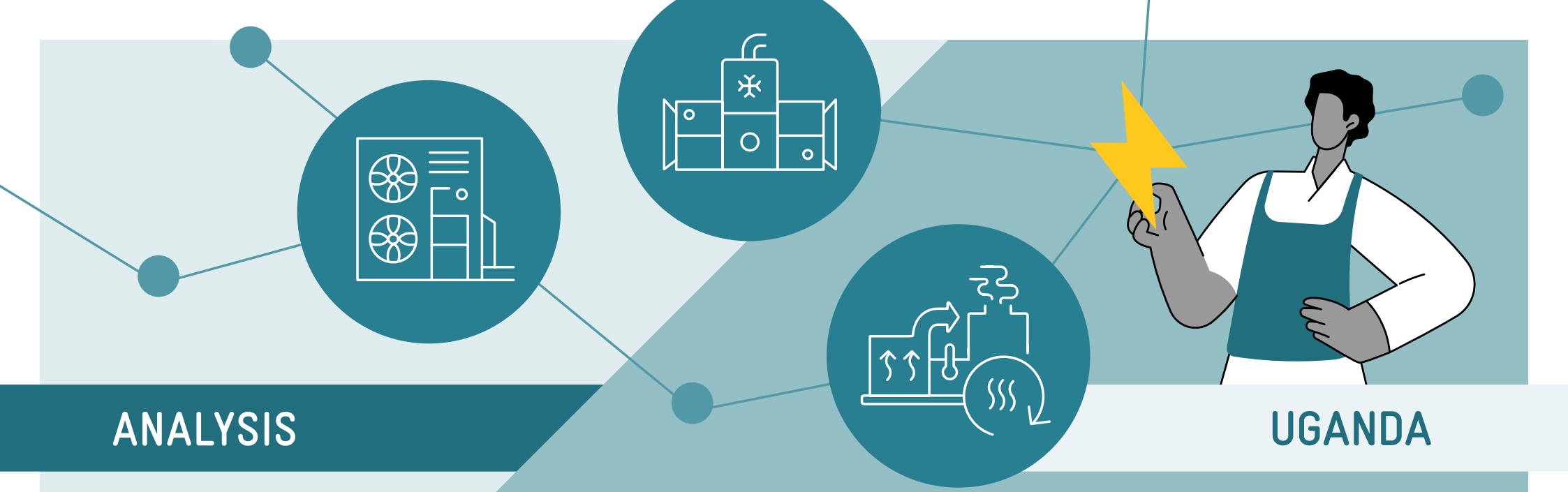

ANALYSIS

UGANDA

Sector Analysis Uganda

Energy Efficiency in Commercial and Industrial Sectors

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

This publication was commissioned by the German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Energy (BMWE)

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Abbreviations/acronyms

AC	Air conditioning
C&I	Commercial and industrial
CTC	Crushing, tearing and curling (tea processing method)
EAC	East African Community
EE	Energy efficiency
EIA	US Energy Information Administration
ERA	Electricity Regulatory Authority
ESCO	Energy service company
EV	Electric vehicle
GDP	Gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GVA	Gross value added
HVAC	Heating, ventilation and air conditioning
ICT	Information and communication technology
IE3/IE4	International Efficiency Class 3/4 (motor standards)
IEA	International Energy Agency
LED	Light emitting diode
MEMD	Ministry of Energy and Mineral Development
MEPS	Minimum energy performance standards
MOFPED	Ministry of Finance, Planning and Economic Development
NDPIV	Fourth National Development Plan
NGO	Non-governmental organisation
NPA	National Planning Authority
OECD	Organisation for Economic Co-operation and Development
RBOB	Reformulated blendstock for oxygenate blending (gasoline)
SMEs	Small and medium-sized enterprises
UBOS	Uganda Bureau of Statistics
UCDA	Uganda Coffee Development Authority
UEDCL	Uganda Electricity Distribution Company Limited
UEGCL	Uganda Electricity Generation Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UNBS	Uganda National Bureau of Standards
VSD	Variable speed drive
WTI	West Texas Intermediate (crude oil benchmark)

Currency units

UGX	Ugandan shilling
USD	United States dollar
EUR	Euro

1 USD = EUR 0.8526
1 EUR = USD 1.1728
1 EUR = UGX 4,171.12
1 UGX = EUR 0.0002397
1 USD = UGX 3,560.28
1 UGX = USD 0.0002809

Last updated 13 August 2025 11:55 am UTC

Source: exchange-rates.org, 2025

Technical units

kg	Kilogram
ktoe	Kilotonne of oil equivalent
kW	Kilowatt (unit of power)
kWh	Kilowatt hour (unit of energy)
MW	Megawatt

ENERGY SOLUTIONS – MADE IN GERMANY

The German Energy Solutions Initiative

The German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Energy (BMWE) aims to globalise German technologies and expertise in climate-friendly energy solutions.

Years of promoting smart and sustainable energy solutions in Germany have led to a thriving industry known for world-class technologies. Thousands of specialised small and medium-sized enterprises (SMEs) focus on developing renewable energy systems, energy efficiency solutions, smart grids, and storage technologies. Cutting-edge energy solutions are also built on emerging technologies such as power-to-gas, fuel cells, and green hydrogen. The initiative's strategy is shaped around ongoing collaboration with the German business community.

The initiative creates benefits for Germany and the partner countries by:

- boosting global interest in sustainable energy solutions
- encouraging the use of renewables, energy efficiency technologies, smart grids, and storage technologies, while facilitating knowledge exchange and capacity building
- enhancing economic, technical and business cooperation between Germany and partner countries

THE PROJECT DEVELOPMENT PROGRAMME (PDP)

PDP is a key pillar of the German Energy Solutions Initiative and is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It connects development cooperation with private-sector engagement and supports climate-friendly energy solutions in selected developing and emerging countries, enabling local businesses to adopt solutions in energy efficiency, electricity and heat supply, and hydrogen, while facilitating market access for German solution providers.

Developing and emerging economies offer promising business potential for climate-friendly energy solutions but also pose challenges for international business partners. The PDP team works closely with local industries to develop financially viable projects by providing technical expertise, financial guidance, and networking opportunities.

It identifies project leads, collects and analyses energy consumption data, and assesses projects from both a technical and economic perspective. This includes outlining the business case, calculating payback periods, and evaluating profitability. Companies can then choose to finance projects using their own funds or explore leasing and other financing options. PDP provides cost-free advice to local companies and connects them with German solution providers for project implementation.

Additionally, by offering training, organising reference project visits, and publishing studies on the potential of climate-friendly solutions and on navigating regulatory frameworks, the programme supports market development and fosters private-sector cooperation.

Executive summary

Uganda's population and economy are growing rapidly, with increasing industrial activity in areas such as food processing and steel production, alongside commercial sectors including hospitality, retail and trade. This puts pressure on the country's energy systems. There is great potential for energy efficiency (EE) in business and industry, but many companies still use old, inefficient technology and equipment. Energy audits show that thermal systems, motors and compressed air systems are often inefficient, especially in manufacturing and food processing.

There is growing interest in EE, especially among small and medium-sized enterprises (SMEs) that want to lower costs and increase productivity. However, the adoption of EE measures is still low because of issues such as limited funding, lack of knowledge, weak policy enforcement and a poorly developed supply chain for energy-efficient technologies. Most commercial and industrial (C&I) energy-efficient products are imported after an energy audit, which means there can be long delays and sometimes cheaper, less effective options are used. These market conditions create both a challenge and a big opportunity for technology and service companies, especially those with experience in complete EE solutions.

Zusammenfassung

Ugandas Bevölkerung und Wirtschaft wachsen rasant. Dabei nimmt die industrielle Aktivität sowohl in der Lebensmittelverarbeitung und Stahlproduktion zu als auch kommerzielle Bereiche wie Gastgewerbe, Einzelhandel und Handel gewinnen an Bedeutung . Dies setzt die Energiesysteme des Landes unter Druck.

In Gewerbe und Industrie bestehen großes Potenzial für Energieeffizienz (EE), doch viele Unternehmen nutzen weiterhin alte, ineffiziente Technologien und Anlagen. Energieaudits zeigen, dass insbesondere thermische Systeme, Motoren und Druckluftsysteme häufig ineffizient arbeiten, vor allem in der verarbeitenden Industrie und der Lebensmittelproduktion.

Insbesondere bei kleinen und mittleren Unternehmen (KMU), die ihre Kosten senken und ihre Produktivität steigern möchten, wächst das Interesse an EnEff. Jedoch setzen sie die EnEff-Maßnahmen noch selten um, weil es an Finanzierungsmöglichkeiten, Wissen, der konsequenten Durchsetzung von Vorgaben sowie einer gut entwickelten Lieferkette für EnEff-Technologien fehlt. Energieeffiziente Technologien, die im kommerziellen und industriellen (C&I) Bereich eingesetzt werden, müssen nach einem Energieaudit oft importiert werden. Dies kann zu langen Verzögerungen führen und manchmal den Einsatz günstigerer, weniger wirksamer Alternativen zur Folge haben. Diese Marktbedingungen stellen sowohl eine Herausforderung als auch eine große Chance für Technologie- und Dienstleistungsunternehmen dar – insbesondere für solche mit Erfahrung in ganzheitlichen EnEff-Lösungen.

STRATEGIC OPPORTUNITIES FOR GERMAN COMPANIES

Uganda's C&I facilities offer considerable scope for replacing outdated, high energy-consuming equipment with high-efficiency motors, boilers, pumps and compressed air systems. Such upgrades can significantly lower energy consumption and operational costs while improving reliability and output quality. The combination of clear technical potential and increasing cost pressures makes this one of the most attractive market entry points for experienced technology suppliers.

In a market where grid power is unreliable and the use of diesel generators is common, combining hybrid solar systems with EE upgrades is a valuable solution. These systems can cut fuel costs, increase energy independence and provide quick returns on investment, especially for businesses with high daytime energy needs, such as beverage bottling, hospitality and food processing. Companies based in Germany that offer complete hybrid solutions, energy storage and smart control systems are in a good position to meet this demand.

The absence of established in-country distribution for C&I-grade energy-efficient products presents a clear opening for new market entrants. By ensuring reliable stock availability, offering after-sales support and providing technical training, suppliers can overcome one of the most significant bottlenecks to adoption. This will not only accelerate market penetration but also create opportunities for ongoing service contracts and repeat business.

STRATEGISCHE CHANCEN FÜR DEUTSCHE UNTERNEHMEN

(C&I)-Unternehmen in Uganda bieten erhebliche Möglichkeiten, veraltete, energieintensive Geräte durch hocheffiziente Motoren, Kessel, Pumpen und Druckluftsysteme zu ersetzen. Solche Modernisierungen können den Energieverbrauch und die Betriebskosten deutlich senken, während gleichzeitig Zuverlässigkeit und Produktionsqualität verbessert werden. Die Kombination aus klar erkennbarem technischem Potenzial und zunehmendem Kostendruck bieten einen attraktiven Markteintrittspunkt für erfahrene Technologieanbieter.

In einem Markt, in dem die Netzstromversorgung unzuverlässig ist und Dieselgeneratoren weit verbreitet sind, stellt die Kombination von hybriden Solarsystemen mit EnEff-Modernisierungen eine wertvolle Lösung dar. Diese Systeme können die Kraftstoffkosten reduzieren, die Energieunabhängigkeit steigern und schnelle Amortisationen ermöglichen, insbesondere für Unternehmen mit hohem Energiebedarf während des Tages, zum Beispiel Getränkeabfüllung, Gastgewerbe und Lebensmittelverarbeitung. In Deutschland ansässige Unternehmen, die Hybridlösungen, Energiespeicher und intelligente Steuerungssysteme anbieten, sind gut aufgestellt, diese Nachfrage bedienen zu können.

Das Fehlen etablierter landesweiter Verkaufskanäle für C&I-taugliche energieeffiziente Technologieneröffnet den Raum für neue Marktteilnehmer. Wird die zuverlässige Verfügbarkeit von Produkten sichergestellt und werden After-Sales-Service sowie technische Schulungen bereitgestellt, können Anbieter eine der größten Hürden für die Einführung überwinden. Dies beschleunigt nicht nur die Marktdurchdringung, sondern schafft auch Chancen für laufende Serviceverträge und Folgegeschäfte.

CHALLENGES AND MARKET DEVELOPMENT NEEDS

Many companies in Uganda are unable to invest in energy-efficient upgrades despite the considerable long-term cost savings that such improvements could bring. The limited availability of financing options, specifically for EE projects, such as leasing arrangements or energy performance contracts, hinders the large-scale implementation of projects with rapid payback.

Uganda's EE policy framework suffers from inconsistent enforcement, which allows outdated and inefficient equipment to continue operating without penalty. This lack of enforcement not only diminishes the immediate appeal of more efficient alternatives but also delays the overall market transformation towards sustainable energy practices. The absence of stringent regulations and monitoring mechanisms means that businesses and industries often continue to use older, less efficient technologies, foregoing the long-term cost savings and environmental benefits that energy-efficient upgrades could provide. Stronger policy enforcement, coupled with incentives for adopting energy-efficient technologies, is essential to drive significant change.

HERAUSFORDERUNGEN UND ANFORDERUNGEN AN DIE MARKTENTWICKLUNG

Viele Unternehmen in Uganda sind nicht in der Lage, in EnEff-Modernisierungen zu investieren – trotz der erheblichen langfristigen Kosteneinsparungen, die solche Verbesserungen mit sich bringen können. Die begrenzte Verfügbarkeit von Finanzierungsinstrumenten speziell für EnEff-Projekte, zum Beispiel Leasingmodelle oder Energy-Performance-Contracts, behindert die großflächige Umsetzung von Vorhaben mit schneller Amortisation.

Politische EnEff-Rahmenbedingungen in Uganda leiden unter einer inkonsistenten Durchsetzung. Dadurch können veraltete und ineffiziente Anlagen ohne Sanktionen weiterbetrieben werden. Diese fehlende Kontrolle mindert nicht nur die unmittelbare Attraktivität effizienterer Alternativen, sondern verzögert die gesamte Markttransformation hin zu nachhaltigen Energielösungen. Das Fehlen strenger Vorschriften und Überwachungsmechanismen führt dazu, dass Unternehmen häufig weiterhin ältere, weniger effiziente Technologien nutzen – und damit sowohl langfristige Kosteneinsparungen als auch ökologische Vorteile ungenutzt lassen. Eine konsequentere Durchsetzung der Politik, kombiniert mit Anreizen für den Einsatz von EnEff-Technologien, ist entscheidend für das Anstoßen substanzieller Veränderungen.

The absence of local suppliers for higher-tier energy-efficient technologies leads to slow purchasing processes, increased expenses and a dependence on inferior substitutes. This deficient supply chain significantly impedes the broader implementation of EE targets in C&I sectors, as companies struggle to access the best available technologies without incurring substantial delays and costs. The lack of local suppliers for energy-efficient technologies also hinders the development of local expertise and support services, further exacerbating the challenges of adopting and maintaining energy-efficient systems. Addressing this gap through strategic partnerships and investments in local supply chains is crucial for fostering a dynamic and sustainable EE approach.

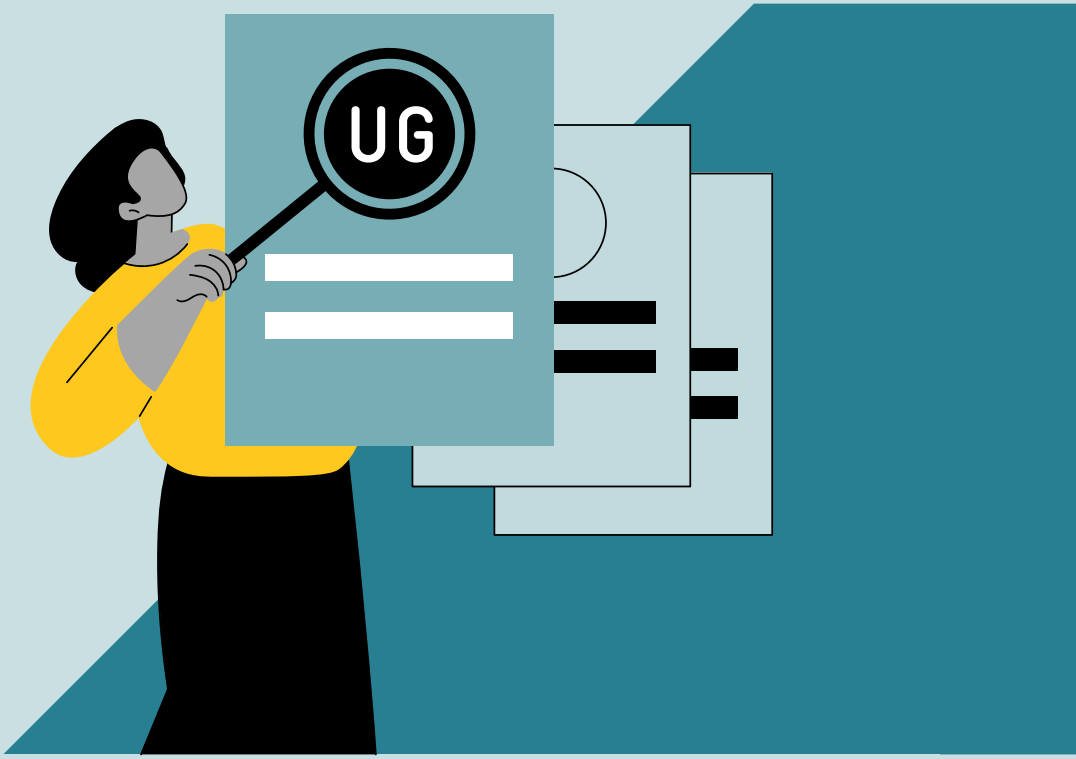
To fully realise this potential, Uganda needs to aggressively pursue stronger policy enforcement, significantly increase financing channels and cultivate a thriving ecosystem of local suppliers and service providers. Success in these areas promises to transform Uganda's EE market from one of slow-moving adoption to a vibrant, rapidly expanding sector, presenting business opportunities for German companies to become key partners in the country's industrial evolution.

Das Fehlen lokaler Anbieter für hochwertige EnEff-Technologien führt zu langwierigen Beschaffungsprozessen, höheren Kosten und einer Abhängigkeit von minderwertigen Ersatzlösungen. Diese unzureichende Lieferkette bremst die breite Einführung von EnEff-Zielen im C&I-Sektor erheblich, da Unternehmen Schwierigkeiten haben, Zugang zu den besten verfügbaren Technologien zu erhalten, ohne dabei erhebliche Verzögerungen und Mehrkosten in Kauf nehmen zu müssen. Das Fehlen lokaler Anbieter für EnEff-Technologien behindert zudem den Aufbau lokaler Expertise und Unterstützungsleistungen, was die Herausforderungen bei der Einführung und Wartung energieeffizienter -Systeme weiter verschärft. Diese Lücke durch strategische Partnerschaften und Investitionen in lokale Lieferketten zu schließen, ist entscheidend dafür, dass ein dynamischer und nachhaltiger EnEff-Ansatz gefördert wird.

Um dieses Potenzial voll ausschöpfen zu können, muss Uganda konsequent eine stärkere politische Durchsetzung verfolgen, die Finanzierungsmöglichkeiten deutlich ausweiten und ein dynamisches Ökosystem lokaler Anbieter und Dienstleister aufbauen. Fortschritte in diesen Bereichen können den EnEff-Markt Ugandas von einer schleppenden Einführung hin zu einem lebendigen, schnell wachsenden Sektor transformieren. Und das eröffnet deutschen Unternehmen die Chance, sich als wichtige Partner in der industriellen Entwicklung des Landes zu positionieren.

1

General profile



Uganda, officially the Republic of Uganda, is a land-locked country in East Africa bordered by Kenya to the east, South Sudan to the north, the Democratic Republic of the Congo to the west, Rwanda to the south-west and Tanzania to the south. The capital city is Kampala, which is the country's primary urban and commercial centre. As of 2024, Uganda's population is approximately 45.9 million, with a growth rate of 2.9% (UBOS, 2024), making it one of the fastest-growing populations in the world. The country covers a total area of 241,038 square kilometres, including significant water bodies, such as Lake Victoria, Africa's largest lake and a vital resource for transportation, fishing and hydroelectric power generation. English and Swahili are the official languages, reflecting Uganda's diverse cultural and linguistic heritage. The country's economy is predominantly agricultural, with a significant portion of the population engaged in subsistence and commercial farming (UBOS, 2024). Coffee, tea, cotton and horticultural products are major exports, and the services and industrial sectors are growing, particularly in urban areas such as Kampala, Jinja and Mbarara. The country boasts considerable natural resources, including fertile soils, minerals such as gold, copper and cobalt, and newly discovered oil reserves, which have the potential to transform its economy.

1.1 Economic development

Uganda's economy has been strong despite global challenges. In 2024, it grew by 6.1%, up from 5.3% the previous year. This was due to growth in services and industry, more exports of coffee and gold, more investment in oil and fewer supply chain problems. Government programmes, such as the Parish Development Model, also helped. Inflation fell in 2024, remaining below the Central Bank's 5% target due to lower food prices, tighter monetary policy, improved global conditions and a stable exchange rate. However, data show that in 2019, 20.3% of Ugandans were living in poverty based on the national poverty line of one dollar per person per day. This decreased further to 16.9% in 2024, compared to 21.4% in 2016 (UBOS, 2024). The country's gross domestic product (GDP) growth averaged 5% for the last nine fiscal years, peaking at 6.4% in 2018 and dipping to a low of 3% in 2019. In the fiscal year 2024/25, the economy grew by 6.3%, up from 6.1% the previous year (UBOS, 2025). Projections indicate a growth rate of 7% by the end of 2024, trending towards 8.5% in 2025 and 10% in 2026. This growth is driven by increased investments in key sectors such as agriculture, industry and services, the latter concentrated particularly in urban areas. Uganda is experiencing rapid urbanisation due to fast population growth, according to the United Nations estimates, Uganda is expected to be one of the nine countries accounting for 50% of global population growth between 2015 and 2050 (United Nations, 2015). Uganda Vision 2040 aims to transform Uganda into a competitive upper-middle-income country. This entails a multi-faceted approach, including strengthening infrastructure, promoting industrialisation, enhancing human capital development and improving governance (NPA, 2024).

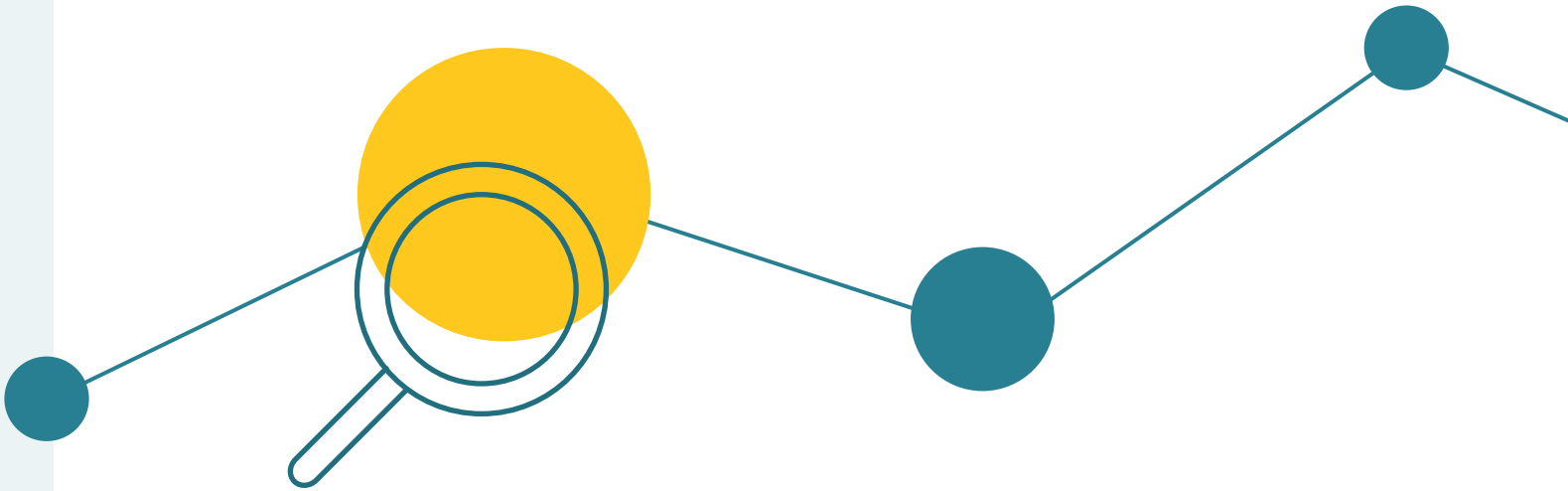
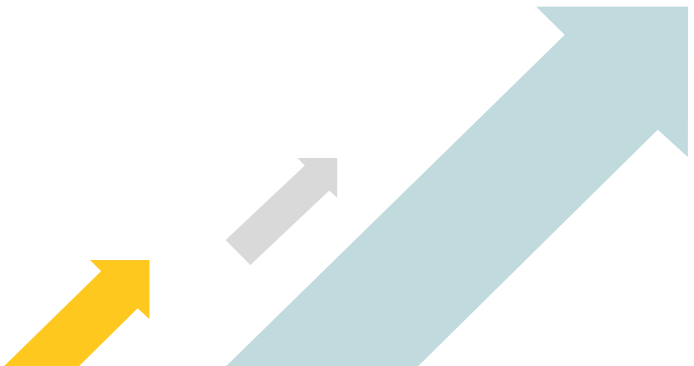


TABLE 1. Uganda's economic indicators

	2015	2020	2024
GDP (million current USD)	29,297	38,061	48,243
GDP growth rate (annual %, constant 2015 prices)	6.1	–1.4	6.5
GDP per capita (current USD)	781.7	857.1	1,021.0
Economy: Agriculture (% of GVA)	23.3	26.6	27.1
Economy: Industry (% of GVA)	29.4	28.5	28.2
Economy: Services and other activities (% of GVA)	47.3	44.9	44.7
Employment in agriculture (% employed)	70.8	67.9	66.3
Employment in industry (% employed)	7	7.1	7.3
Employment in services (% employed)	22.2	25	26.4
Unemployment (% of labour force)	2.8	3.8	2.8
Labour force participation rate (female/male population %)	66.7/73.9	66.9/71.9	67.6/72.3
CPI: Consumer price index (2010=100)	151	111	128
Agricultural production index (2014–2016=100)	103	139	136
International trade: Exports (million current USD)	2,267	4,149	5,610
International trade: Imports (million current USD)	5,528	8,251	12,568
International trade: Balance (million current USD)	–3,261	–4,102	–6,958
Balance of payments, current account (million USD)	–1,649	–3,598	–4,172

Source: UNData, Uganda economic indicators (United Nations, 2025)

The Fourth National Development Plan (NDPIV) aims to tripple Uganda's GDP from USD 53.2 billion in fiscal year 2023/2024 to USD 158 billion by 2029/2030. This ambitious plan targets an annual growth rate of 10.1% by 2029/2030, up from 6.6% in 2024/2025. Additionally, the plan seeks to increase per capita income from USD 1,146 to USD 2,008 and reduce the proportion of households engaged in subsistence farming to 31%. Uganda plans to invest UGX 593.6 trillion (approximately USD 160 billion) over five years, with 69.6% funded by the public sector and 30.4% by the private sector. The NDPIV emphasises investments in key growth areas, including agro-industry, tourism, mining, oil and gas development, the knowledge economy, information and communication technology (ICT) and finance (NPA, 2025).



This section provides an overview of the key economic sectors in Uganda that drive development, including agriculture, industry and manufacturing, and the service sector.

1.2 Key economic sectors

1.2.1 Agriculture

Agriculture is a vital component of Uganda's economy, employing approximately 68% of the workforce and accounting for about 24% of GDP. The sector is characterised mainly by subsistence and smallholder production, with coffee featuring as a significant export crop.

Uganda's coffee exports for 2024/2025 are expected to grow by 1.44% (6.9 million metric tonnes), thanks to government measures to combat pests and diseases (UCDA, 2024). As of 2024, Uganda ranked as Africa's second-largest coffee producer, following Ethiopia, with coffee exports constituting approximately 20% of the country's total exports in 2023/24 and generating around USD 1.84 billion. In May 2025, Uganda overtook its rival to become the continent's leading exporter. That month, it delivered a record 47,606.7 tonnes, 43.59% more than in May 2024, earning USD 243.95 million. Annual exports from June 2024 to May 2025 reached 7.43 million 60 kg bags of coffee worth USD 2.09 billion, with Europe taking the largest share by far (67%), followed by Africa (18%) and Asia (13%). The nation also produces substantial quantities of sugar cane, plantains, maize, cassava and sweet potatoes (FAO, 2023).

The dairy sector has experienced considerable growth, with annual milk production rising from 2.2 billion litres in 2018 to 5.3 billion litres by June 2024. Milk exports in the twelve months leading up to January 2024 reached USD 264.5 million, up from USD 102.6 million the previous year (FAO, 2023).

1.2.2 Industry and manufacturing

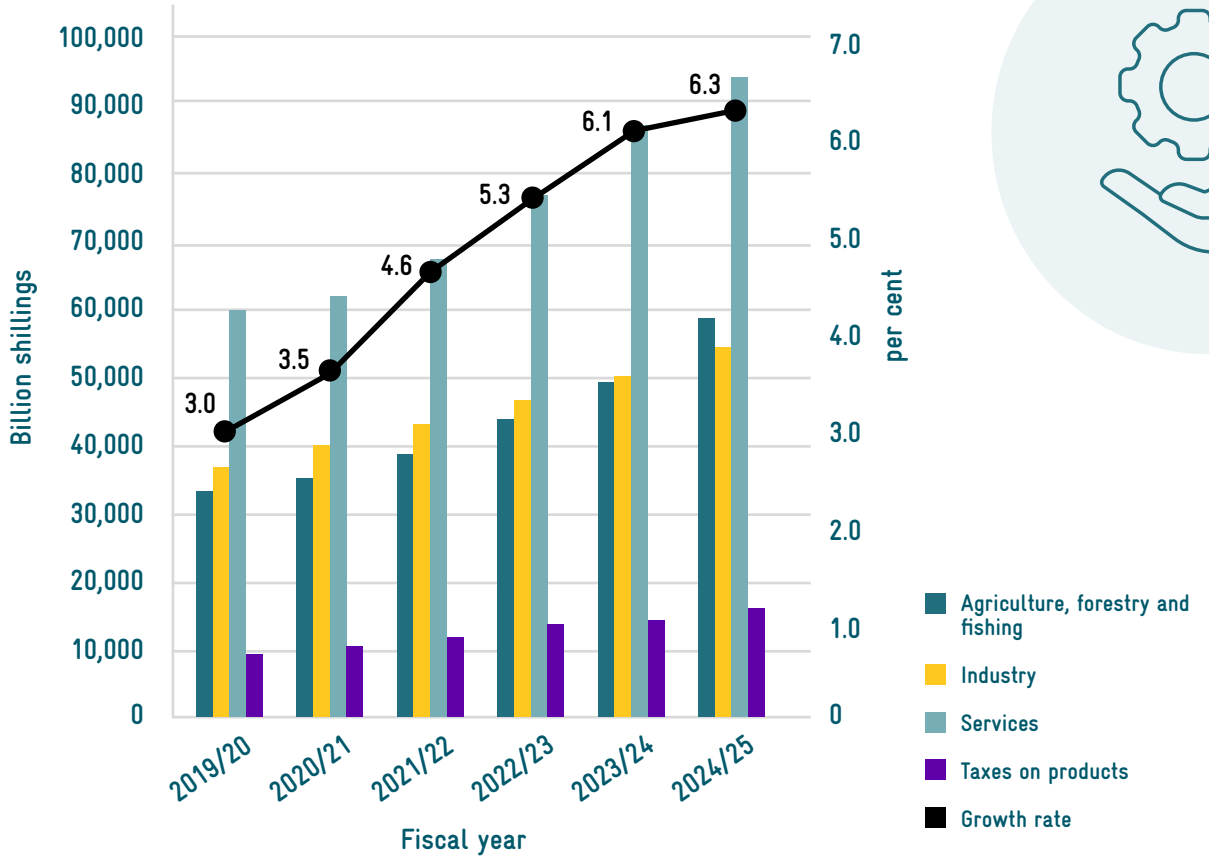
Uganda's industrial sector, while smaller than its agricultural sector, plays a crucial role in economic diversification and value addition, contributing approximately 25% to the country's GDP. Growth in this sector is bolstered by investments in infrastructure and the burgeoning oil and gas industry (UBOS, 2024).

Manufacturing, a subset of the industrial sector, contributed 15.8% to GDP in 2020 and employed approximately 6.6% of the formal sector labour force. Key manufacturing activities include food processing, beverage production, textiles, chemicals and construction materials. Between 2016 and 2020, the manufacturing sector experienced steady growth, with notable increases in the production of textiles, chemicals and cement.

The industrial sector experienced 7% growth in 2024/2025, an increase from 4% in 2023/2024, primarily driven by improved performance in manufacturing and construction, which grew by 5.5% and 12.2% respectively. Mining and quarrying grew by 3.4% and electricity by 10.3% (UBOS, 2024).

Manufacturing benefited from increased grain milling, starch production, cement, lime and plaster, beer, sugar, furniture, plastics, edible oils and fats, and pharmaceuticals. The construction sector's growth was attributed to increased public construction activities. Additionally, electricity production rose by 8.9% to meet the growing power demands of large industries (MOFPED, 2024). The government's ongoing efforts to establish and support industrial parks and markets, coupled with the provision of affordable credit, continue to foster growth in the industrial sector.

FIGURE 1. GDP growth rate and sectoral performance 2019/2020–2024/2025



Source: Uganda Bureau of Statistics (UBOS), 'Preliminary Annual Gross Domestic Product 2024/25', Press release (UBOS, 2025)

1.2.3 Services

The service sector is the largest contributor to Uganda's GDP, with a share of approximately 43%. It encompasses trade, transport and financial services, indicating a diversifying economy.

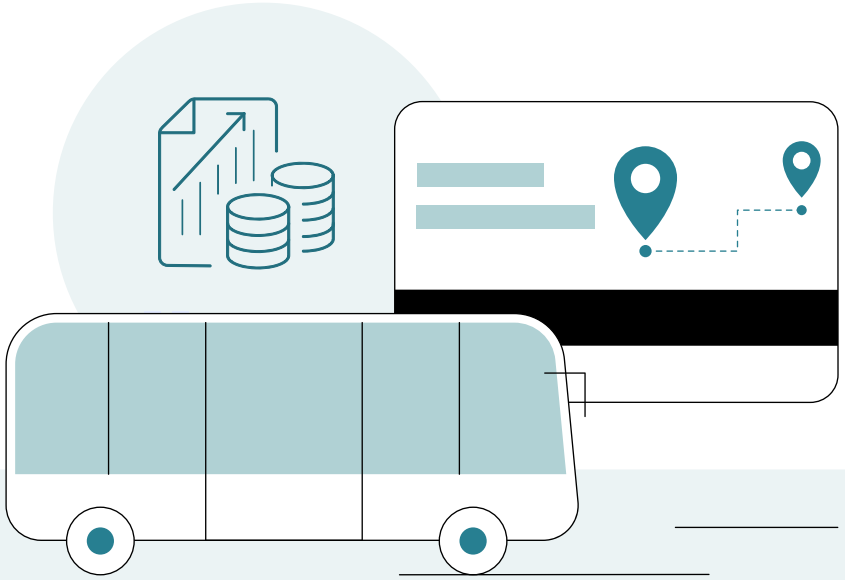
Uganda's service sector experienced a growth rate of over 6.0% in 2024/2025 (UBOS, 2025). Growth is fuelled by strong performances in wholesale, retail, hotels, tourism, ICT and public administration. The finance and transport sectors have also rebounded, demonstrating significant growth within the services sector. This growth is largely attributed to private sector activity and increased trade, supported by lower inflation (UBOS, 2025).

Tourism, a key component of the service sector, is poised for growth under the NDPIV, which identifies it as a priority area for investment. The plan seeks to capitalise on Uganda's natural attractions to boost tourism revenues and generate employment opportunities (NPA, 2025).

Uganda provides a liberalised and open investment climate, allowing for 100% foreign ownership across all sectors. The country has enacted pro-business regulations and established a One-Stop Centre to facilitate investment processes.

Significant investments are underway in the oil sector, including the East African Crude Oil Pipeline and the planned refinery, which are anticipated to improve economic prospects.

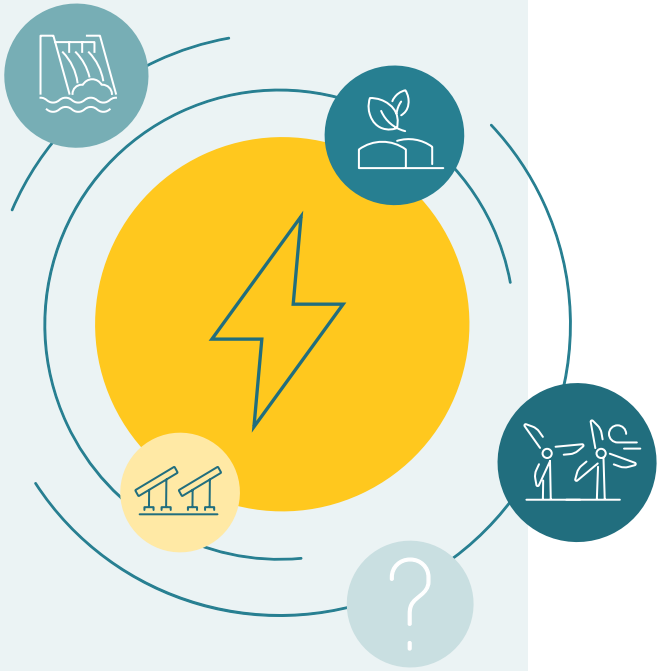
The NDPIV aims to increase the revenue-to-GDP ratio from 13.7% in 2023/2024 to 18.3% by 2029/2030 and to maintain the debt-to-GDP ratio below 50%. The plan also aims to create an average of 884,962 direct jobs annually over a five-year period. However, the industrialisation process in Uganda is largely spontaneous and private sector-led, with limited government support, which could hinder the sector's overall growth and development (Nicholas, 2023).



2

Uganda's power sector

This section provides a detailed analysis of Uganda's power sector, focusing on the country's electricity sector, energy potential, EE and tariffs for electricity and fuel. The majority of electricity is generated from renewable energy sources, including hydro, solar, wind and biomass.



2.1 Overview of Uganda's electricity sector

Uganda's power sector is experiencing transformative changes, with significant enhancements in generation capacity, transmission infrastructure and distribution networks. It is characterised by a heavy reliance on biomass, which meets over 90% of the country's energy needs, a common trait in East African nations. The energy mix is dominated by biomass-based energy sources, contributing about 95% to total primary energy consumption. The introduction of commercial electricity in Uganda occurred in the late 1930s, after the Kenya-based East African Power and Lighting Company obtained a licence in 1936 to generate and distribute power. The commissioning of the Owen Falls Dam in 1954 marked a pivotal moment, establishing Uganda as a key electricity exporter in the region. This dam, later renamed Nalubaale, significantly boosted Uganda's generation capacity, fostering industrial and economic development (Meyer et al., 2018).

Currently, Uganda's electricity generation mix is dominated by hydropower, which accounts for a large percentage of installed capacity. Thermal power plants and renewable energy sources, such as solar and biomass, also contribute to the mix, albeit to a lesser extent. The government's strategy includes diversifying energy sources to reduce reliance on hydropower and enhance energy security (Akankunda et al., 2024). By 2022, renewable energy sources accounted for 90% of Uganda's installed capacity, with hydropower representing the largest share.

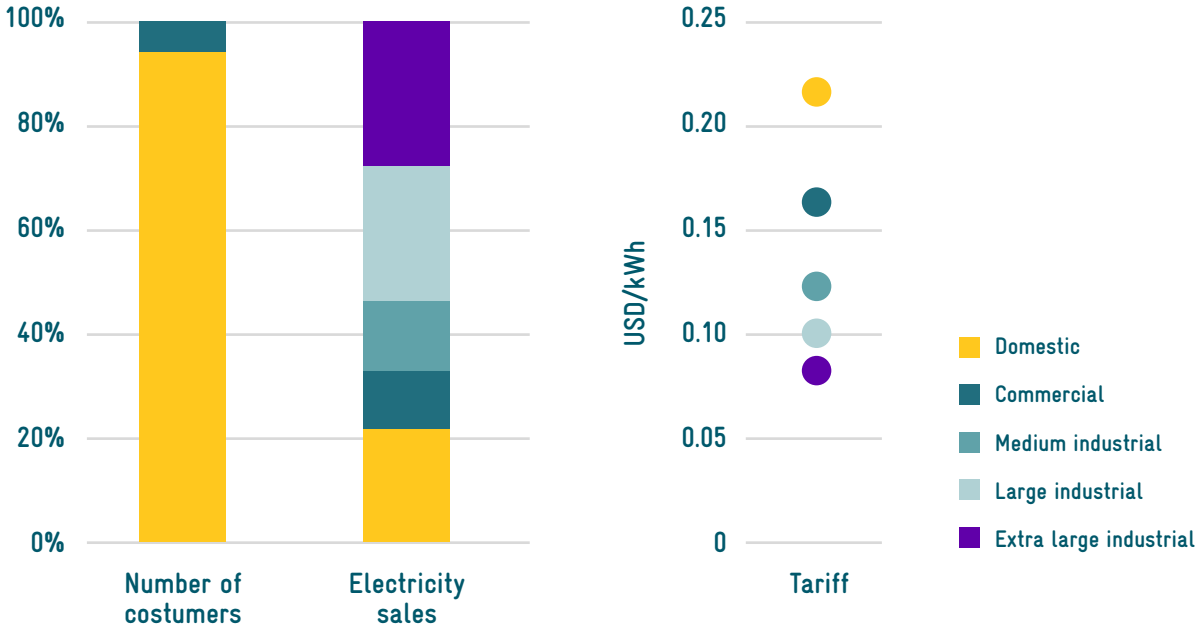
2.2 Energy potential in Uganda

Uganda is endowed with abundant energy resources, which present significant opportunities for sustainable energy development, including a substantial hydropower potential, estimated to exceed 2,000 MW (Punys et al., 2023), with viable sites identified for development. These resources are critical for improving the national power grid and bolstering regional energy exports. The exploitation of these sites will not only enhance domestic power generation but also position Uganda as a key player in the East African energy market.

Uganda has one of the lowest electricity consumption rates in the world, estimated at around 100 kWh per capita per year. This low rate reflects limited access to electricity and the prevalence of biomass as the primary energy source for households and industries. Efforts to increase electricity access and promote EE are crucial for advancing Uganda's economic development and improving living standards.

Industries are significant consumers of electricity and petroleum products, with energy-intensive sectors, such as manufacturing and mining, accounting for a substantial portion of total energy consumption. Industries consume approximately 60% of the country's total electricity, while 40% is used by households, underscoring the substantial energy demands of the industrial sector relative to domestic consumption (ERA, 2025b).

FIGURE 2. Total electricity sales by customer category for the 2nd Quarter of 2025



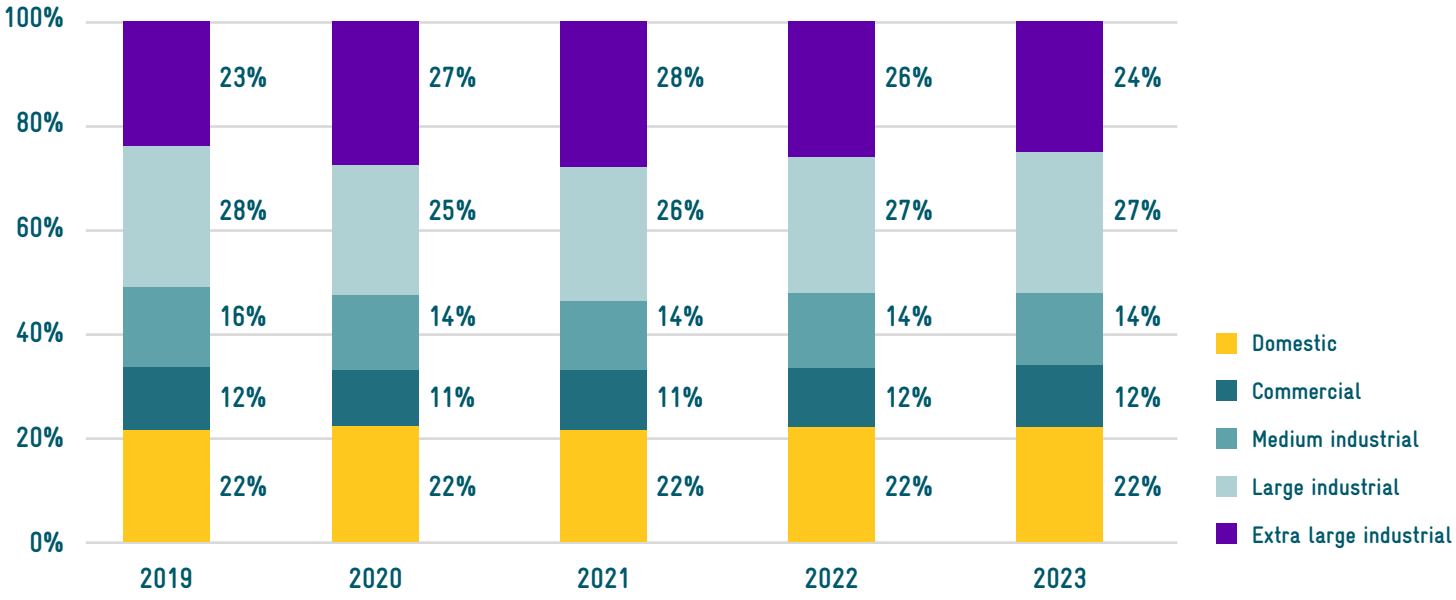
Source: International Energy Agency (IEA), based on data from the Electricity Regulatory Authority (ERA) (IEA, 2023).

2.3 Energy efficiency as a strategy for Uganda

EE is crucial for Uganda to improve energy access, ensure sustainability and mitigate environmental impacts, particularly given the country's heavy reliance on biomass and limited electricity access. Uganda Vision 2040 lays out a bold trajectory; the country aims to bring about a shift from a largely agrarian economy to an industrialised and urban one powered by modern energy. To get there, it has set a target of increasing electricity generation capacity from just over 1,000 MW to 41,738 MW, which will result in a surge in per capita electricity use and push grid access up to around 80%. The emphasis will be on improving EE by promoting energy-efficient technologies and encouraging their adoption by C&I sector players. Total energy demand is currently at 4,883 ktoe, and the country still relies greatly on biomass and fossil fuels. The commercial and industrial sectors account for 14.3% and 12.8% of total energy demand respectively and for the largest share of electricity consumption.

Hydropower is the most developed renewable energy source, followed by solar. The installed capacity of commissioned grid-connected renewable energy power plants, including large hydro, is 2,048.1 MW, of which 1,710.9 MW is hydro, 88.3 MW solar, 100 MW thermal and 148.9 MW bagasse (ERA, 2025c). With the commissioning of the Isimba (183 MW) and Karuma (600 MW) hydro power plants, Uganda's installed capacity rose from 1,251 MW in 2019 to 2,048.1 MW, a 63.7% increase. The country has high potential in terms of renewable energy resources, including hydro, solar, geothermal and biomass, offering opportunities for diversification and a transition to a more sustainable energy mix.

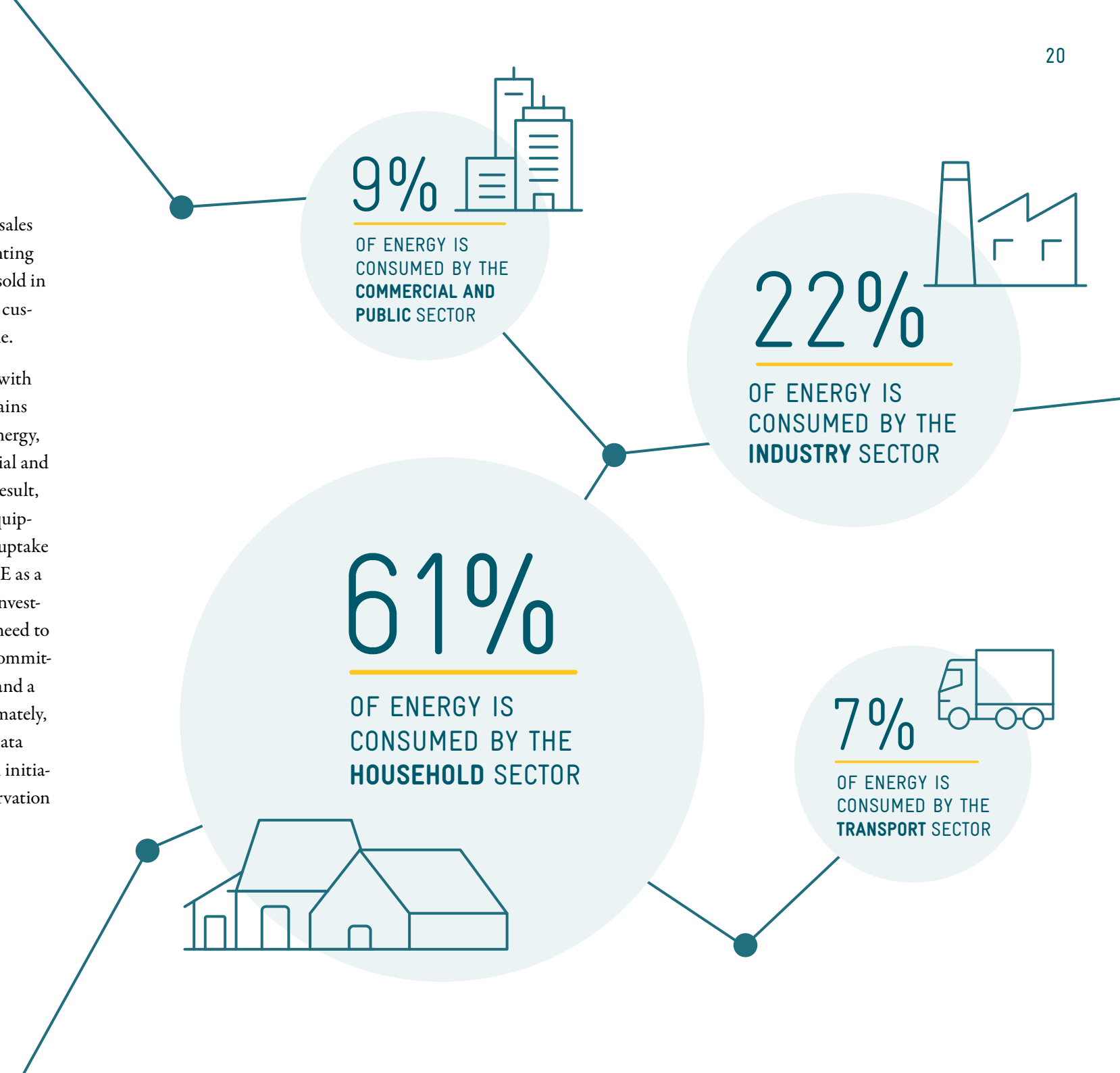
FIGURE 3. Energy sales by customer category



Source: ERA (ERA, 2025b)

In recent years, there has been a rise in energy sales overall, with large industrial customers accounting for the largest proportion (27%) of electricity sold in 2023. The shares of domestic and commercial customer categories have remained relatively stable.

Electricity demand is growing rapidly in pace with economic development, yet per capita use remains low. The household sector consumes 61% of energy, industry 22%, transport 7% and the commercial and public sectors together 9% (IEA, 2023). As a result, industries and buildings often use outdated equipment, and commercial sectors exhibit limited uptake of EE practices. Uganda has now recognised EE as a mechanism for reducing energy demand and investment in energy supply infrastructure and the need to develop the EE market. To that effect, it has committed to drafting an Energy Efficiency Strategy and a National Energy Efficiency Action Plan. Ultimately, the establishment of regulatory frameworks, data systems and stakeholder relationships through initiatives such as the Energy Efficiency and Conservation Bill is vital for the success of EE programmes.



This section provides an overview of fuel prices across the countries of the Organisation for Economic Co-operation and Development (OECD) for 2024 and 2025. It also looks at the electricity tariffs approved by ERA for the first quarter of 2025. The tariff categories are domestic, commercial, medium industrial (manufacturing), large industrial (manufacturing), extra-large industrial, large consumers and public amenities.

2.4 Electricity and fuel tariff forecasts

2.4.1 Fuel

In the second quarter of 2025, gasoline prices generally dipped across OECD countries compared to the same period in 2024. Canada saw a big drop of USD 0.23 per litre, but Japan went the other way, with a rise of USD 0.14 per litre, which is a 13% jump up from last year. The 21% plunge in West Texas Intermediate (WTI), the crude oil benchmark, probably helped bring prices down overall (EIA, 2025).

In Uganda, the Petroleum Authority of Uganda (PAU), under the Ministry of Energy and Mineral Development (MEMD), oversees the petroleum sector. It ensures compliance with regulations, but it does not directly set retail prices. Fuel prices are generally deregulated. Fuel tariffs can be expected to remain volatile and sensitive to global oil prices (EIA, 2025), geopolitical factors and domestic tax policies. Pump prices are set by individual fuel companies which make their own decisions based on factors such as their own costs, taxes and profit margins, but they are primarily determined by market forces.

TABLE 2. Crude oil and petroleum product prices

Item	Apr 25	May 25	Apr–May 2025 Average	Apr–May 2024 Average	2022–2024 Average
Brent Front Month Futures Price ($ per barrel)	66.46	64.01	65.24	83.81	87.03
WTI Front Month Futures Price ($ per barrel)	62.96	60.94	61.95	84.39	82.57
Dubai Front Month Futures Price ($ per barrel)	67.85	63.86	65.86	87.02	85.98
Brent 1st–13th Month Futures Spread ($ per barrel)	2.43	0.72	1.58	40.78	7.42
WTI 1st–13th Month Futures Spread ($ per barrel)	2.7	1.27	1.99	8.44	7.46
RBOB Front Month Futures Price ($ per gallon)	2.08	2.1	2.09	2.75	2.59
Heating Oil Front Month Futures Price ($ per gallon)	2.13	2.08	2.11	2.63	2.93
RBOB – Brent Futures Crack Spread ($ per gallon)	0.5	0.57	0.54	0.76	0.52
Heating Oil – Brent Futures Crack Spread ($ per gallon)	0.55	0.56	0.55	0.63	0.86

Source: US Energy Information Administration (EIA, 2025), based on Chicago Mercantile Exchange (CME), Intercontinental Exchange (ICE) and Dubai Mercantile Exchange (DME)

2.4.2 Electricity tariffs

ERA is responsible for setting electricity tariffs and issuing licences to generation, transmission, distribution and retail companies. Tariff adjustments are typically made to reflect the cost of generation, the cost of fuel on the international market and the need for grid expansion. The most recent adjustments approved by the regulator saw tariffs on extra-large industrial consumers (Code 40) decline from UGX 299.1 per kWh for Block 1 and UGX 284.2 per kWh for Block 2 in the first quarter (January–March 2025) to UGX 203.6 per kWh in the third quarter (July–September 2025). The reduction in tariffs for industrial consumers will result in lower operating costs, which is good for business competitiveness and industrial expansion. It aligns with the government's industrialisation agenda and may stimulate increased production and hence create more EE investment opportunities.

TABLE 3. Approved electricity end-user tariffs – UEDCL (July to September 2025)

Category	Tariff type	Average	Peak	Shoulder	Off-peak	Maximum demand charge (UGX/kW)
Domestic – Code 10.1	Lifeline (≤15 kWh/month)	250				
	15.1–80 kWh	756.2				
	81–150 kWh	412	Cooking tariff			
	>150 kWh	756.2				
Commercial – Code 10.2	–	546.4	650.8	546.4	414	19,639
Medium industrial (manufacturing) – Code 20.1	–	355.1	428	355.1	275.6	16,644
Medium consumers – Code 20.2	–	412.8	497.5	412.8	320.4	16,644
Large industrial (manufacturing) – Code 30.1	Block 1	300.4	375 to 370	300.4	231.6	16,644
	Block 2	282.9	349.0	282.9	218.1	16,644
Large consumers – Code 30.2	–	348.7	420.5	348.7	278.2	11,096
Extra-large industrial – Code 40	–	203.6	229.1	203.6	184.6	11,096
Public amenities – Code 50	–	360	–	–	–	_

Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on ERA (ERA, 2025b)

This section covers the legal and regulatory framework for EE in Uganda. It looks at the energy governance landscape, regulatory gaps, challenges and opportunities, and key legal and regulatory instruments.

2.5 Legal and regulatory framework

2.5.1 Energy governance landscape

The MEMD is responsible for energy policy formulation, sector planning, regulation and the promotion of renewable energy and EE technologies. The main policy is the Energy Policy for Uganda 2023, which governs the management of the country's energy sector and aims to address challenges and opportunities in the sector, including increasing energy access, promoting renewable energy and improving EE. The Electricity Act of 1999 and its amendments provide the legal framework for the regulation of the electricity sector. It establishes the Electricity Regulatory Authority (ERA), which is responsible for licensing, tariff regulation and monitoring the performance of the electricity sector. Currently, the key electricity generation, transmission and distribution licences are held by Uganda Electricity Generation Company Limited (UEGCL), Uganda Electricity Transmission Company Limited (UETCL) and Uganda Electricity Distribution Company Limited (UEDCL) respectively.

Uganda has made strides in establishing a regulatory framework to support EE integration and promotion. There have been initiatives to promote renewable energy, such as feed-in tariffs, tax incentives and support for small-scale renewable energy projects, and to set standards and improve labelling for electrical equipment.

2.5.2 Regulatory gaps, challenges and opportunities

Weak enforcement of existing policies and regulations

Although Uganda has introduced EE-related policies and regulatory frameworks, implementation and enforcement remain weak. Many industries do not comply with energy audit requirements, and there are minimal penalties or follow-ups for non-compliance. Regulatory agencies often lack the manpower, tools and budget to monitor and enforce standards effectively.

Sector players also attribute the slow progress to inadequate funding and limited awareness, technical expertise and financial resources as well as bureaucratic bottlenecks, especially for private investors.

Absence of mandatory EE standards and codes

There is no fully enforced set of minimum energy performance standards (MEPS) for industrial machinery, appliances or equipment. Additionally, Uganda lacks mandatory building codes for energy performance, leaving construction and retrofitting of industrial facilities unchecked in terms of thermal performance and energy-efficient design.

Inadequate institutional coordination

Several institutions, including the MEMD, ERA and the Uganda National Bureau of Standards (UNBS) have roles in promoting EE, but their mandates often overlap or conflict. This creates confusion among private sector players and reduces accountability. A harmonised institutional framework is still lacking.

Limited public awareness and education mandates

Legal frameworks do not sufficiently address the need for widespread EE awareness campaigns, nor do they mandate training programmes for public institutions or industrial energy managers. As a result, knowledge of EE benefits, tools and practices remains low, especially among SMEs and public sector facilities.

No accreditation framework for energy service companies (ESCOs) and energy auditors

Although Uganda's EE policy recognises the role of ESCOs, there is no legal framework to accredit, regulate or monitor them. This undermines trust in service providers and limits the growth of a professionalised EE service market.

Generally, EE offers a cost-effective strategy to expand energy access, reduce emissions and support sustainable development. Adopting comprehensive approaches, such as MEPS, and technology frameworks is crucial for guiding efficiency improvements across different sectors. Additionally, the country has implemented demand-side management programmes that have proved successful in reducing power demand and stimulating the creation of EE consulting companies, with the number of ESCOs and EE companies in the country continuing to grow.

2.5.3 Key legal and policy instruments

The Electricity Act of 1999 is the main law governing the electricity sector and specifies the functions of the ERA. It was amended in 2022, streamlining licensing and regulation, particularly for renewable energy projects, and introducing net metering arrangements for grid-connected renewable energy systems.

Energy Policy for Uganda 2023

The recently approved Energy Policy explicitly includes EE as a national priority, stating that the government will 'increase energy efficiency' and strengthen the legal framework. It builds on previous plans (Vision 2040, Uganda's Nationally Determined Contribution, etc.) and sets sectoral targets (e.g. 30% electric motorcycles by 2030 (IEA, 2023) but does not itself create enforceable measures – these will need to be established in legislation or regulations.

Energy Efficiency and Conservation Bill (2024)

The draft bill (currently at first reading in Parliament) would establish the institutional and legal basis for EE. It mandates the creation of an EE Commissioner (in MEMD/ERA) and provides for EE regulation across sectors. Key features include setting MEPS and labelling for appliances, requiring mandatory energy audits for designated facilities, promoting efficient cookstoves and biogas and electric cooking, incorporating fuel economy/vehicle emissions standards, planning electric vehicle (EV) charging infrastructure and enabling financing schemes (grants/loans/subsidies) for EE. If enacted, the bill will fill the current gaps and provide opportunities for the adoption of energy-efficient technologies.

MEPS

Uganda has begun developing standards via the UNBS in collaboration with the East African Community (EAC) regional bodies. For example, the East African Standard on household refrigerating appliances (rated volume of 10 to 1,500 litres) specifies minimum energy performance and energy labelling requirements. Similar standards for lighting (e.g. LED minimum lumens per watt), air conditioning (AC) and building equipment are under consideration (The Uganda Gazette, 2023). However, UNBS currently has no binding MEPS for many high energy consumption products, as noted in the Energy Efficiency and Conservation Bill. The implementation of labelling and standards will require the establishment of regulations on labelling, testing facilities and enforcement measures.

TABLE 4. Standards and labelling in Uganda

Product category	Description	Existing standards/ labelling	Enforcement status
Lighting	LED lamps, fixtures (lumen/watt)	UNBS gazette bans low-efficiency bulbs (Standards Act 2023) (The Uganda Gazette, 2023)	Mandatory (low-efficiency bulbs banned)
Fans and AC units	Minimum efficiency or coefficient of performance (COP) ratings	Draft standards developed for ceiling fans; yet to adopt the EAC regional MEPS for air conditioners	Voluntary
Motors	IE3/IE4 efficiency levels	Not legally required, but promoted in procurement	Voluntary/ encouraged
Refrigerators	Energy label (annual kWh) and MEPS	Labelling under UNBS; MEPS not mandatory	Labelling active, MEPS limited
Industrial boilers	Thermal efficiency %, emissions	No specific MEPS – general environment regulations	No dedicated EE enforcement

Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on the Electricity Act (ERA, 1999)

The Electricity (Amendment) Act 2022 (UEGCL, 2022) introduced provisions relevant to EE. Notably, Section 75 now requires distribution licensees to include net metering plans for all customer categories. In practice, this means anyone (including small businesses) feeding solar/back-up power into the grid is accommodated. The law also removed the obligation for the system operator to publish fixed avoided-cost tariffs. These changes encourage distributed generation and prosumers and can reduce losses. However, the Act still focuses on utility licensing and bulk supply and contains no direct obligations for end-users to save energy (it does not address consumer demand-side management).

TABLE 5. Summary of key policy instruments in Uganda

Instrument	Status	EE Provisions
Energy Policy for Uganda 2023	2023 (approved) (IEA, 2023)	Sets goals for expanding access and explicitly 'increasing energy efficiency'; cites Vision 2040 targets. No direct enforcement mechanisms.
Energy Efficiency and Conservation Bill	2024 (draft) (The Uganda Gazette, 2024)	Establishes EE governance: regulatory functions, standards, audits and EE funding. Targets efficient cooking, vehicles, buildings and appliances. Empowers the Minister/Commissioner to set MEPS, labelling and penalties.
Electricity Act (Cap. 145)	1999; amended 2022 (UEGCL, 2022)	Requires net metering plans for all customers; enables bulk supply arrangements. Does not mandate end-user EE or demand-side management.
UNBS Act	1983; in force	Enables the development of national standards. EE Bill notes the current UNBS Act has no MEPS for appliances/industries. UNBS adopted the EAC regional MEPS for lighting (lamps and luminaires) which were gazetted by EAC in July 2022. EAC regional MEPS for residential refrigerators and room air conditioners were gazetted in July 2025; UNBS has yet to adopt them.
National Cooking Strategy	2022 (approved)	Targets transition to 'clean and efficient cooking solutions' (improved stoves, biogas, liquefied petroleum gas (LPG), electric cooking). Institutional basis for cookstove regulations.
Transport/Vehicle Policy	None (draft only)	No fuel economy or emissions standards yet. The EE Bill would introduce mandatory vehicle efficiency standards and EV infrastructure.

Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on literature reviewed from different policies

2.6 Financing EE projects in Uganda

EE presents a high-impact, low-cost opportunity for Uganda to address climate change, reduce energy bills, improve energy security and enhance productivity across sectors. Despite its critical importance, the financing of EE projects in Uganda remains underdeveloped, with limited tailored financial products, low investor awareness and weak regulatory incentives. EE measures can be deployed in multiple sectors including commercial buildings, manufacturing, agro-processing, hospitality, water pumping and street/public lighting. Examples include LED lighting, efficient motors, insulation, solar water heating, building retrofits and smart controls. However, the high upfront cost of equipment and a lack of accessible, affordable financing options often hinder uptake.

2.6.1 Current financing landscape

Most EE projects in Uganda are self-financed or donor-supported, with limited participation from local financial institutions. Where loans are available, they typically attract interest rates between 12% and 18%, depending on the size, risk profile and term of the loan. Development cooperation agencies and some commercial banks have begun piloting green or EE-linked loans, but these remain small in volume and highly centralised in urban areas.

Financial institutions often lack the technical expertise to assess EE project viability, resulting in a risk-averse stance. Only one financial institution was found to offer dedicated EE loan products, and business development services for EE investments were largely lacking. Most promotional efforts focused on product marketing rather than awareness creation for sustainable energy adoption.

2.6.2 Financing mechanisms and instruments

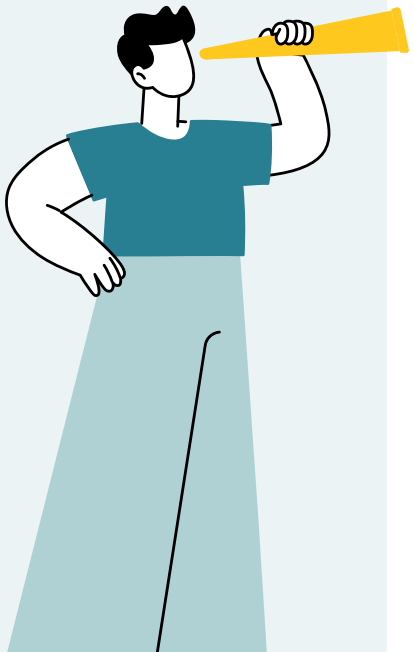
To scale EE financing, Uganda can deploy several innovative mechanisms:

- Financial institutions can develop EE-specific loan products, with concessional capital from development finance institutions or green funds. These loans can target SMEs in manufacturing and commercial sectors seeking to invest in efficient machinery, lighting or heating systems.
- Partial credit guarantees from non-governmental organisations (NGOs) can de-risk commercial banks' exposure and incentivise lending to EE projects at lower rates (potentially as low as 8%–10%).
- ESCOs can implement EE projects upfront and be paid from realised energy savings, reducing the need for client-side financing.
- Output-based incentives can be used to stimulate the adoption of EE technologies in key sectors (e.g. cold chains, hotels, schools), especially in rural and peri-urban settings.
- Green bonds targeting EE in public buildings (schools, hospitals, markets) and street lighting can be issued by municipalities.

3

Overview of the EE market-barriers, challenges and key actors

Uganda's C&I sectors are increasingly seeking ways to reduce energy consumption and operating costs. This trend presents significant business opportunities for service providers and technology suppliers to offer EE solutions, particularly in the areas of motors and drives, heating, ventilation and air conditioning (HVAC) systems, compressed air, process heating and industrial facility retrofits.



3.1 Market insight: EE products for Uganda's C&I sectors

Currently in the Ugandan market, there are very few companies specialising in EE solutions. Those that do exist are normally engineering consultancy firms that partner with technology providers to develop EE products. The market for such products remains largely project-driven rather than there being continuous supply channels. Equipment is normally imported to order, with typical lead times of four months or more. Such contracts are often triggered by investment-grade energy audits or donor-funded or project-funded interventions. The main business model deployed is outright purchase. Leasing, lease-to-own or technology-as-a-service models are not available.

A combination of weak regulatory enforcement and the voluntary nature of most existing EE provisions limits the development of a market ecosystem that supports the growth of the EE space. Despite the legal frameworks that are being developed, implementation remains minimal, reducing incentives for both suppliers and end-users to prioritise energy-efficient technologies.

High upfront capital costs, import duties and low awareness of the long-term operational and cost-saving benefits of energy-efficient machinery further constrain market adoption. Procurement decisions in many cases are still driven by lowest initial price rather than life-cycle value or EE performance. This trend has kept the sector fragmented, with no clear base of consistent product availability outside of project-specific intervention. As things stand, the most promising market for EE adoption remains in the small, medium and large industrial space (peak demand <1,000 kW). While the large-scale industrial space has high potential, it is often plagued by burdensome bureaucratic processes, coupled with centralised decision-making often at regional headquarters outside of Uganda.

3.2 Experiences of C&I companies in EE projects

Motors account for over 60% of electricity use in industrial facilities globally, and Uganda is no exception. Most industrial facilities operate many motors which are outdated, oversized or poorly maintained. A key opportunity lies in replacing inefficient motors with high-efficiency IE3 or IE4 motors and retrofitting variable speed drives (VSDs) to optimise motor speed according to process load. For example, several beverage and plastics companies operating in the country have shown strong interest in VSD retrofits after donor-funded energy audits revealed savings potentials of up to 30%. Companies offering motor audits, load assessments and retrofit services stand to gain from growing interest in life-cycle-based cost reductions.

Although not always the most visible load in industrial facilities, HVAC systems in offices, warehouses and clean production areas consume substantial energy. There is an opportunity for HVAC service providers to offer system redesign, inverter-based units, thermal insulation and automated temperature controls. In food processing plants, cold storage accounts for a major portion of the load. Businesses have already begun integrating more efficient refrigeration systems, indicating growing market potential for solutions focused on humidity control and smart thermostat cooling systems.

Most facilities in Uganda operate compressors without VSDs or leak detection systems. According to field data, up to 30% of compressed air is typically lost to leaks, and most systems operate above the required pressure level. This opens the door for companies to offer compressed air audits, leak detection and repair services, and installation of more efficient compressors. In particular, some companies, such as Uganda Breweries Limited, have partnered with energy consultants to upgrade their compressed air systems, which sets a precedent for similar projects.

Process heating is another significant energy consumption process in C&I sectors. Biomass has been used as a source of heating, especially in the tea sector, while heating oil is deployed in other sectors, such as steel and cement. There is an opportunity for electric boilers, through the electrification of heating processes, and alternatives such as green hydrogen to reduce dependence on biomass and fossil fuels for heating processes.

3.3 Challenges in implementing EE initiatives and opportunities driving uptake

Uganda's C&I sectors are steadily evolving, yet the implementation of EE projects remains slow and inconsistent. The surveyed facilities span agro-processing (52.4%), manufacturing (28.6%) and other service-oriented industries. Despite an increase in awareness and a few scattered initiatives, systemic barriers persist across the value chain. One of the core challenges is cost, with a resounding 95% of respondents citing the high initial cost of EE technologies, such as IE3/IE4 motors, VSDs and energy-efficient HVAC systems, as a primary deterrent. Coupled with limited access to finance (reported by 100% of facilities), even those facilities aware of EE benefits find themselves stuck between operational needs and capital constraints.

In terms of technical capacity, most facilities lack the human or technical resources to initiate or maintain EE programmes. Only 19% of facilities reported that over 75% of their motors were compliant with MEPS, while 52% admitted having no MEPS framework or tracking at all. Preventive maintenance was practised by about 76% of facilities, but condition-based monitoring, essential for predictive efficiency, was virtually non-existent. Moreover, over two thirds of facilities had no awareness of MEPS for critical equipment such as lighting, air conditioners or pumps. This lack of awareness, coupled with limited enforcement and verification, means that even well-intentioned actors may unknowingly operate below their EE potential.

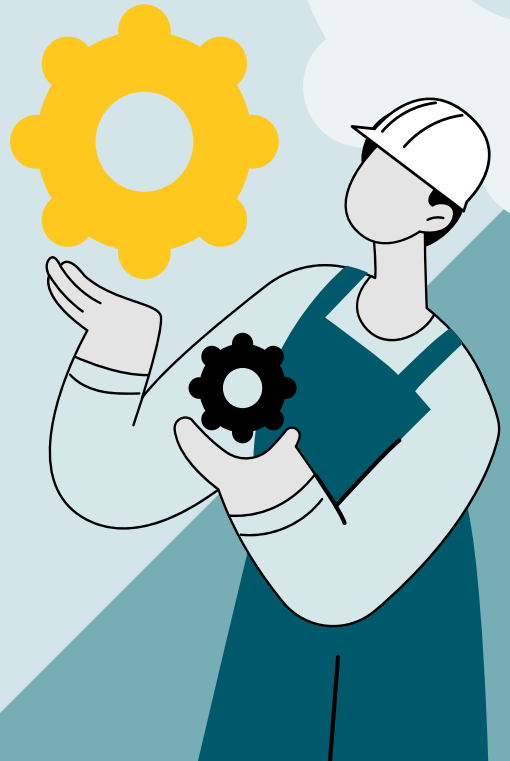
Technological readiness across the sector is uneven. While larger facilities (e.g. cement or beverage manufacturers) may have begun integrating supervisory control and data acquisition (SCADA) systems or adopted VSDs on select equipment, the bulk of the sites surveyed are still operating aging, manually controlled systems. The uptake of high-efficiency motors, for instance, is still under 20%, even though many facilities run over 100 motors each. For compressed air systems, only 9.5% of facilities had integrated VSDs, and just 19% had conducted a leak audit in the previous two years. This underscores a sector-wide issue: even when facilities have the equipment, optimisation is rare and monitoring practices remain superficial.

Despite these barriers, there are clear opportunities for accelerated EE uptake. The data shows strong intent, with over 83% of facilities planning investments that prioritise motor systems, and 66.7% are eyeing solar photovoltaic installations. What is encouraging is that more than half (52.4%) of facilities have already conducted an energy audit, and over 90% implemented at least some of the recommendations. The willingness to engage further is robust; every respondent expressed interest in more detailed follow-ups, and 75% of facilities now employ dedicated energy personnel. This results in a readiness for action if technical assistance, structured support and appropriate financial instruments can be aligned.

ESCOs represent one of the most promising enablers for bridging the implementation gap. The ESCO model, where financing and risk are shared and repayment is performance-based, has generated moderate interest, with 45% of facilities open to it and another 50% requesting more information. However, the model remains underutilised in Uganda, primarily due to a lack of trust, limited local ESCO presence and the absence of clear regulatory frameworks. For ESCOs to thrive, a pyramid of enabling conditions must be built: at the base, robust awareness and demand from industry; in the middle, accessible financial and legal structures; and at the apex, credible ESCOs capable of effective service delivery and monitoring.

4

Sector overview



This section highlights potential areas for investment in EE that would be of interest to German energy technology companies and indicates what key technologies are possible for investment in specific sectors. These technology focus areas are relevant as a driver of optimised energy use in accordance with the company's line of business.

4.1 Sectors with high potential for EE

The findings of the surveys undertaken revealed the sectors with the best potential for EE, for each of which a particular EE technology can be deployed. The criteria for identifying these sectors included:

a. Existence of high energy-intensive processes that could be optimised to realise significant energy savings, making an EE intervention economically feasible.

b. A well-developed sector with sustainable value chains. This makes it more likely that the facility will remain in business long enough to realise the returns from deploying an EE solution. In addition, if it involves leasing, the facility can operate for the entire duration of the leasing period.

c. An economically thriving sector. Companies in such sectors are most likely to be able to afford to invest in an EE solution.

The major sectors identified are shown in Table 6.

TABLE 6. Major economic EE intervention areas for various sector value chains

Sector	EE intervention area
Agro-processing	Motors, pumps, process heat, HVAC
Manufacturing	Motors, pumps, process heat, HVAC, Compressors, motors, process heat
Hospitality	HVAC
Commercial buildings	HVAC

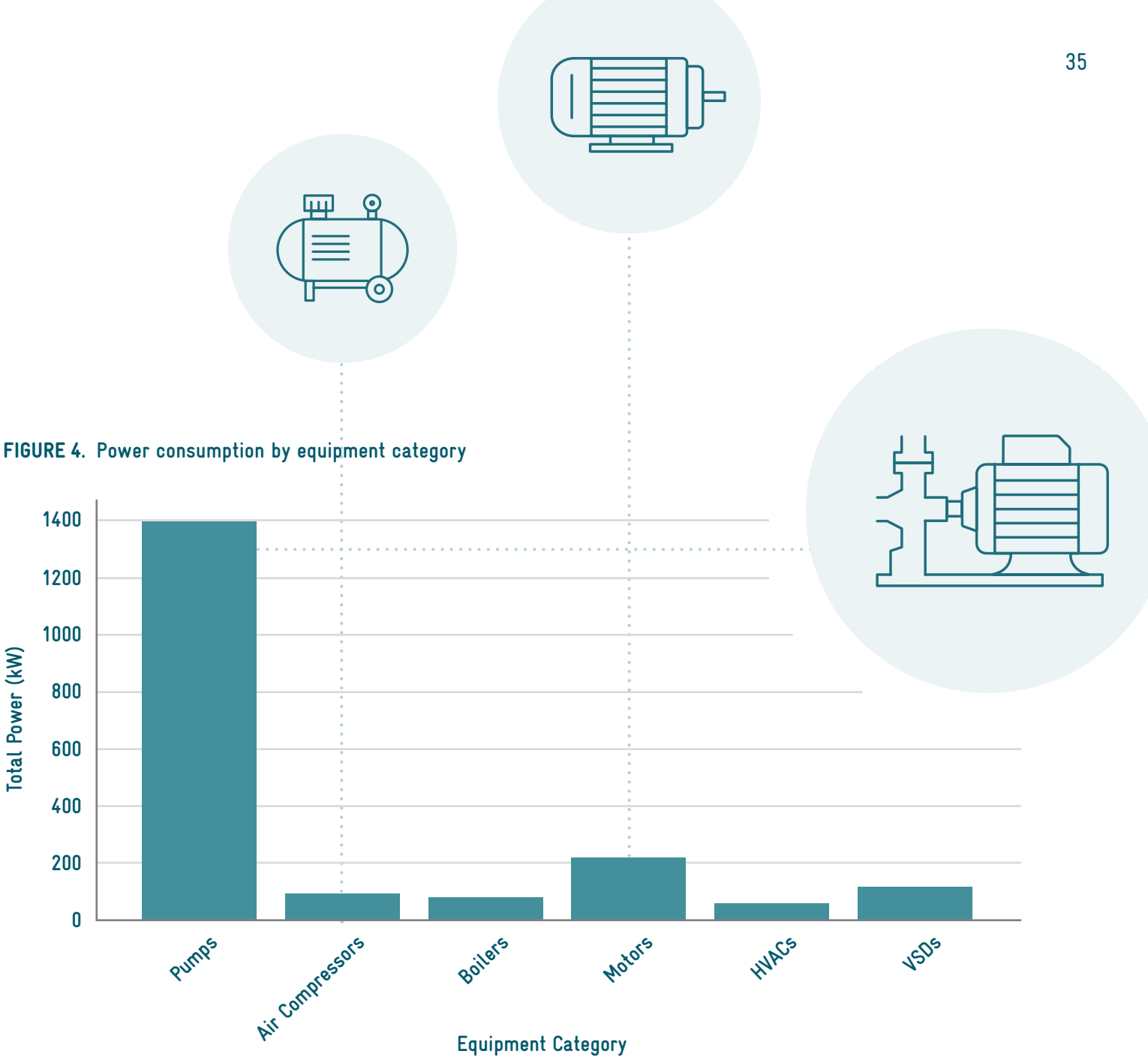
Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on site visits to facilities

4.2 Sector value chains

Agro-processing is Uganda's largest energy-consuming industrial segment, accounting for over 50% of surveyed facilities. Key sub-sectors include tea, coffee and grain processing, which are geographically spread across south-western, central and eastern Uganda. Actors range from cooperative unions and private processors to export-oriented commercial plants.

The figure illustrates total power consumption by equipment category for various facilities surveyed. It shows that across key equipment categories, including pumps, air compressors, boilers, motors, HVACs and VSD-equipped systems, it is pumps and motors that dominate the energy consumption landscape, with significant loads also attributed to compressors and boiler systems. The figures show that, while accounting for a smaller slice, VSDs are currently in use and that there is potential for scaling up to optimise energy consumption.

FIGURE 4. Power consumption by equipment category



Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on field data collected

This section covers the production processes and energy demand profile for the following sectors: agro-processing, tea processing, grain agro-processing, coffee processing, manufacturing, commercial and hospitality, and water utilities. The majority of industries in Uganda are agro-based, creating employment opportunities in the agricultural sector and contributing to the country's economic growth.

4.3 Production processes and energy demand profile

4.3.1 Agro-processing sector

It includes tea, coffee and grain processing and is the largest industrial energy consumer. Over half of the surveyed facilities are processing plants, which are mainly located in south-western, central and eastern Uganda. In the tea sub-sector, facilities use a sequential process that involves withering, crushing, tearing and curling (CTC), fermentation, drying, grading and packing. The main energy consumption component is thermal energy used in drying, typically via boilers, and electricity for powering fans and rollers. Many factories were established in the 1960s and 1970s and continue to use inefficient mechanical dryers and outdated equipment.

Electricity costs can reach up to 30% of total processing expenses. Although a few factories have begun to adopt solar pre-heaters and efficient stoves, VSDs and control systems are still uncommon.

Table 7 shows potential EE opportunities in the agro-processing sector.

FIGURE 5. Conveyor belt at a tea processing facility

Source: Heden Engineering Solutions Limited (2025), during a site visit

TABLE 7. Agro-processing sector EE opportunities

Recommended EE measure	Description based on walkthrough assessment
Upgrade milling motors and equipment	Many grain processing facilities are operating with aging or inefficient hammer mills, often with motors that have been in operation for over 20 years. These are typically standard-efficiency motors with poor load matching. Replacing them with modern, IE3-rated motors and efficient mill designs can reduce electricity consumption by up to 30%.
Install VSDs	Grain separators, conveyors and aspiration systems often run continuously at full speed, even during partial loading. No facility assessed had VSDs on this equipment. VSDs allow motors to operate based on real-time load, which can yield both energy and mechanical savings.
Conduct regular maintenance of motors and drives	The walkthrough revealed a reliance on reactive maintenance, with many motors only serviced after breakdown. Introducing preventive maintenance (e.g. greasing, vibration checks, belt tensioning) would improve motor efficiency, reduce downtime and extend asset life.
Implement energy sub-metering	Most facilities lacked sub-metering of energy-intensive machinery. Without granular visibility, operators cannot identify inefficiencies or monitor the impact of EE upgrades. Installing meters on milling lines, dryers and compressors enables targeted interventions and data-driven decision-making.
Optimise compressed air use	Air compressors at agro-processing sites were often oversized, lacked heat recovery and operated at constant speed. Some facilities experienced leaks, and none had conducted audits in the previous two years. EE potential includes leak detection, compressor sizing and heat recovery integration.
Replace inefficient lighting with LEDs	Lighting systems, especially in storage and packaging areas, often consisted of high-wattage fluorescent or incandescent bulbs. Retrofits with LED fixtures would cut lighting costs by over 50% while improving illumination and safety.
Introduce solar-assisted drying or hot water systems	Traditional firewood or diesel-based drying and water heating systems are fuel-inefficient and pose health risks. Introducing solar dryers or solar thermal heaters would reduce reliance on fossil fuels and align with Uganda's clean energy goals.
Improve insulation and airflow control	Walkthroughs revealed uninsulated ducting and uncontrolled airflows around dryers and pneumatic systems. Simple measures such as sealing air leaks and insulating ductwork could reduce thermal losses and enhance drying uniformity.
Provide capacity building and operator training	Operators frequently lacked knowledge of efficient start-up/shut-down practices, correct belt tensioning and equipment-specific energy controls. Routine EE training empowers staff to identify and act on low-hanging savings opportunities.

Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on data collected during site visits

4.3.2 Tea processing

The main tea-growing districts are in south-western Uganda (greater Ankole and greater Kigezi sub-regions), with a few in the western, northern and central parts of the country.

Tea processing is an energy-intensive activity, with heat and power consumed at various stages. Tea factories depend on electricity to power fans and machinery, and they require heat for drying tea leaves. Most of the factories were constructed in the 1960s and 1970s and still utilise older, inefficient machinery, resulting in elevated energy costs that constitute approximately 30% of total processing costs. Mechanical dryers are the most common, but many are fuel-inefficient boilers using firewood to generate steam and heat for the drying process. VSDs are scarce.

Tea factories face significant costs in terms of electricity and diesel. Some newer ones are integrating solar-preheat systems or efficient stoves. They often source the wood fuel needed from eucalyptus plantations, providing income for local farmers.

The level of technical processing is generally low to moderate. Biomass efficiency remains the biggest EE opportunity. Some EE programmes led by NGOs and international cooperation agencies, for example, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and Enabel, have introduced solar dryers, improved stoves and LED lighting.

Key tea processes include withering → CTC → Fermentation → Drying → Grading → Packing. Each facility supports 150 to 300 direct employees, plus hundreds of seasonal workers during harvest time.

FIGURE 6. Wood fired boiler furnace at a tea processing facility

Source: Heden Engineering Solutions Limited (2025), during a site visit

4.3.3 Grain agro-processing

The major energy consumption processes in the grain value chain are mechanical and thermal. Mechanical processes, deployed where grain is milled into flour, are motor-driven processes for grinding, blowing and transportation within the facility. A challenge in the grain sector is the large number of small facilities that individually do not present an opportunity for large-scale investment projects. There are, however, some large mills that do offer significant opportunities for investment in EE solutions.

Grain agro-processing, which includes activities such as shelling, cleaning, milling and packaging, exhibits inefficiencies similar to those observed in coffee processing. Facilities rely heavily on diesel-powered or electric milling machines, often operating for long hours during peak harvest. Preventive maintenance is uncommon, and there is little to no tracking of energy consumption. Opportunities for energy savings lie in upgrading motors, improving load management, adopting solar–diesel hybrids and introducing energy monitoring tools to guide operations

4.3.4 Coffee processing

Following our site visits, a series of walk-in audits were conducted at selected coffee processing sites in Uganda to assess energy use patterns, the condition of machinery and operational EE-related challenges. The sites varied in scale, from smallholder cooperative wet mills to mid-sized commercial processors and one partially modernised export-oriented plant. The aim of the audits was not just to capture consumption data but to develop a first-hand understanding of energy behaviour, equipment state and overall operational efficiency.

Power sources varied by site, but a common theme was dependency on diesel-powered generators – not by choice but due to poor or inconsistent grid access. Even at grid-connected facilities, back-up generators were run daily due to voltage fluctuations and outages. The most outstanding observation was the prevalence of outdated drying systems, particularly traditional drum or cabinet dryers using firewood or diesel, poorly insulated drying chambers with visible heat loss and no thermometers or control mechanisms to regulate temperature.

The hulling machines, often over 10 years old, were still operational but had worn-out motors (most were oversized or poorly matched to load) and showed visible signs of wear, including loose belts and exposed wiring, with no energy-efficient controls or automation.

FIGURE 7. Coffee grader at a coffee processing facility

Source: Heden Engineering Solutions Limited (2025), during a site visit

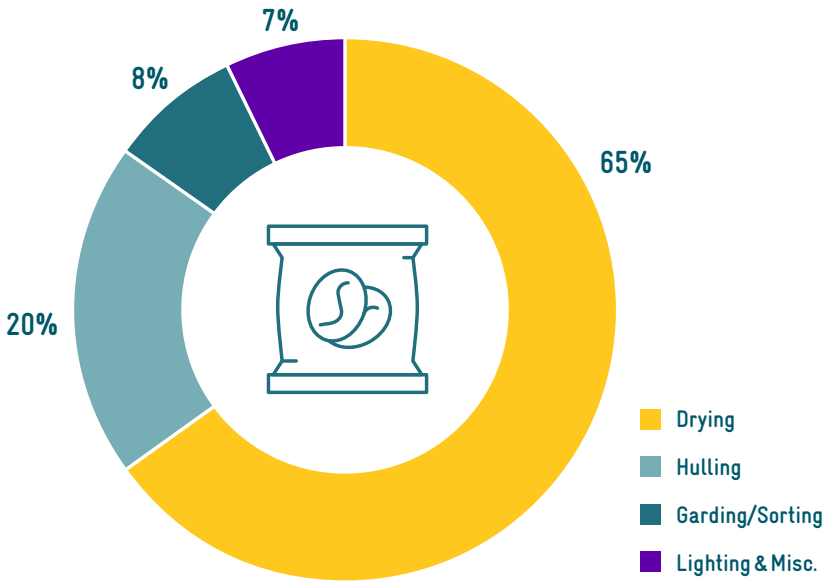
Operators ran machines continuously during operating hours, even during idle periods, due to the effort required to shut down and restart aging motors. A recurring theme across the sites was a reactive maintenance culture. Equipment was only serviced when it failed. There were minimal maintenance logs, preventive schedules and training provided to machine operators on energy-saving techniques. Some machinery, especially pumps and motors, were affected by issues such as visible leakage, misalignment or inefficient installation. This not only increased energy use but posed safety risks.

In terms of energy awareness and monitoring, there was a near-total absence of energy monitoring, such as sub-metering of equipment and tracking of generator fuel use versus output, and the lack of a basic understanding of power factor, load balancing and off-peak optimisation. Operators relied on anecdotal estimates or supplier invoices to guess at consumption. This lack of data made it difficult to assess true operational costs or identify high-loss areas.

However, there was a clear willingness to learn and adapt. Managers expressed interest in hybrid systems and efficient motors but cited upfront costs, lack of technical support and poor access to affordable finance as key barriers.

Figure 8 shows in coffee processing, drying is the most energy-intensive stage, accounting for roughly 65% of the facility's energy use. Many processors rely on diesel-fuelled or biomass-fired mechanical dryers with minimal insulation and temperature control. Hulling, the second largest energy user (about 20%), relies on aging motors that are often oversized and inefficient. Grading and sorting represent around 8% of energy use and are gradually becoming mechanised. During audits, it was evident that energy management practices were lacking, with no sub-meters, maintenance schedules or energy audits. Equipment was typically maintained only after failure, and operator awareness of energy saving techniques was minimal. Despite these challenges, operators and managers expressed willingness to invest in energy-efficient systems, citing interest in hybrid solar–diesel setups and high-efficiency motors, provided that financial and technical support was available.

FIGURE 8. Energy demand profile for coffee processing facilities



Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on data collected

As can be seen, drying dominates energy use, making it the highest-impact area for EE improvements. The high energy share is largely due to:

- Prolonged drying times during peak harvest
- Inefficient, uninsulated kilns
- Lack of automated temperature control
- Heavy use of diesel during rainy or humid periods

This singles out drying as the most strategic point for EE interventions.

Hulling is process of de-husking the coffee beans which requires electrical energy to run motors. The EE improvement opportunities during hulling include:

- Motor efficiency upgrades
- Power factor correction
- Load balancing and better machine sizing

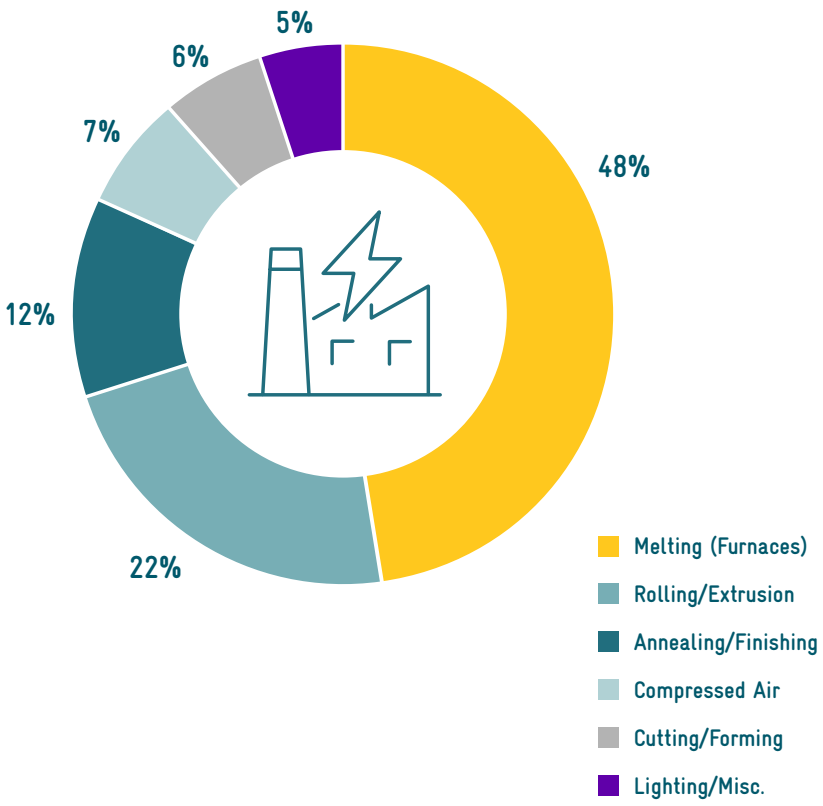
Next is the grading and sorting stage. Depending on the level of mechanisation, grading may involve vibrating screens, aspirators or air blowers, most of which are driven by electric motors. Manual grading (still common) requires minimal energy but sacrifices speed and consistency. With more exporters demanding uniform quality, energy use in this stage may grow as more processors mechanise.

4.3.5 Manufacturing

Processing industries form a vital part of Uganda's industrial base, including the construction, infrastructure, manufacturing and transport sectors. These industries are energy-intensive, with operations predominantly involving thermal and mechanical processes. A walk-in audit was conducted at several facilities, including both large-scale and mid-sized processors, to assess energy usage and equipment condition and identify opportunities for greater efficiency.

The manufacturing facilities visited included steel, rubber, cement, food and beverage plants. These operations are energy-intensive due to their reliance on thermal and mechanical processes, including melting, extrusion, annealing and refrigeration. For example, in steel and aluminium production, the stages of melting, casting, rolling and galvanising require substantial electricity and thermal input. Facilities often run dozens to hundreds of motors, compressors and heating systems, most of which are outdated or inefficient. Compressed air systems typically lack leak detection, pressure controls and energy-efficient components. HVAC systems and refrigeration units are also aging, with some still using R22a refrigerant, which is being phased out due to environmental con-

FIGURE 9. Energy demand profile for manufacturing facilities



Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on analysis of data collected

cerns. Only a few facilities had building management systems or controls in place to optimise energy use. Similarly, rubber and plastic factories use energy-intensive processes, such as extrusion, moulding and curing, where inefficient heaters and compressors contribute to high energy use. In food and beverage manufacturing, key operations such as boiling, sterilising and refrigerating rely heavily on steam boilers and outdated chillers. Many of these systems are poorly maintained and lack energy management features. Despite these inefficiencies, there is growing interest in upgrading systems, particularly if financing options and technical support are provided. Several manufacturers reported having full-time energy personnel and expressed interest.

TABLE 8. Manufacturing sector EE opportunities

Recommended EE measure	Description based on walkthrough assessment
Upgrade to IE3/IE4 high-efficiency motors	Many factories use standard or older motors, some over 15 years old, with low EE and frequent breakdowns. These motors were oversized or underloaded in several cases. Replacing them with properly sized IE3/IE4 motors can reduce energy use by 15% to 30% and improve operational reliability.
Install VSDs on compressors, pumps and process drives	None of the surveyed facilities had VSDs on high-consumption equipment, such as water pumps, chillers or conveyor belts. VSDs help match motor speed to actual load, cutting waste in processes such as extrusion, pumping and compressed air delivery.
Conduct compressed air leak detection and system audit	Compressed air systems were among the most intensive yet least optimised. Leaks, oversized compressors and high operating pressures were common. Leak audits and pressure optimisation can deliver savings of up to 30%, with rapid payback.
Upgrade HVAC systems and improve thermal insulation	In facilities with significant cooling or heating loads (plastics, beverages, food), audits revealed outdated air conditioners and poor insulation. Upgrading to inverter-based ACs, improving duct sealing and insulating roofs and cold storage areas can yield major savings.
Install sub-metering on major process equipment	Very few facilities tracked energy usage beyond the main meter. Installing sub-meters on high-consumption zones (melting furnaces, air compressors, cooling towers, extrusion lines) can help target EE investments and verify impact.
Replace inefficient lighting with LED technology	Most manufacturing floors still use high-wattage mercury vapour lamps, halogen bulbs or fluorescent tubes. LEDs provide equivalent or better lighting with up to 60% less energy use, especially in high-ceiling environments.
Recover waste heat for preheating or process use	In industries such as cement and aluminium manufacturing, exhaust gases and hot flue air were vented without recovery. Capturing this waste heat using heat exchangers can preheat feedstock or power secondary processes, improving overall system efficiency.
Optimise motor maintenance practices	Many motors and fans showed signs of belt slippage, misalignment and lack of lubrication. Shifting from reactive to preventive maintenance reduces friction losses and avoids costly downtime. Routine vibration analysis and cleaning, which can offer high returns, were mostly absent.
Engage staff in EE awareness and training programmes	Operators lacked awareness of simple energy-saving actions, such as shutting off idle machines or adjusting process sequencing. Staff training and internal energy champions can play a key role in embedding a culture of efficiency on the factory floor.

Source: Author's compilation, Heden Engineering Solutions Limited (2025), based on data collected

4.3.6 Commercial, retail and hospitality

The hospitality, retail and commercial service sectors are growing energy consumers due to increased demand for AC, refrigeration, lighting and water heating. Hotels, office buildings and shopping malls in Kampala and major towns often have inefficient HVAC systems and lighting. These sectors show strong potential for EE interventions, such as HVAC upgrades and energy management systems. The commercial building boom also offers a chance to embed EE into design and construction through green building standards and MEPS enforcement.

4.3.7 Water utilities

The water utilities sector, although represented by fewer facilities, presents significant energy-saving opportunities due to its dependence on continuous pumping. Uganda's main utility uses pumps for water extraction, treatment and distribution, accounting for over 80% of total energy consumption in its operations. Most pumps are not optimised for load or pressure, and smart scheduling based on time-of-use tariffs is rare. Key EE measures include right-sizing pumps, adopting variable frequency drives (VFDs), introducing solar-powered pumping systems and using energy management system dashboards to track real-time consumption and pressure.

5

Recommendations for EE service providers and investors

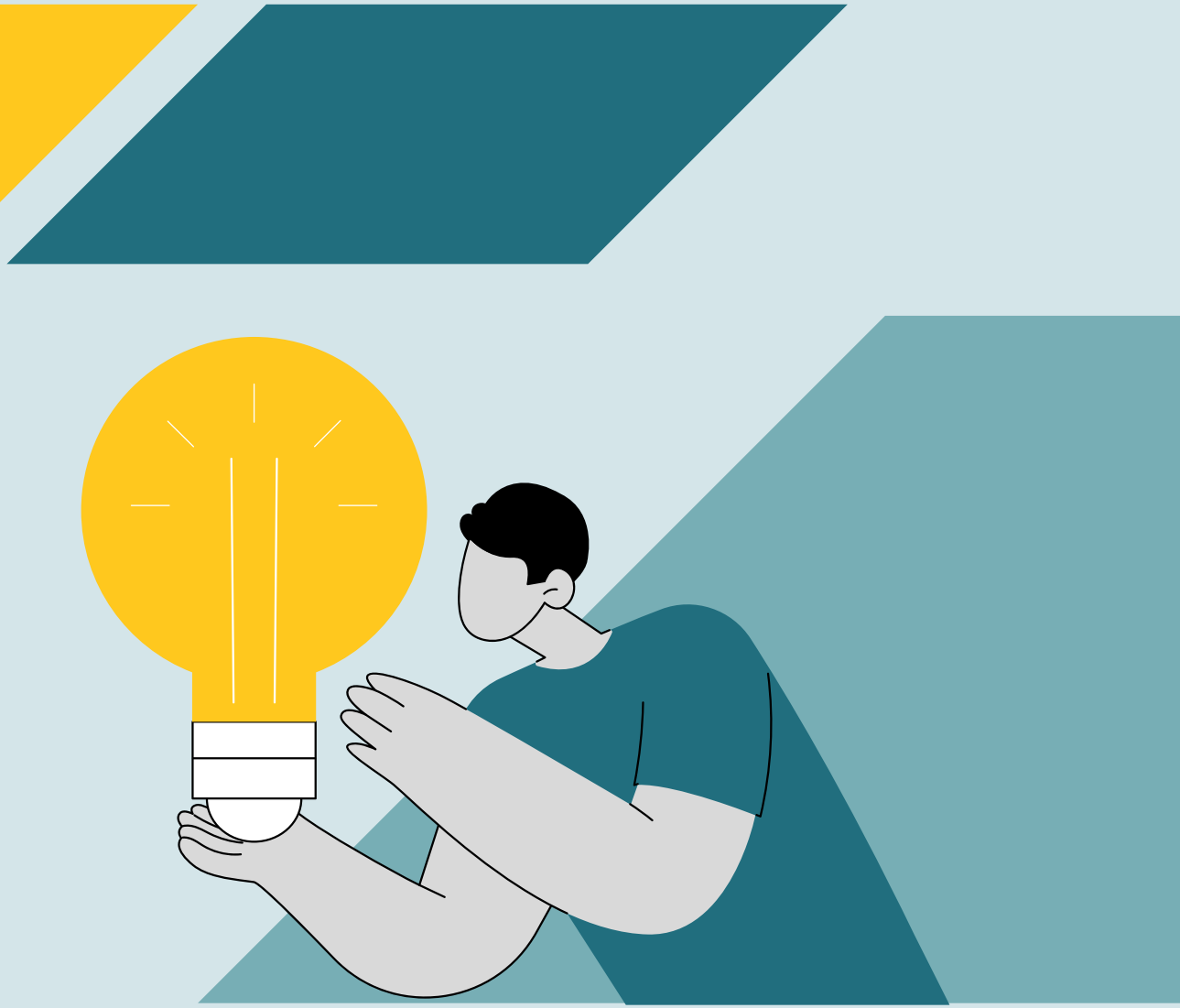
Uganda's C&I sectors present a timely and compelling opportunity for German EE providers. The market is growing fast, driven by rising energy costs, expanding industrial activity and increasing awareness of the role of EE in competitiveness. However, the adoption of energy-efficient technologies remains low, particularly in agro-processing, manufacturing and hospitality. This gap represents an entry point for companies with proven solutions in thermal systems, motor controls and compressed air and hybrid renewable energy systems.

One of the clearest insights from audits and stakeholder interviews is the urgent need for demonstration projects. Many businesses are open to EE interventions but require real-world proof of performance, payback and maintenance feasibility. German companies can build trust and visibility by deploying targeted pilots through partnerships with local industries or donor-backed programmes. Collaborating with Ugandan ESCOs, industrial parks or sector associations can also ease market navigation and help tailor solutions to the context, especially for SMEs operating with limited technical capacity.

Finally, entering Uganda's EE market is not just about equipment; it is also about ecosystems. German providers will gain from engaging in policy dialogue, supporting training and certification schemes and leveraging emerging green finance tools. The most successful actors will likely be those who combine technology leadership with local partnership, flexible business models and a long-term approach to market development. Uganda does not just need new machines; it needs trusted partners to power a smarter, more sustainable industrial future.

6

Conclusions

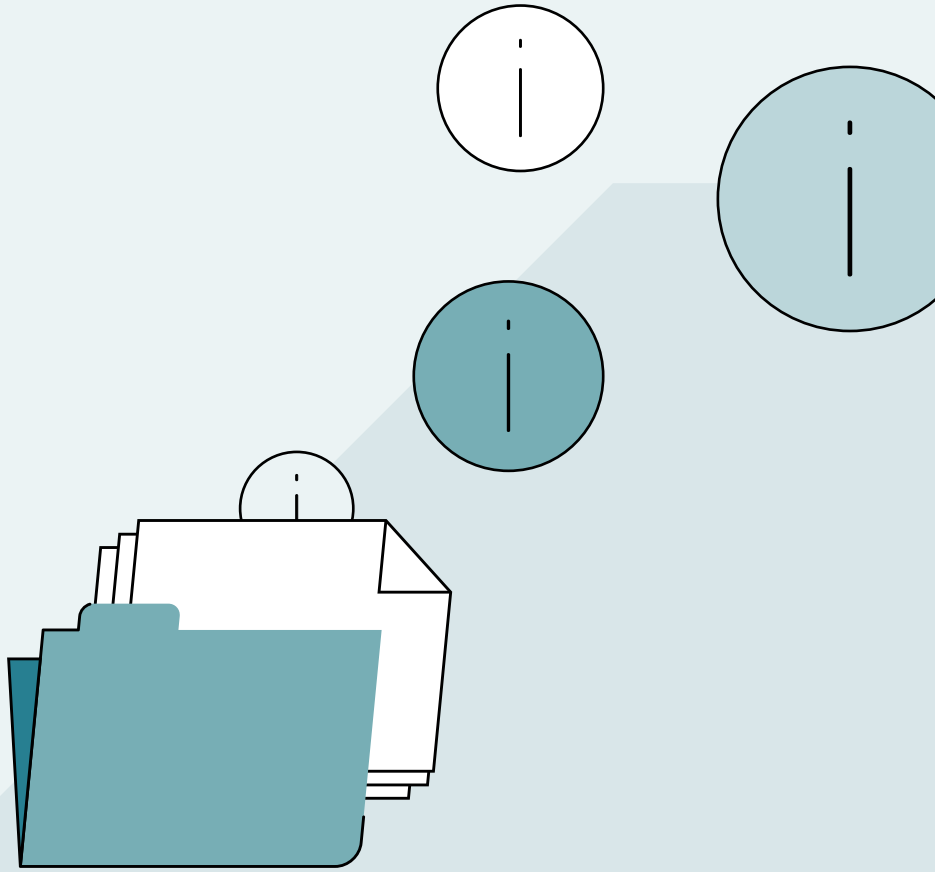


Uganda's C&I sectors offers a wealth of untapped opportunities for EE initiatives. These sectors, ranging from agro-processing to large-scale manufacturing, these sectors can significantly curtail energy waste, decrease operational expenses, and enhance productivity through well-targeted investments in energy-efficient technologies. The food and beverage, steel, and hospitality industries, in particular, present substantial opportunities for upgrades, including state-of-the-art thermal systems, advanced motor controls, hybrid solar-dryers, and optimised compressed air systems.

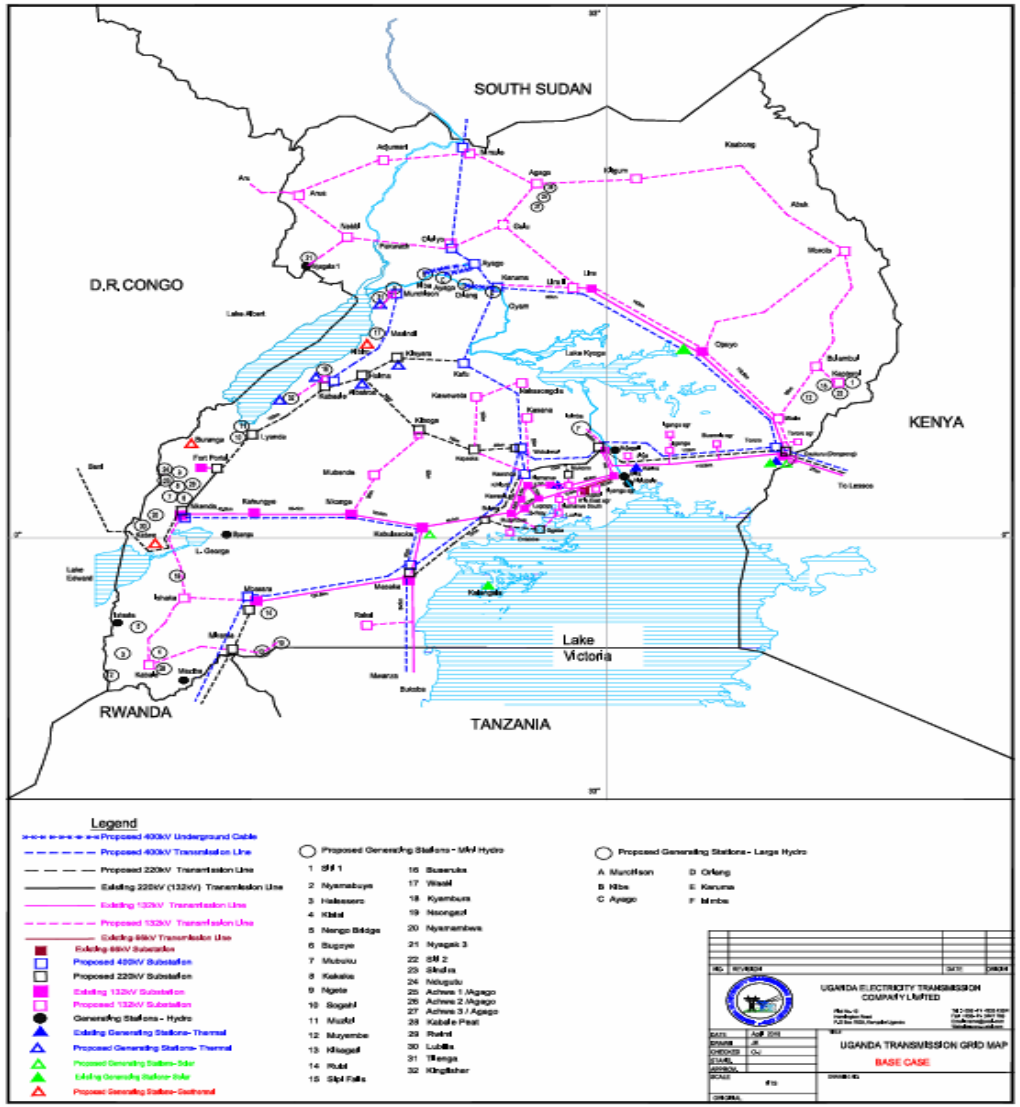
The findings derived from on-site facility audits and in-depth consultations with stakeholders paint a picture of a sector that is enthusiastic but lacks the necessary resources. A significant number of facilities are running on outdated, oversized, or poorly maintained equipment. Audits have consistently highlighted issues such as fuel-inefficient dryers, a lack of VSDs, inadequate maintenance protocols, and an excessive reliance on diesel-powered systems. Despite these challenges, many business owners and managers have expressed a strong interest in investing in energy- saving solutions.

Looking forward, the prospects for EE in Uganda's C&I sectors appear bright, contingent upon the implementation of appropriate policy measures and market incentives. With robust regulatory enforcement, readily available financing options, and a cadre of skilled local service providers, Uganda has the potential to undergo a transformative shift towards a cleaner, more efficient, and more competitive industrial landscape.

Annexes



Annex 1 Uganda power system – present and future network



Source: UETCL Grid Development Plan 2018–2040

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