CIG UGANDA
Creating Future Cities

MANUFACTURING SECTOR ENERGY DEMAND MAPPING STUDY

High Level Presentation to the Energy Development Partners Group
30 March 2021

UKaid
from the British people

UMA

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Cardno

Agenda for Today's Session

01	Setting the Scene	Ludovic / EU	
02	Presentation of the Study	Erastus Kibugu / CIG	20
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Outline of presentation

1. **Introduction and background**
2. Key findings and insights of the study
3. Conclusions, recommendations, and suggested next steps

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Introduction and background

- Ugandan power sector performance has significantly improved since the sector's privatization in the early 2000s. However, the pace and magnitude of sector's improvement has lagged the growth in productive demand for reliable and quality power
  - Causes of underperformance are varied/complex, and include: high tariffs across all customer segments; a lag of, and inadequate investment in transmission and distribution system; and, grid growth and connection ambitions that are not fully matched by investments
- Targeted investments in generation have increased the installed electricity generation capacity to 1,254MW (as of Dec. 2019), and is projected to grow to over 2,000MW in 2022 when various power plants are connected to the grid
  - Peak domestic demand (excluding exports) was 629.5MW at the end of 2019, indicating a generation capacity utilization of c. 50%
  - Industrial sector is the largest power consumer at c. 68%, followed by domestic consumption, and the commercial sector (Umeme data)
- This study was completed for, and with the Uganda Manufacturers Association (UMA). Overall, the study aims to support UMA's efforts to work with the Government of Uganda (GoU) and the Energy Supply Industry (ESI) to sustainably increase the utilization of power by manufacturers

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Objectives of the study

Objectives of the Manufacturing Sector Energy Demand Mapping Study

A **Size the current and projected demand** by manufacturers located in the Jinja-Kampala-Entebbe industrial corridor

B **Estimate the cost of unserved energy** by sampled manufacturers, based on firm level data and analysis

C **Spatially map** current and projected demand of productive power in selected industrial parks

D **Recommend** ways to sustainably unlock unserved energy demand for productive power

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The study's methodology

Our methodology included extensive research, data collection and analytical techniques

To complete the study, the team conducted extensive research, and collected a wide range of data

- **Primary research** – interviews were conducted with extra-large, large, and medium sized manufacturers. UMA helped with introductions and out reach to their members. The UIA helped with introductions to manufacturers who are located in the Uganda Investment Authority (UIA) managed industrial parks, and who are not members of UMA
  - Primary data included: average power demand, quality of supply, direct cost of buying diesel to address outages, and data on outage hours
- **Secondary research** – information collected included demand data by major power users as provided by Umeme, industrial park locations and their electricity demand, power generation sites, transmission lines and substation locations, etc. This presentation primarily covers the demand side findings and dynamics.
- **Analysis** – Data from field research was synchronized with secondary demand data obtained from Umeme. Final dataset comprised a total of 295 manufacturers, representing extra-large, large, and medium-sized manufacturers
  - Of these, 100 firms, representing the largest energy consumers were selected and further analyzed. Demand by these (100) manufacturers was extrapolated (using key energy demand and growth assumptions) to determine the total demand by 475 extra-large, large, and selected medium sized manufacturers located in the Greater Kampala Metropolitan Area (GKMA)/Jinja-Kampala-Entebbe (JKE) industrial corridor
  - Rigorous analysis was undertaken to determine the 2019 demand, and to then project annual demand growth to 2025, based on key assumptions
  - For unserved energy demand determination, we applied the cost of remediation based on a small sample of 19 firms
- **Conclusions, recommendations and suggested next steps** – These were formulated based on the analysis conducted

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Limitations of the study

The main limitations of the study are based on 3 contexts

1. **Due to COVID-19** that emerged during the research, it was difficult to conduct face to face meetings. This was a result of social distancing requirements and safety precautions. In addition, this presentation does not include data on the current status of energy demand by manufacturers as a result of COVID

2. **Data did not include the UIA managed Jinja Industrial Park,** and some independent industrial parks, especially those located in Kawempe, Mbalala/ Mukono and Lugazi industrial areas

3. **Study focused primarily on the extra-large and large power users** because this is the category with the highest potential to drive load growth. Extra-large and large power users (c. 621 in total across Uganda) contributed c. 50% of power sold (315 MW vs 629.5 MW) in 2019, excluding exports. Nevertheless, SME manufacturers are the major employers in the Ugandan manufacturing sector

To address the 3 limitations, CIG applied rigorous triangulation of data, framing assumptions and testing hypothesis

One cross cutting limitation relates to the time the study was completed, and when this presentation is being made. Since its completion in mid 2020, a number of actions have been undertaken by ESI to improve reliability, and quality of supply. These are not fully reflected in this presentation

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Major supply constraints facing the manuf. Sector (1 of 5)

Reliability and quality of supply problems

While efforts are being put to solve these problems, challenges still exist. These include **regular and prolonged power outages,** and **voltage variations/tripping**

Lack of sufficient investment

In **transmission** and **distribution** infrastructure specific to the needs of manufacturers, e.g., the lack of dedicated **"second supply line"** to ensure reliability of supply for sensitive manufacturing processes

Underdeveloped industrial parks

Making it difficult for the electricity supply industry to efficiently plan load growth and ensure a focus on associated investments

Inadequate strategic (and tactical) sector coordination

For example the **sub-optimal engagement of manufacturers in load growth planning** and **inadequate investment for reliability improvement**. This results in scarce resources not being applied to tackle the highest priority constraints

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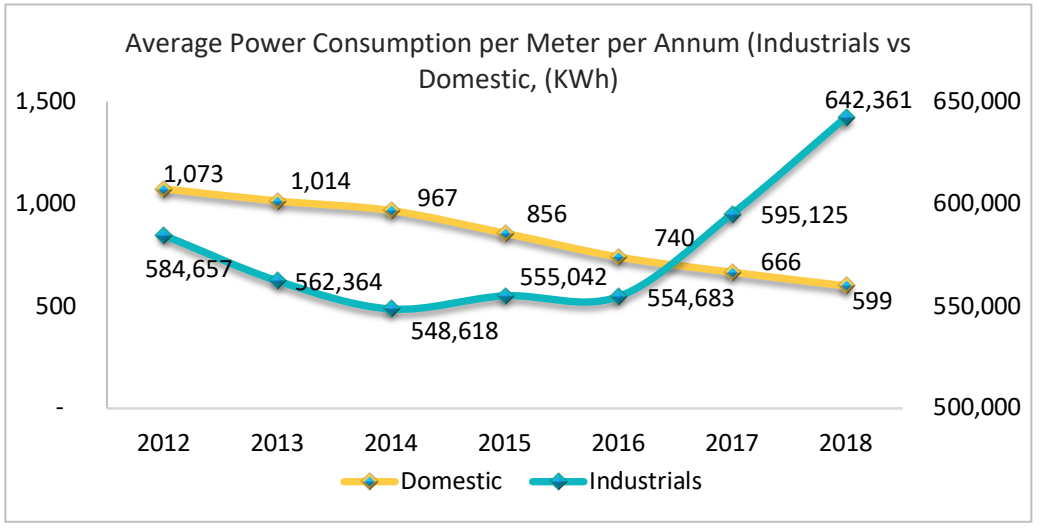
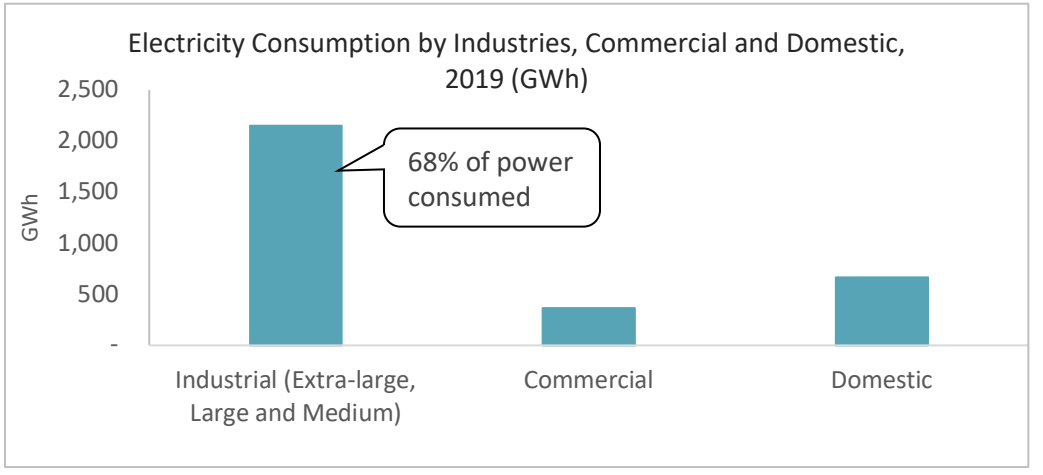
Manufacturing consumes 68% of the electricity sold (2 of 5)



- The per capita power consumption by the industrial sector grew by a CAGR of 4.02% (2014 – 2018), while the per capita domestic consumption declined by (-ve) 11.28%
- Growth in industrial power consumption reflects an increase in industrial activity, and demonstrates gradual growth in manufacturing



- The industrial sector (extra-large, large, and medium categories) consumed 68% of all power sold by Umeme. Commercial consumed 11% and domestic 21%
- The manufacturing sector is therefore vital not only for the financial viability of the power sector, but also for overall economic growth and job creation

Source: Umeme Tariff Parameters 2019-2025, Application for Modification of Licence #048, Presentation at Public Hearing, 16 August 2019; Umeme 2019 Annual Report for breakdown of consumption by sectors, CIG analysis

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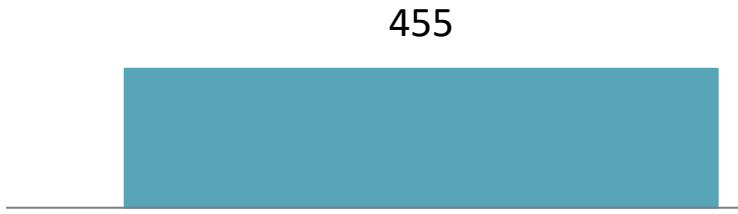
Projected demand and cost of unserved energy (3 of 5)

1: Projected energy demand growth in the Jinja-Kampala-Entebbe industrial corridor

Projections based on consumption analysis

- Energy demand by 475 extra-large, large and medium (at the cusp of becoming large), is estimated at 256 MW (2019), **310 MW** (2021) and **455MW** in 2025. Demand for projections compare favorably with UIA's projections of 275MW in 2025 - which only applies for UIA managed industrial parks
- Demand growth was based on the projected CAGR of 100 factories surveyed, and extrapolated to 475 factories (extra-large, large and medium), estimated to be located on the JKE

Power demand projections, 2025 (MW)

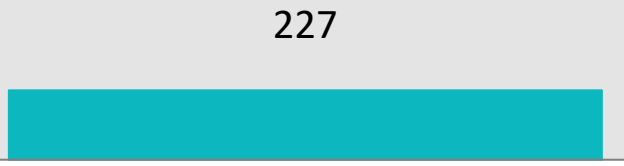


2: Direct cost of unserved energy by manufacturers located in the Jinja-Kampala-Entebbe industrial corridor

Example of the cost of remediation of unserved energy

- The cost of unserved energy is based on expenditure data obtained from a survey of 19* extra-large and large factories
- Data was collected on cost of diesel, and/or cost of surge power injection, to e.g., achieve very high temperatures in the case of iron and steel industry, after an outage or tripping event
- The cost of unserved energy was based on primary data directly obtained from manufacturers, engaged in various types of production

Annual cost US$ ('0000') of diesel purchases by 19 surveyed firms*****



* The firms surveyed were engaged in: Pharmaceuticals, iron and steel, printing and publishing, wood processing, food and beverages, etc.

** Monthly cost of diesel purchases, excluding capital cost of generator purchases and excluding O&M cost was UGX 700,538,372/= (US$ 189,335 based on RoE of 3700). However, 34% of the total cost was by one firm engaged in steel and iron. In this case, the cost relates to the additional electricity that is injected to fire furnaces to the correct temperatures once power is restored, vs firing the furnaces once. Note that these costs do not include the indirect costs of down time, lost markets, and lost labor productivity, etc. Total annual costs are US$ 189,335x12 = US$2,272,020.

*** Given that operational decisions at firm level are the key determiners of whether to purchase diesel or shut down factories until quality power is restored, the research team did not find it prudent to extrapolate the costs to all extra-large and large manufacturers located in the JKE industrial corridor

Type of manuf. industry & size of firm drive demand (4 of 5)

	KEY FINDING	SUMMARY DESCRIPTION	IMPLICATIONS/INSIGHTS
1	**Five manufacturing sub-sectors constitute the largest consumers of electricity**	• The largest power consumers by sub-sectors are: Agro-processing, food and beverages; iron and steel; plastics; wood processing and furniture; and pharmaceuticals	• In the context of limited resources, targeting investments to address power quality and reliability constraints to these sub-sectors can help to absorb a significant part of current generation capacity
2	**Energy demand by extra-large and large sized manufacturers had the highest rate of growth**	• Demand by extra-large and large manufacturers grew by a Compound Annual Growth Rate (CAGR) of 10% for the period 2008-2018 • Demand by medium sized manufacturers grew by 8%	• Tackling unserved demand by extra-large and large manufacturers can improve sector revenues that now go to competing energy sources • Increasing investment in reliable power for especially this category of industrials is vital to the utilization of the surplus generation capacity
3	**Unserved energy is highest for intensive energy users**	• Industries that are classified as intensive energy users incur the highest cost of remediating unreliable supply	• These industries include: Iron and steel industries • Paper, printing and publishing • Grain milling, and food processing, • Pharmaceuticals, etc.

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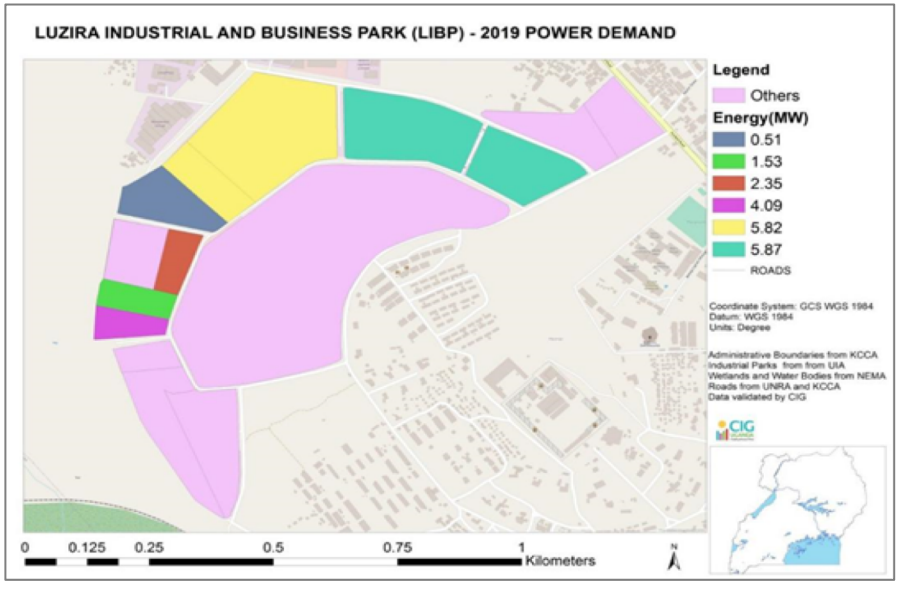
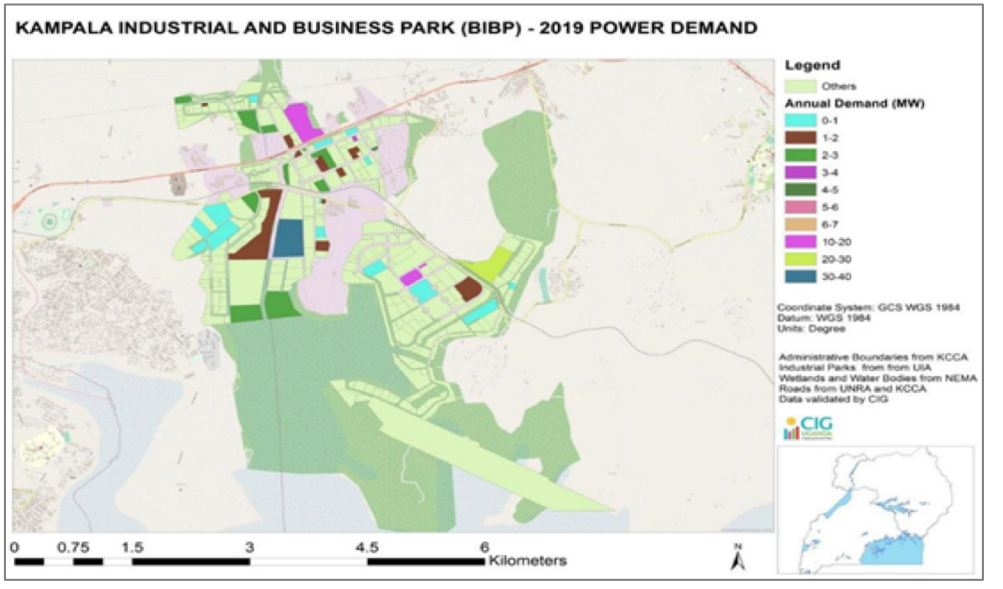
Energy demand maps by selected UIA IPs (5 of 5)

- In Luzira Industrial and Business Park, the largest power consumers in 2020 were engaged in: pharmaceutical manufacturing, pipe design, beverages, and printing industries
- To improve reliability and quality of supply, the Uganda Electricity Transmission Company Ltd (UETCL) is constructing a 132 KV substation in Luzira Industrial Park with financing from Chinese Exim Bank
- A similar investment is being completed for Namanve, and Mukono - awaiting commissioning

- In the Kampala Industrial and Business Park (Namanve)*, of the 307 firms had been allocated industrial land, 49 were operational with 22 engaged in manufacturing. The rest were under construction, or in pre-start / feasibility phase
- Iron & steel, and plastic firms were the top users of energy
- The Lagan Group, a UKEF financed EPC contractor is building suitable infrastructure and utility services**. Works are planned to begin May 2021 for a 4 year period





*Based on meetings with the Namanve Industrial Park Manager, there are now 82 operational companies, majority of whom are in the manufacturing sector.

** Services include: power system (underground cables), water systems, paved roads, waste water system, solid waste management, street lighting, and ICT/CCTV

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Conclusions

- Sub-optimally planned industrial parks, especially those located in residential areas make it difficult to solve reliability and quality of supply problems efficiently

- There exists significant unserved energy, as demonstrated by the proxy indicator of energy cost of unserved demand by the 19 sampled firms. If quality of supply and reliability can be improved, the ESI can earn the revenues that now go to other sources of energy. Accelerating the delivery of transmission and distribution projects that are underway is therefore vital to unlocking these revenues

- Improving the quality of supply will also help manufacturers increase investments in production capacity, resulting in faster load growth

- Strategic coordination in the establishment of modern industrial parks is urgently required. Stronger collaboration between the UIA, UMA, Umeme, UETCL and ERA is vital in ensuring that transmission and distribution resources are efficiently deployed in support of productive demand

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Key recommendations and proposed next steps (1 of 2)

Recommendation	Actions required	Suggested/Immediate next steps
Provide technical assistance to manufacturers to address reliability problems where no current/near term plans by the power sector exist	• Support individual extra-large power users facing serious reliability problems. This assistance is most relevant to extra-large power users, for whom remediation provides higher returns on investment vs maintaining the status quo • Assist the firms to complete feasibility studies and investment / transaction facilitation support	• Prioritize (working with the power sector) investment in reliability improvement for industrial parks • Develop a framework for conducting feasibility studies and investment plans for improved reliability
Facilitate investments in the upgrade of transmission and distribution infrastructure	• Help to mobilize finance to improve reliability and quality of power supply with priority going to manufacturing sector • Increase the use of modern electricity distribution management system. This would ensure, for example, that overloading of distribution transformers is minimized, and/or, transformers are replaced or upgraded well before they crash	• Help with project preparation and finance close for electricity transmission, to enable capital raising for the strengthening of the transmission and distribution grid • Support efforts in sector coordination and decision making
Build capacity of UMA to enhance their capability to more effectively engage with power sector stakeholders on behalf of their members	• Given that manufacturing comprises c. 68% (GWh) of the power sold by Umeme, and UMA is the relevant association, improving their ability to engage the power sector and GoU is vital • Support to UMA could include the strengthening of the secretariat to build capacity for developing fact-based positions for more effective engagement with GoU and the power sector	• Help UMA to build the capacity of their policy department to effectively engage GoU and the power sector

Source: Team analysis

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Key recommendations and proposed next steps (2 of 2)

Recommendation	Actions required	Suggested/Immediate next steps
Enhance the use of GIS and spatial tools to improve investment deployment, and enhance the efficiency of power utilities	• Assist in the strengthening and capacity building of the Uganda Energy Sector GIS Working Group • Improve the quality of GIS data collection, including the frequency and regularity of its collection, capacity for analysis, dissemination and utilization in decision making	• Prioritize critical data requiring GIS interventions • Build capacity of the Energy Sector GIS Working Group • Support the establishment of National Spatial Data Infrastructure
Support manufacturers in the area of sustainable energy management, and green energy investment	• Efficient management of energy is vital in boosting productivity of manufacturing, and enhancing cost competitiveness • Case studies drawn from other markets have demonstrated that energy costs can be sustainably reduced through better energy management	• Conduct a rapid study on manufacturers readiness to integrate energy management and green investment in their operations • Prepare recommendations for how to address the energy management challenges, and promote green investment
Assist with strategic coordination in the establishment of modern industrial park	• Enhance collaboration between the UIA, UMA, Umeme, UETCL and Electricity Regulatory Authority (ERA) to mobilize and efficiently deploy capital for improved electricity transmission and distribution • Prioritize support for productive demand/productive use of energy	• Provide support for technical assistance to manufacturers, and the electricity supply industry to enable sustainable sector coordination, with a focus on productive use of green energy

Source: Team analysis

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