Climate change adaptation

The adaptation component of the updated NDC (2022) covers 13 sectors, including the energy sector. According to the updated NDC, priority sectors for adaptation to climate change remain the same as in the first NDC, focusing on ecosystems, water, agriculture and forestry. However, the updated NDC also notes an increased risk to several additional sectors, including energy production.

Important possible impacts of climate change in Uganda include a statistically significant trend for decreased rainfall, which could increase fluctuations in lake levels and water availability for hydropower production. While the southwestern highlands could see a 5-10% increase in annual rainfall, parts of mid-western and north-eastern Uganda could experience a 5-10% decline (MWE, 2022b).

Box 9.1 Climate impacts on African hydropower

A 2020 IEA report assesses climate change impacts on African hydropower generation using general circulation models and global hydrological models comparing two different greenhouse gas concentration pathways. These are associated with levels of global warming by 2100 of below 2°C and around 3°C, respectively. The assessment considers 80% installed hydropower capacity in 13 African countries between 2020 and 2099, comparing projected results with values from the baseline period from 2010 to 2019.

From now until the end of the century, the mean hydropower capacity factor of selected hydropower plants is projected to decrease due to climate change in both scenarios. The average capacity factor of analysed African hydropower plants is likely to decrease by approximately 3% between 2060 and 2099 compared to the baseline period 2010-19. The projected accumulative loss in generation output due to climate change for the remainder of the 21st century is approximately 130 terawatt-hours (TWh); equivalent to the current total annual generation output from all African hydropower plants.

Country-specific data show that climate change will have significant impacts on most African countries, although the patterns of change may vary from one country to the other and there will be regional differences within countries. For example, the hydropower capacity factor in the Democratic Republic of Congo, Morocco, Mozambique, Zambia and Zimbabwe and is projected to decline considerably. The decrease would be offset by an increase in the hydropower capacity of the Nile basin countries, notably Egypt, Kenya and Sudan.

Source: IEA (2020).

According to the updated NDC, priority adaptation actions in the energy sector are:

- improve access to and use of electricity from sustainable sources
- promote the use of renewable energy sources and energy-efficient technologies
- increase access to clean energy cooking technologies rehabilitate and climate-proof electricity transmission infrastructure (see Table 9.1 for more details).[3]

[3] The Third National Communication contains a similar list (see, for example, Table ES 4.1 and list of measures on p. xlvi).

Table 9.1 Priority adaptation actions for the energy sector in Uganda

Outcome: A climate-resilient energy sector					
Priority adaptation actions	**Indicator**	**Baseline**	**2025 target**	**2030 target**	**Target alignment**
Improve access and use of electricity from sustainable sources	Proportion of the population with access to electricity	24% in 2020	60%	75%	NDP III
	Per capita electricity consumption	100 kWh in 2020	145 kWh	578 kWh	NDP III
	Transmission capacity (in km of high-voltage 7 transmission lines)	2 354 km in 2019	4 354 km	6 300 km	NDP III
Promote the use of energy sources and energy-efficient technologies	Electricity generation capacity	1 276.2 MW	3 500 MW	4 200 MW	NDP III
Increase access to clean energy cooking technologies	Increased share of clean energy for cooking	15%	50%	65%	NDP III
	Share of biomass energy used for cooking	88%	50%	40%	NDP III
	Proportion of households and institutions using efficient cooking technologies	1%	10%	TBD	
Rehabilitate and climate-proof electricity transmission infrastructure	Access to electricity	28%	60%	75%	BFP, NDP III
	High voltage transmission lines	2 354 km	4 354 km	TBD	NDP III
	Renewable off-grid energy solutions	10 000 km of (medium-voltage networks) 15 000 km of (low-voltage networks)	TBD	TBD	BFP

Notes: km = kilometre; kWh = kilowatt hour; MW = megawatt; TBD = to be determined, NDP III = Third National Development Plan; BFP = Budget Framework Paper.

Source: MWE (2022a).

Air quality

Cooking with biomass is the leading cause of indoor pollution in Africa. The cost of premature deaths from air pollution, measured by loss of productivity, is estimated at almost 9% of Africa's GDP. (Read more about the effects of indoor air pollution in Chapter 5.)

Pollution from old and inefficient vehicles and industrial processes presents further health and environmental risks, including outdoor air pollution. Generally, the older the vehicle, the higher the CO_2 emissions. In Uganda, the average age of imported used vehicles is more than 15 years. In comparison, Kenya is enforcing a maximum age limit of 8 years for used car imports. (See Chapter 8.) The government is considering stricter efficiency standards for imported used vehicles and incentives to adopt EVs, including motorbikes.

Deforestation and biodiversity loss

Biomass remains Uganda's primary energy source and plays an important role in the country's economy, accounting for more than 89% of total primary consumable energy (MWE, 2022a). Uganda has a forest cover of 11.66%, though this is declining at an annual rate of 1.44% (MWE, 2022a), causing Uganda to have one of the highest deforestation rates in sub-Saharan Africa. Biomass use, and charcoal production in particular, is one of the major causes. The government is attempting to address this in various ways. For example, in May 2023, an executive order banned cutting trees for charcoal making in northern and north-western Uganda (Monitor, 2023). The government is also trying to reduce the country's dependence on biomass by pursuing cleaner energy sources, especially in the cooking sector. (See Chapter 5 for more information on biomass use and deforestation.)

Mining activities lead to environmental pressures, such as deforestation, the disposal of large amounts of wastewater, and biodiversity loss through changes in land cover and habitat degradation. The 2018 Mining and Minerals Policy for Uganda acknowledges the environmental impacts of the mining industry and states that the "government shall ensure that mining activities shall be undertaken in ways that minimize carbon emissions and other mining effects that have been deemed to cause climate change and ensure that emissions from the sector meet global climate change guidelines and standards. Mining in forests and wetlands shall ensure conservation of ecosystems and biodiversity" (MEMD, 2018). However, small-scale mining accounts for 80% of Uganda's mining activity and is only lightly regulated (NPA, 2020).

Uganda first discovered oil in 2006 in the Lake Albert basin. Drilling started in January 2023, and commercial production is scheduled to begin in 2025 (see Chapter 6). The East African Crude Oil Pipeline will stretch 1 143 km from Lake Albert in western Uganda, through Uganda and Tanzania to the Tanzanian coast. Oil activities, especially the pipeline project, have attracted strong opposition from some environmentalist human rights groups, which claim that it poses threats to ecosystems and livelihoods. Part of the pipeline as well as some well pads will be located in Murchison Falls National Park, one of Uganda's major national parks. ESIAs of EACOP were carried out and approved by the governments in both Tanzania and Uganda in 2019 and 2020, to predict and assess potential social and environmental impacts and develop mitigation measures. The EACOP's developers point out that the pipeline and its route have been designed to avoid environmental impacts and that measures have been taken to mitigate impacts.

Waste management and the circular economy

One of the objectives of the Uganda Renewable Energy Policy 2007 is to promote the conversion of municipal and industrial waste to energy. This will be carried out by providing incentives to convert waste to energy and putting in place fiscal measures to discourage open burning or disposal of waste without extracting their energy content (MEMD, 2007).

Solid waste in Uganda is generally composed of wet carbon and nitrogen-rich materials such as organic waste from households, agro-industrial waste from slaughterhouses and the food industry, and agro-waste such as manure and straw. Current practice is to burn these wastes without extracting and utilising their energy content. This results in energy waste, environmental risks due to uncontrolled burning and landfills, and health risks due to air pollution. The combustible waste matter could instead be used for electricity generation, and the non-combustible organic matter can be digested to produce biogas, which could be used both for cooking and as fuel for vehicles (MEMD, 2007; see also Chapter 3).

Assessment

The most significant environmental impacts concerning Uganda's energy sector include deforestation and related biodiversity loss, depletion of natural heritage and carbon sink potential, and air pollution related to the use of biomass in cooking. The government is considering the future impacts of extractive operations on land, water and air resources, as well as adaptation measures in the sector, particularly related to the vulnerability to climate change of the country's large hydropower-generating capacity. The government is taking steps to mitigate deforestation, particularly by promoting clean cooking, though much remains to be done, given the population's continued high dependence on unsustainably produced biomass.

Uganda is also pursuing objectives related to the circular economy. It is looking at the potential of waste-to-energy approaches, such as the use of organic waste for briquette production and reinforcing e-waste management. Both have the potential for creating a future-proof cluster of excellence in the region. In addition, organic waste can help reduce unsustainable biomass consumption.

The priority adaptation actions for the energy sector considered under the NDC are related to the vulnerability of the country's large hydropower-generating capacity to climate change. They encompass a comprehensive set of actions aimed at a climate-resilient energy sector, including improving access to electricity, promoting the use of renewable energy sources and energy-efficient technologies, increasing access to clean cooking, and rehabilitating and climate-proofing electricity transmission infrastructure. Although the rationale behind the selection of measures is consistent with the objective of energy access, the analysis may not adequately cover the resilience of the existing and future power systems. In particular, estimating possible adaptation requirements and related investment needs would require analysing transmission infrastructures and the risks associated with the intensity of variables such as wind, rain and temperature.

Under the adaptation plan, it could also be useful to take account of measures related to the water-energy nexus, both for water shortages, with potential solutions such as rain harvesting and storage for mini-hydro, as well as situations of water surplus, such as a new initiative regarding the cascading impacts on hydropower dams of rising water levels in Lake Victoria.

Uganda is exploring diverse energy sources, including oil production, in a bid to promote economic development and energy security. However, the drilling of the first commercial oil well in Murchison Falls National Park and the proposed routing of a cross-border pipeline through sensitive ecosystems have sparked concerns among some stakeholders despite plans published by the oil companies and measures taken to mitigate environmental impacts. Further capacity building for local technical personnel will also be important for lowering the risks of environmental damage from oil and gas operations, as well as close monitoring to make sure environmental rules are respected.

Recommendations

To reach its objectives, the government of Uganda should consider:

- Ensuring that extractive projects, notably oil-drilling, pipeline and mining operations, are subject to rigorous environmental impact assessments, as well as monitoring, reporting and verification requirements. In particular, it could strengthen plans and deploy enforcement measures preventing flaring and venting from oil and gas operations and address the environmental impacts of mining activities during the exploitation and decommissioning phases.
- Further developing initiatives in the circular economy, particularly those aimed at using sustainable types of waste as an energy resource.
- Complementing the existing climate change adaptation plan with measures to ensure the resilience of power infrastructure, including dams and distribution networks, in the face of extreme weather events.
- Prioritising transparency and open communication with all stakeholders, including by making environmental impact assessment reports publicly available.

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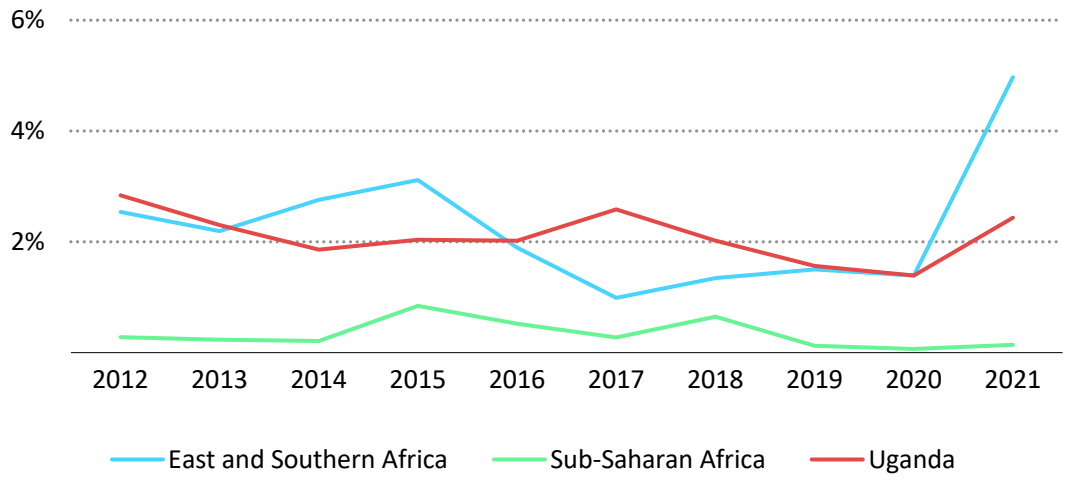
10. Investment

Overview

Uganda presents a broadly attractive legal environment to both international and private investors, with limited restrictions on investments as well as clear incentives and investment protections enshrined in law. Foreign direct investment to Uganda has been above the average for East and Southern Africa, reaching nearly 3% of GDP between 2017 and 2021 (latest data available), compared to the regional average of just over 2% (Figure 10.1). Analysis from the Bank of Uganda has attributed this primarily to consistent policy, a series of reforms that included incentive schemes, and the creation of the Uganda Investment Authority – a body that promotes investment while also simplifying administration (Obwona and Egesa, 2013).

Despite these strengths, foreign direct investment flows to Uganda have been slower to rebound following the Covid-19 pandemic than in the rest of the region. This is partly due to the prominence of commodities-related investments in Uganda, especially in the oil sector, where investment has slowed as discussions continued over the financing of the future oil export pipeline (see Chapter 6).

Figure 10.1 Foreign direct investment in Uganda compared to regional averages, 2012-2021



Source: IEA based on data from World Bank (2023b).

Investment environment

One of Uganda's primary strengths in attracting investment stems from its predictable investment climate. Multiple overarching government strategy documents, notably the NDP III, emphasise the importance of attracting greater investment from abroad while also freeing up domestic and regional pools of capital. The NDP III includes objectives to increase investment in oil and gas and the mineral sector (see Chapters 6 and 7), as well as private sector investment in industry, singling out manufacturing as being particularly important. However, the Plan does not include any concrete targets for investment – either for general foreign direct investment or more specific targets such as regional investment or domestic private sector involvement.

Investment and financing issues are generally governed by economy-wide legislation, primarily the Investment Code Act 2019. The Act lays out a series of tax incentives, as well as other key protections for international investors, such as allowing the repatriation of capital (Table 10.1). There are occasionally special investment considerations within energy-specific legislation, for example, if certain areas of the energy sector are not open to foreign or private investment. In Uganda's case, private sector involvement is authorised across the energy space, although it is currently limited to electricity transmission. These energy-specific policies are discussed in Chapters 1 and 2.

Table 10.1 Key investment legislation relevant to the energy sector in Uganda

Policy	Key elements
Investment Code Act, 2019	The Investment Act allows for foreign investment via a range of different investment vehicles but applies the principles of the government's national content policy – Buy Uganda Build Uganda – by requiring investors to use local services, raw material and labour where possible. The Act requires foreign investors to acquire an investment licence from the Uganda Investment Authority. It lays out several priority areas, including mining and transport, but does not mention the energy sector.
Companies Act, 2012	The Companies Act oversees the registration of companies – a process that is generally completed in less than a week. The Act permits the registration of companies outside of Uganda and does not prescribe minimum share capital requirements and/or local or resident director requirements.
Public-Private Partnership Act, 2015	The Act established a Public-Private Partnership (PPP) Committee that oversees and approves all projects by the PPP Unit, which serves as the secretariat and technical arm of the committee. The Act outlines the process for entering into a PPP. The private party must be incorporated in Uganda as a special-purpose company to implement a specific PPP. Prior to the commencement of a PPP, the contracting authority must conduct a cost-benefit analysis of the project. After this, it is registered with the relevant ministry, then a feasibility study is carried out and approval can be granted. The government is expressly prohibited from borrowing, guaranteeing or raising a loan for a PPP except with approval by parliament. Where the government is a financial sponsor, funds must already be available from the ministry's budget.

Policy	Key elements
Tax laws	Key tax laws include: • Tax Procedures Code Act 2014 and Income Tax (Amendment) Act, 2022 – these Acts state that every person liable to pay tax must register with the Uganda Revenue Authority while also defining when a company is considered resident in Uganda. • East African Community (EAC) Common External Tariff – the EAC Customs Union Protocol 2017 governs the tax rate on imported goods. The Protocol established a three-band external tariff: 0% for raw materials and capital goods; 10% on intermediate goods; 25% on finished goods. In 2022, a fourth band of 35% was added for selected products to protect local industries.

The government has sought to streamline bureaucratic processes for investors, limiting the number of government bodies and agencies that potential investors need to deal with. Foreign investors are most likely to rely on the Uganda Investment Authority – established under the Investment Code Act (2019) to serve as a one-stop shop for investors, issuing investment licences and co-ordinating with the relevant other ministries and agencies. Particularly for large extractives or utility-scale projects, investors are also likely to rely on the Ministry of Energy and Mineral Development as well as the Ministry of Finance, Planning and Economic Development, which is where the PPP Unit is housed. The Capital Markets Authority – a semi-autonomous body set up in 1996 to regulate the domestic capital markets – is also likely to play a more important role as institutional investors become more involved in the energy sector.

Despite the interest from investors, businesses setting up or operating in Uganda report a variety of cross-sectoral risks, including:

- **Capacity issues:** Limited capacity in many government agencies and departments can result in bureaucratic delays. The Uganda Investment Authority is designed to be a focal point for investors, streamlining their interactions with the government. However, investors have also reported significant delays when dealing with the Uganda Investment Authority, occasionally forcing them to circumvent the body (US Department of State, 2022).
- **Land:** Foreigners do not have the right to own land and the tenure system is complex and can prove difficult to navigate. This can lead to delays in projects and the potential for legal challenges.
- **Infrastructure deficits:** Almost all cargo is transported by road, but the road network is in poor condition, particularly outside of major urban areas. The government has an ambitious Road Development Plan that prioritises key trade links and roads around industrial parks, but the Plan has been hit with repeated budgetary shortfalls (The Independent, 2023).
- **Political uncertainty:** Uganda's ranking within the World Bank's Worldwide Governance Indicators on areas such as the rule of law and political stability has been gradually decreasing over the past few years, reflecting uncertainty over the long-term political outlook. For investors, this may result in higher costs associated with derisking mechanisms such as political risk insurance.

Within the energy sector, investors report a generally strong legal framework, but gaps in the supporting regulation make implementation more complex and time-consuming. The recent amendment to the Electricity Act opened the transmission sector to private investment, which is already authorised in distribution via concession arrangements, although this system is also currently under review. Since the reform process is ongoing, some regulatory gaps remain. Notably, despite moving away from a single buyer model, regulations have not yet been designed for alternatives, nor has a net metering strategy for commercial and industrial solar PV installations. Additionally, uncertainly about the reforms, particularly the rebundling of the utilities, risks causing delays to investments in both new and existing projects, particularly if there is a loss in technical expertise due to personnel changes.

Key public financing bodies in the energy sector

Several public financing bodies either have a specific mandate to support investment into the energy sector – such as the Uganda Energy Credit Capitalisation Company – or the potential to play a greater role in the sector in the future – such as the Uganda Development Bank and the Uganda Development Corporation.

Uganda Energy Credit Capitalisation Company

The UECCC was established to provide financing options to facilitate investment in renewable energy projects. It works with various partners, including, but not limited to, development partners and financial institutions, to offer the following credit support instruments and technical assistance services:

- lines of credit to participating financial institutions for on-lending to end users including households, institutions and enterprises for the acquisition of renewable energy technologies
- partial risk guarantees to participating financial institutions as risk-sharing mechanisms for on-lending for renewable energy technologies and projects/programmes of the participating financial institutions
- working capital facilities to alleviate the working capital challenges faced by ESCOs (solar companies and clean cooking companies)
- provision of result-based grants in the form of price subsidies to address end user affordability constraints associated with the acquisition of renewable energy technologies
- provision of results-based grants to ESCOs to address market entry barriers
- liquidity refinance to extend the tenor of loans of renewable energy projects
- development of stand-alone renewable energy loan products at participating financial institutions
- capacity building of independent power producers and financial institutions through the organisation of skills transfer events
- coaching and linking renewable energy developers/projects to carbon finance schemes.

In addition, the UECCC offers various forms of technical assistance to independent power producers and financial institutions, including how to address pre-investment barriers and match-making events/services.

The government of Uganda has received USD 600 million in funding from the World Bank for the implementation of the Energy Access Scale-up Project to be implemented over a

period of five years. The UECCC will implement the financial intermediation component (USD 105 million), deploying most of the above financing instruments with the aim of contributing to reducing financing and affordability barriers affecting renewable energy uptake. It is a scale-up from the interventions started under the Energy for Rural Transformation Project – Phases II and III.

Uganda Development Bank

The Uganda Development Bank may play a key role in sustainable energy investment since it is in the process of applying to become an accredited entity of the Green Climate Fund – one of the key distributors of the USD 100 billion climate finance pledge from developed nations. According to the Ministry of Finance, Uganda needs USD 28 billion to finance its climate change mitigation measures pledged under its NDC, 85% of which will be mobilised from international partners. To support this, in April 2023, the Uganda Development Bank set up a climate finance facility – similar to those already operational in Rwanda and South Africa – that will be used to support private investment in climate-smart agriculture and low-carbon energy infrastructure and industries.

Uganda Development Corporation

The Uganda Development Corporation is an investment institution established as a wholly owned government entity in 1952 to make long-term investments in strategic sectors of the economy to stimulate industrial and economic growth. The Uganda Development Corporation does not currently fund any projects in the energy sector but could serve as a vehicle for government investment, particularly since further capitalising the Uganda Development Corporation was emphasised as a priority within the 2023/24 budget.

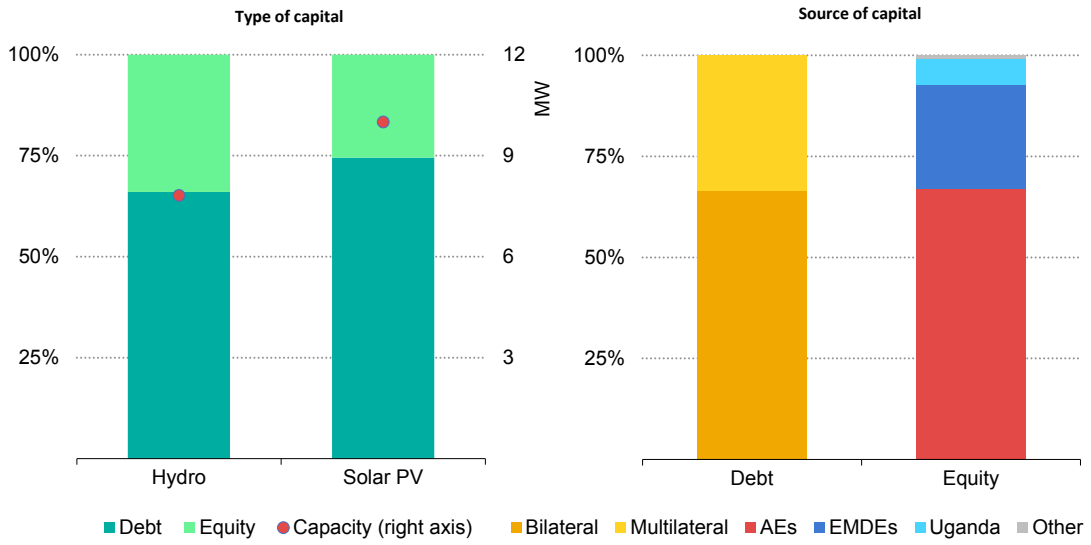
Current energy investment trends

Energy sector reforms in the late 1990s unbundled the power sector, but most generation transmission and distribution assets remain state-owned. It is clear the private sector must play a key role in developing commercial areas of the energy sector. There is significant appetite from private players and the generation sector represents a success story. Over the last decade, more than USD 500 million has been mobilised into IPPs with private involvement.[1] This has funded over 100 MW in hydro and 20 MW in solar PV developments. The large majority of capital provided for these projects came from development finance institutions (DFIs). On the debt side, 66% was provided directly by DFIs and the remaining 34% from the Emerging Africa Infrastructure Fund, which includes a blend of donor and private capital. Equity sponsors for these projects came from a variety of different sources, but DFIs have also played a key role, either as the primary provider of capital or via a derisking element in a blended finance structure. Ugandan companies have played only a small role to date, accounting for less than 10% of equity in projects so far.[2]

[1] Based on World Bank Private Participation in Infrastructure projects data and the GET FiT Uganda renewable energy programme.

[2] Domestic players are more prominent in the off-grid space, where investments can be significantly smaller. Off-grid developments are not included in the World Bank data.

Figure 10.2 Breakdown of finance for solar PV and hydro projects with private involvement



Notes: AEs = advanced economies; EMDEs = emerging market and developing economies. Based on ten projects between 2012 and 2022.

Source: IEA based on data from World Bank (2023a).

Power investments outside of generation have been heavily reliant on the public sector. Transmission was only recently opened to the private sector, with a pilot project for a leasing arrangement between Gridworks and the government currently under negotiation, with support from the World Bank (see below for more details). Within the distribution sector, several concession agreements exist between the government and the private sector, although the ongoing reforms and the end of Umeme's concession have created a level of uncertainty over the future nature of private involvement.

Beyond the power sector, on the supply side, oil developments have so far been led by Western and Chinese companies. However, pressure on financiers, particularly in Europe, to align their portfolios with a net zero scenario will likely continue to reduce the capital available for such projects in the future (see Chapter 6). Meanwhile, there is a growing appetite globally to support developments in critical mineral mining. The sector remains nascent in Uganda but is likely to attract private capital without the need for significant derisking support once geological viability is confirmed and the regulatory framework fully established (see Chapter 7).

Box 10.1 The role of development finance institutions and donors

Development finance institutions (DFIs) and donors provide key sources of grants, equity and concessional long tenor loans. This is particularly vital to move projects from concept to bankability. These providers are already involved across the energy sector in Uganda, but there are several areas that they are uniquely suited to finance:

- **Technical assistance and capacity-building grants:** Grants are essential to support non-commercial outlays, such as strengthening the policy and regulatory environment. Projects such as the government's ambition to strengthen its energy data tools will also likely rely on grant funding.
- **Feasibility studies and project preparation:** The costs involved in early-stage project development are high, and many local players lack the necessary finances or technical expertise. Funding training on business development skills and providing finance specifically tailored to support feasibility studies can help unlock a pipeline of bankable projects. When DFIs do get involved in funding feasibility studies, they should be sure not to lock other parties out of investing in projects that make it to development.
- **Cheap capital for on-lending:** Local commercial banks play a key role in supporting the energy sector, particularly energy access and efficiency projects. However, these banks cannot provide affordable lending capital at market rates. Examples from elsewhere, including in South Africa, have shown the effectiveness of DFI programmes that combine training commercial banks with providing a line of cheaper credit to support on-lending activities.

Additionally, organisations often report the challenge in accessing DFI capital due to the standards and reporting requirements. Further efforts to streamline or standardise these processes would likely enable more local organisations to tap into DFI funds.

Assessment

Although Uganda has created a solid investment environment and has proved successful in attracting investment to the oil and gas and the power generation sector to meet its growing energy needs, two major challenges lie ahead: 1) planning and standardisation; and 2) accessing affordable capital. These two areas are vital to ensure the most efficient development of the energy sector, including by attracting private actors to the most relevant areas and keeping costs reasonable for end users.

Planning and standardisation

To support the efficient allocation of public and private capital, detailed energy sector development plans can provide an important building block to identify which sector or projects the private sector should focus on. This exercise is particularly important in the power sector, where further investment is needed in transmission and distribution. Ideally, this process includes mapping from a neutral party that identifies where projects can be developed, leaving the private sector to then carry out the necessary due diligence.

Although the government has identified the value of PPPs – which are authorised under the PPP Act, 2015 – for both utility-scale projects and aggregated mini-grid or off-grid projects, so far they have been pursued on an *ad hoc* basis. The government has had a mixed experience with PPPs, with questions over whether they should be public- or private-sector led, and how to ensure that risks are adequately split between the parties involved.

That said, lessons can be learnt from recent positive examples outside of the energy sector, including the Kampala-Jinja expressway project. This project has been structured

to include a bridge loan that will be raised by special-purpose vehicles and partially funded through local commercial banks. Guarantees are provided by GuarantCo, along with insurance from the Multilateral Investment Guarantee Agency, which reassures private investors without requiring a sovereign guarantee. After five years, the project aims to refinance through an infrastructure bond that will be listed on the exchange. This structuring means that risk is shared between the public and private sector while also ensuring benefits to the Ugandan financial system via the inclusion of local banks and a listed bond. This latter development is important to improve the chances of replication, with local capital markets expected to play a growing role in the energy sector later in the decade.

As electricity demand increases, an underdeveloped transmission network can serve as a major bottleneck. In the European Union and the United States, solar PV projects take 1-4 years to develop, whereas high-voltage or ultra-high voltage lines can take up to 13 years. In Uganda's case, limited funds mean the government is unable to finance the expansion of the transmission network and generators are already being forced to evacuate power directly into the distribution network, which acts as a block on generation and leads to high losses.

Under recent reforms, the private sector is now authorised to participate in the transmission sector. However, attracting investment has been slow so far due to the nascent state of the regulations. Gridworks and the World Bank are working on a pilot to include the private sector in transmission, focusing on upgrading four existing substations to improve capacity. The pilot is structured as a lease agreement, reducing the private sector's exposure to demand risk, and will likely be a 70:30 debt to equity, with DFIs providing the debt. DFIs will likely remain a key source of low-cost debt for the transmission sector as it further develops.

Another area to consider during the planning process is where further gains can be made through standardisation. The power generation sector has been effective at attracting investment, and there are a number of valuable lessons to draw on. Initiatives like the GET FiT programme proved particularly effective, whereby a standardised PPA reduced negotiation periods from months to a matter of days. Replicating this approach wherever possible, notably in the transmission and distribution sectors, should be encouraged.

Accessing affordable capital

The cost of capital remains one of the major challenges across the energy sector, with costs being passed through to consumers via the tariff. There is pressure from both residential and commercial and industrial users to lower these costs, but solutions for one can end up increasing costs for the other. For example, the Uganda Manufacturing Association proposed a system where industrial parks would be able to buy power directly from the transmission system, thereby removing the distribution costs from their tariff. The government trialled a five-cent industrial tariff, but this failed, as it required too much subsidisation in order to not drive up the cost for other users.

Reducing the tariff further will rely on attracting cheaper capital across the electricity system. The government has been successful at refinancing some existing projects at more concessional rates. However, private capital providers still require derisking or credit enhancement mechanisms that drive up the costs for the government. The government has therefore sought to develop its own generation projects, such as the Karuma dam. However, such developments are expensive and government debt levels are already high, so they can only be pursued on a case-by-case basis. Equally, given the current

oversupply of generation, such financial outlays may now best be concentrated on the transmission and distribution networks, which both face operational issues and need to be further expanded.

Challenges in attracting appropriate and affordable capital are particularly pronounced for local developers. Foreign companies – both in the on- and off-grid spaces – are able to raise significantly more capital due to their access to international financial markets and their ability to meet stringent DFI standards and reporting requirements. In many cases, foreign developers have prior experience in similar environments that can support their capital raising, and in some cases have a cross-country portfolio that allows them to diversify the risk to their investors. This is particularly useful when funding the early stages of project development, such as feasibility studies, where risks are higher and local developers generally struggle to raise capital.

Increasing the sources of domestic capital

Domestic financing institutions play a key role in unlocking further capital, particularly for local developers. Local energy companies, many of which are small and medium-sized enterprises in the off-grid space, heavily rely on local commercial banks. However, banks do not generally lend to start-ups and may not always understand energy sector business models. For example, off-grid companies have reported that commercial banks struggle to assess the end user risk within PayGo models, and there is a mismatch between the funds banks are willing to provide – which tend to be a one-off loan – and the financing needed by developers – who generally need revolving facilities that you can draw down more than once. Additionally, commercial banks struggle to provide affordable capital once they factor in their own costs and capital requirements. For example, if the bank gives a 4.5-5% interest on a dollar deposit, this tends to translate to lending at over 9%.

A key facilitator for unlocking more capital for local companies, particularly in the off-grid space, would therefore be providing cheaper capital for on-lending,[3] accompanied by training on energy sector business models. Various on-lending schemes exist, such as development partners providing concessional capital or a revolving fund managed by the Uganda Energy Credit Capitalisation Company; however, these have not yet been able to reduce costs enough to meet the needs of many smaller players in the sector.

One of the other major challenges in reducing the cost of local capital is the impact of recent domestic government debt raising. In early 2023, short-term t-bills (i.e. short-term debt) had yields of roughly 10% with treasury bonds (i.e. long-term debt) at 13-15% depending on tenor. These high yields reduce the appetite of domestic capital providers to support energy projects, opting instead for government securities. For example, the National Social Security Fund – a potential source of patient domestic capital – holds over 75% of its portfolio in government-fixed income assets. As domestic savings increase from the current estimated level of USD 4.3 billion, there is potential for pension funds to play a greater role. Given their risk appetite and fiduciary duties, this is likely to be concentrated in the refinancing of operational utility-scale assets or aggregated distributed assets via securitisation. As more assets become operational, leveraging this pool of long-term domestic capital will be an important means to increase local currency finance within the

[3] On-lending refers to the practice of loans being provided, generally by DFIs, to local finance partners to lend to local companies, generally small and medium-sized enterprises.

system but also to provide an exit for capital providers that are more able to fund the riskier construction and development phases.

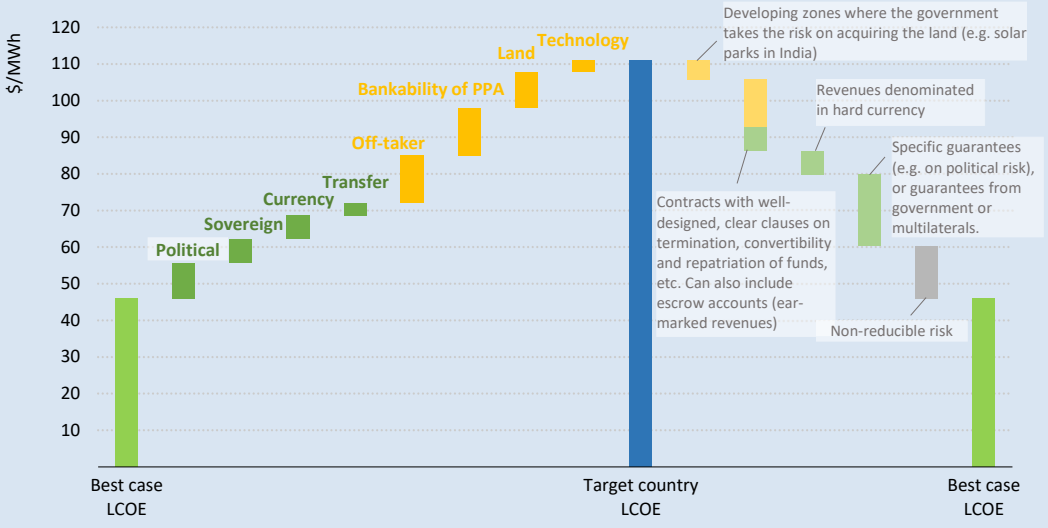
Box 10.2 Cost of Capital Observatory

The challenge of reducing the cost of capital for renewable projects is not unique to Uganda – it is one of the biggest obstacles to scaling up investment in clean energy across emerging markets and developing economies (EMDEs). In early 2023, the IEA, alongside the World Economic Forum, ETH Zurich and Imperial College London, introduced the Cost of Capital Observatory – an initiative to increase transparency on this vital topic.

Financing costs accounted for around half of the levelised cost of electricity of a solar photovoltaic (PV) plant reaching final investment decision in EMDEs in 2021, compared to 25-30% in advanced economies and China, leading to a disproportionate impact on investment spending in EMDEs. Analysis from the initial data within the Observatory found that the cost of capital for a typical solar PV plant in 2021 was two to three times higher in EMDEs than in advanced economies and China.

Based on survey data, the Observatory also seeks to illustrate some of the drivers behind these higher capital costs. It provides a methodology for calculating at the country level and provides potential solutions to reduce costs (Figure 10.3). Such analysis can serve as a helpful tool for policy makers and development finance institutions to understand where to focus efforts and how to produce the most cost-effective derisking solutions.

Figure 10.3 Illustrative breakdown of risks that explain country-by-country variations in the levelised cost of electricity for a given clean energy project



Notes: MWh = megawatt hour; LCOE = levelised cost of electricity; PPA = power purchase agreement.

Source: IEA (2023).

Climate finance and carbon markets

International attention to climate-related finance has increased, as evidenced by initiatives such as the as-yet-unmet target for developed nations to provide USD 100 billion per year to developing countries, as well as the announcement at COP 27 of the creation of a new Loss and Damage Fund. These climate-related funds can serve as a good source of capital for clean power projects, and critically can include grants that are vital for increasing the pipeline of bankable projects.

There are several means to access this capital, but much of it is distributed through large funds such as the GEF or the GCF, that can be complex to access. For example, one Ugandan government official reported that it took four years to access the funding for one GEF-financed project on GHG emissions reduction in waste management. Within the Ugandan government, there are limited climate finance officers with the knowledge and expertise on how best to unlock this capital. Development partners are funding the salaries of several new climate finance officers to support this capacity development. Additionally, the Global Green Growth Initiative (GGGI) has also been working with local organisations to get accredited to access GCF funds. This has included supporting the Uganda Development Bank to set up a climate finance facility that will seek GCF accreditation.

International carbon markets allow countries and companies to generate and trade carbon credits, which are verified metric tonnes of GHGs reduced, avoided or removed from the atmosphere. As carbon markets develop, these can drive foreign inflows by strengthening the commercial viability of projects, as well as supporting foreign investors' own carbon-reduction targets.

Project developers can generate and sell credits either under the international crediting mechanism of the UNFCCC (such as the Clean Development Mechanism under the Kyoto Protocol in the pre-2020 period or Article 6 under the Paris Agreement post-2020), or via voluntary carbon markets, which are independent crediting mechanisms, self-regulated and managed by non-governmental entities (such as Verra or Gold Standard). The impact of these carbon markets has so far been limited. Under the CDM, all 54 African countries accounted for only 3% of credits issued globally, although Uganda was one of the four largest issuers of these credits on the continent.

In the post-2020 regime, Article 6 presents new opportunities for African countries to engage in carbon markets. They can exchange internationally transferred mitigation outcomes among each other (under Article 6.2) or issue credits in a new UNFCCC-governed international carbon market, known as the Article 6.4 mechanism.

The Ugandan government has established the National Climate Change Mechanisms Taskforce to create a framework to include guidelines and regulations on both Article 6 and voluntary markets, with support from the UNDP. This task force operates under the Climate Change Department at the Ministry of Water and Environment. The framework will seek to cover the processes to participate in Article 6.2 – including around registration, internationally transferred mitigation outcomes authorisation, and validation and verification procedures – as well as setting the criteria to convert CDM activities to Article 6.4 (Gold Standard, 2023).

Recommendations

To reach its objectives, the government of Uganda should consider:

- Identifying sectors and key projects for public-private partnerships that would allow for the design of mutually beneficial financing structures, including domestic sources of capital where relevant.
- Providing further clarity on the timelines and project management of the upcoming electricity sector reform, ensuring skill retention and providing notice periods of any change in responsibilities to reduce uncertainty and disruption to financiers.
- Working with development partners to reduce capital costs and ensure that domestic financiers are involved in the design of blended finance instruments, particularly multi-stage instruments including grant, equity and debt elements.
- Seeking to confirm regulation around commercial and industrial options to allow generators to take advantage of the end of the single offtaker market.
- Prioritising investments – both public and private – into supporting the operation and maintenance of transmission and distribution infrastructure assets, as well as driving investment into developing these sectors.
- Seeking to develop transmission lines to neighbouring captive power markets while simultaneously engaging in discussions to develop the Eastern Africa Power Pool.
- Working with development partners to access climate finance channels and set national guidelines on carbon markets (both Article 6 and voluntary markets).

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ANNEX A: Acknowledgements

Review criteria

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

Review team and preparation of the report

The IEA in-depth review team visited Kampala on 20-27 March 2023. The team met with government officials, energy suppliers, interest groups and other stakeholders.

This report was drafted on the basis of these meetings, the team's preliminary assessment of the country's energy policy, the government's response to the IEA energy policy questionnaire and other information.

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The Norwegian Development Agency

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IEA Secretariat

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The report was designed and directed by Rebecca Gaghen, Head of Division of EMAL and Syrine El Abed, Africa Programme Officer.

Principal authors include: **Yuya Akizuki** (critical minerals, oil and gas), **Jenny Lindseth Birkeland** (access to cooking), **Syrine El Abed** (environment and climate change), **Emma Gordon** (investment), **Armin Mayer** (energy efficiency), **Arnaud Rouget** (energy access), **Philip Swanson** (electricity, renewables, oil and gas) and **Gianluca Tonolo** (energy access). Thank you to **Geofrey Bakkabulindi** for local coordination and contribution to the report.

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Organisations visited

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ANNEX B: Energy balances and key statistical data

	2000	2005	2010	2015	2020	2021
Indicators						
Population (millions)	24	28	32	37	44	46
GDP (billion USD, 2015 prices and PPPs)	31	44	65	85	103	109
TES/GDP (toe per thousand 2015 USD PPP)	0.30	0.25	0.21	0.21	0.21	0.20
Share of renewables in TES	96%	95%	92%	92%	92%	91%
Share of renewables in power generation	100%	97%	59%	98%	99%	99%
Share of modern renewables in TFC	14%	18%	20%	20%	19%	20%
Total energy supply (ktoe)	**9 278**	**10 970**	**13 610**	**17 607**	**21 051**	**22 105**
Coal	-	-	-	-	-	-
Oil	439	602	1 094	1 463	1 725	1 929
Natural gas	-	-	-	-	-	-
Renewables	8 860	10 373	12 519	16 150	19 344	20 209
Hydro	133	158	128	266	351	399
Bioenergy	8 727	10 214	12 390	15 882	18 983	19 799
Solar PV	-	0	2	3	10	11
Wind	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-
Other renewables	-	-	-	-	-	-
Others	-21	-	-	-	-	-
Imports (ktoe)	**477**	**641**	**1 187**	**1 576**	**5 033**	**4 623**
Coal	-	-	-	-	-	-
Oil	477	641	1 184	1 572	1 790	2 013
Natural gas	-	-	-	-	-	-
Electricity	0	0	3	4	2	2
Bioenergy	-	-	-	-	3 242	2 608
Others	0	-0	-	-	-	-

	2000	2005	2010	2015	2020	2021
Total final consumption (ktoe)	**7 368**	**8 819**	**10 675**	**13 845**	**15 899**	**16 822**
Coal	-	-	-	-	-	-
Oil	402	599	748	1 450	1 715	1 918
Natural gas	-	-	-	-	-	-
Electricity	60	87	140	216	281	307
Bioenergy	6 906	8 134	9 787	12 179	13 902	14 597
Others	-	- 0	-	-	-	- 0
Industry	**1 119**	**1 696**	**2 302**	**3 057**	**3 385**	**3 634**
Coal	-	-	-	-	-	-
Oil	78	159	198	350	377	414
Natural gas	-	-	-	-	-	-
Electricity	35	56	83	136	187	206
Bioenergy	1 006	1 481	2 021	2 571	2 821	3 014
Transport	**302**	**339**	**421**	**915**	**1 131**	**1 258**
Oil	302	339	421	915	1 131	1 258
Electricity	-	-	-	-	-	-
Others	-	-	-	0	0	-
Buildings	**5 936**	**6 770**	**7 889**	**9 793**	**11 195**	**11 721**
Residential	5 445	6 045	6 928	8 593	9 892	10 289
Coal	-	-	-	-	-	-
Oil	12	50	41	65	15	26
Natural gas	-	-	-	-	-	-
Electricity	22	27	36	52	63	67
Bioenergy	5 412	5 969	6 852	8 476	9 814	10 196
Others	-	0	0	0	0	-
Commercial and public services	490	725	961	1 200	1 303	1 431
Coal	-	-	-	-	-	-
Oil	-	37	25	41	5	11
Natural gas	-	-	-	-	-	-
Electricity	3	4	21	28	31	34
Bioenergy	487	684	915	1 132	1 267	1 386
Others	-	-	-	-	-	-

	2000	2005	2010	2015	2020	2021
Others	**1**	**3**	**25**	**30**	**127**	**142**
Agriculture/forestry	1	3	25	30	127	140
Final consumption not elsewhere specified	-	-	-	-	-	2
Coal	-	-	-	-	-	-
Oil	1	3	25	30	127	142
Electricity generation (GWh)	**1 587**	**1 958**	**2 733**	**3 556**	**4 521**	**5 185**
Nuclear	-	-	-	-	-	-
Coal	-	-	-	-	-	-
Oil	6	68	1 109	79	58	52
Natural gas	-	-	-	-	-	-
Renewables	1 581	1 890	1 624	3 477	4 462	5 132
Hydro	1 551	1 839	1 485	3 092	4 081	4 640
Bioenergy	30	47	117	353	259	367
Wind	-	-	-	-	-	-
Solar PV	-	4	22	32	122	125
Solar thermal	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-
Other renewables	-	-	-	-	-	-
Others	-	-	-	-	-	-
CO_2 emissions (kt)	**1 190**	**1 860**	**3 009**	**4 363**	**5 142**	**5 731**
Oil						
Motor gasoline excluding bio	491	475	661	1 732	2 126	2 434
Gas/diesel oil excluding bio	427	1 094	2 025	2 259	2 814	3 034
Fuel oil	106	131	109	143	51	45
Kerosene	164	148	202	154	118	138
Kerosene type jet fuel excluding bio	0	3	6	3	1	2
Liquefied petroleum gas	3	9	6	72	32	77
Power generation	3	58	779	59	51	45
Transport	905	1 022	1 280	2 742	3 391	3 766
Manufacturing industries and construction	241	494	605	1 073	1 151	1 264
Agriculture, forestry, fishing	6	19	143	174	494	548

		2000	2005	2010	2015	2020	2021
	Agriculture/forestry	3	9	71	87	388	426
	Fishing	3	9	71	87	106	122
Buildings		34	268	201	316	55	101
	Residential	34	153	124	192	43	72
	Commercial and public services	0	116	77	124	12	29
Others		0	0	0	0	0	6

Notes: GDP = gross domestic product; USD = United States dollar; PPP = purchasing power parity; TES = total energy supply; ktoe = kilotonnes of oil equivalent; PV = photovoltaic; GWh = gigawatt hour; kt = kilotonne.

ANNEX C: International Energy Agency "Shared Goals"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Türkiye, the United Kingdom and the United States.

ANNEX D: Glossary and list of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

AFOLU	agriculture, forestry and other land use
BGFA	Beyond the Grid Fund for Africa
CDM	Clean Development Mechanism
CNOOC	China National Offshore Oil Corporation
CREEC	Centre for Research in Energy and Energy Conservation (at Makerere University)
CSO	civil society organisation
DFI	development finance institution
EACOP	East African Crude Oil Pipeline
EACREEE	East African Centre of Excellence for Renewable Energy and Energy Efficiency
EASP	Energy Access Scale-up Project
ECP	Electricity Connections Policy
EITI	Extractive Industries Transparency Initiative
EMDE	emerging markets and developing economies
ERA	Electricity Regulatory Authority
ESCO	energy service company
ESIA	environmental and social impact assessment
EV	electric vehicle
FY	fiscal year
GCF	Green Climate Fund
GDP	gross national product
GEF	Global Environment Facility
GET FiT	Global Energy Transfer Feed-in-Tariff
GGDS	Uganda Green Growth Development Strategy
GHG	greenhouse gas
GIS	geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German development agency)
GOGLA	Global Off-Grid Lighting Association
HPP	hydropower plant
IAEA	International Atomic Energy Agency
IERMP	Integrated Energy Resource Master Plan
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer

LCOE	levelised cost of electricity
LPG	liquified petroleum gas
MEMD	Ministry of Energy and Mineral Development
MEPS	minimum energy performance standard
MoU	Memorandum of understanding
MWE	Ministry of Water and Environment
NBRB	National Building Review Board
NDC	Nationally Determined Contribution
NDP III	Third National Development Plan
NEMA	National Environmental Management Authority
NPA	National Planning Authority
O&M	operations and maintenance
OPEC	Organization of the Petroleum Exporting Countries
PAU	Petroleum Authority of Uganda
PPA	power purchase agreement
PPP	public-private partnership
PPP	purchasing power parity
PSA	Production Sharing Agreement
PV	photovoltaic
R&D	research and development
REA	Rural Electrification Agency
REF	Rural Electrification Fund
REFiT	Renewable energy Feed-in Tariff
RESP	Rural Electrification Strategy and Plan
S&T	science and technology
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SNV	Netherlands Development Organisation
tbc	to be confirmed
TES	total energy supply
TFC	total final consumption
UBOS	Uganda Bureau of Statistics
UECCC	Uganda Energy Credit Capitalisation Company
UEDCL	Uganda Electricity Distribution Company Limited
UEGCL	Uganda Electricity Generation Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UGX	Uganda shilling
UNBS	Uganda National Bureau of Standards
UNDP	United National Development Programme
UNFCCC	United Nations Framework Convention for Climate Change
UNOC	Uganda National Oil Company

UNREEEA	Uganda National Renewable Energy and Energy Efficiency Alliance
USD	United States dollar
VAT	value-added tax
WHO	World Health Organization

Units of measure

bcm	billion cubic metres
b/d	barrels per day
CO_2-eq	carbon dioxide equivalent
GJ	gigajoule
GW	gigawatt
GWh	gigawatt hour
kb/d	thousand barrels per day
$kgCO_2$-eq	kilogramme of carbon dioxide equivalent
km	kilometre
km^2	square kilometre
kt	kilotonne
ktoe	kilotonnes of oil equivalent
kV	kilovolt
kWh	kilowatt hour
kWh/m^2	kilowatt hours per square metre
m	metre
m/s	metres per second
mb	million barrels
MJ	megajoule
Mt	million tonnes
$MtCO_2$	million tonnes of carbon dioxide
$MtCO_2$-eq	million tonnes of carbon dioxide equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
PJ	petajoule
toe	tonne of oil equivalent
TWh	terawatt hour
USDc/kWh	USD cent per kilowatt hour
Wp	watt-peak

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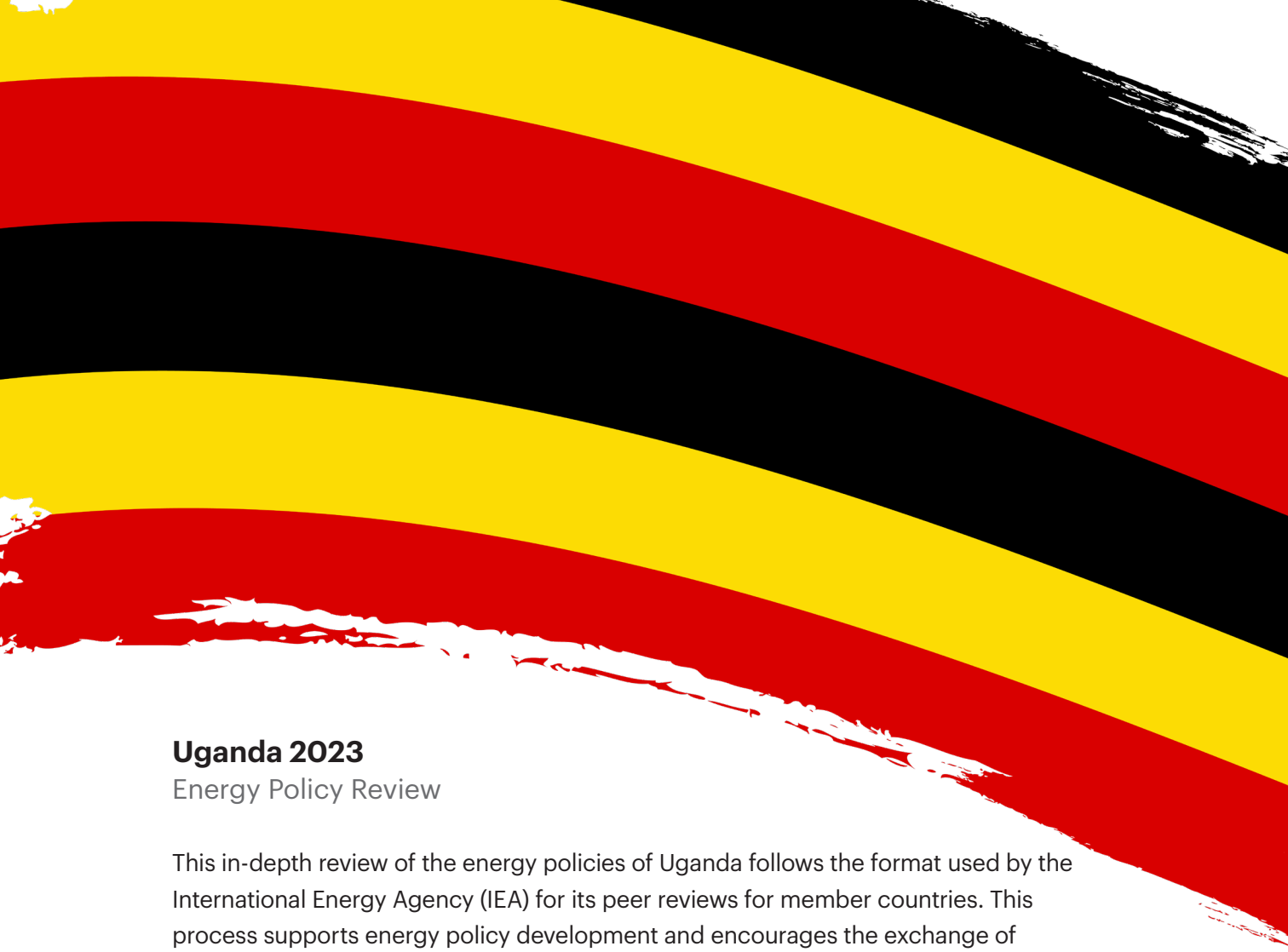

Uganda 2023

Energy Policy Review

This in-depth review of the energy policies of Uganda follows the format used by the International Energy Agency (IEA) for its peer reviews for member countries. This process supports energy policy development and encourages the exchange of international best practices and experiences.

Uganda has set an ambitious agenda to develop its substantial energy and mineral resources, promote economic development, end energy poverty, and lead the country to a just energy transition. Uganda's stated objective in Vision 2040 is to transform into "a modern and prosperous country", ensuring a better future for its citizens. The energy sector will play an important role in helping Uganda achieve this.

The newly launched Energy Policy for Uganda 2023 will serve as a crucial tool and major contribution to the country's ambitious agenda. Uganda already has in place much of the technical expertise, government institutions and policy frameworks to reach its energy goals. It has also made significant progress over the past two decades in providing access to electricity and expanding generation capacity, and further ambition is encouraged to achieve universal energy access by 2050.

This report assesses the energy sector and the related challenges facing Uganda and serves as a situational analysis that feeds into the development of the country's Energy Transition Plan to provide policy recommendations and support the development of the energy sector and the path towards universal access for all.