KNUST POLICY 0033

Kwame Nkrumah University of Science and Technology, Kumasi

Energy POLICY

ENERGY
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KWAME NKRUMAH UNIVERSITY OF SCIENCE
AND TECHNOLOGY, KUMASI-GHANA
**QUALITY ASSURANCE AND
PLANNING OFFICE**

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Foreword

The Kwame Nkrumah University of Science and Technology, Kumasi has a mission to advance knowledge in science and technology through creating an environment for undertaking relevant research, quality teaching, entrepreneurship training and community engagement to improve quality of life. The supply of secure, reliable and sustainable energy is critical to the fulfilment of this mission. Consequently, there is the need to have an Energy Policy to guide the supply and use of energy in the University.

This Energy Policy document seeks to provide an overarching direction to the University on the management of its energy supply, consumption and cost, by optimising energy use and minimising energy wastage.

I therefore urge all Provosts, Deans, Heads of Departments, Procurement Office, Development Office and other Units of the University to make sure that all the policy directives are adhered to in order to help manage our energy use in a more sustainable way and to minimise wastage.

The University is grateful to all those who ensured the initiation, development and approval of this policy.

PROFESSOR (Mrs.) Rita Akosua Dickson
VICE-CHANCELLOR
KNUST

Acknowledgement

As part of the strategic planning mandate of the Quality Assurance and Planning Office (QAPO), University Policies are initiated and proposed for approval by the Academic Board.

The QAPO is grateful to Dr. Richard Opoku (KNUST's Energy Efficiency Consultant) for initiating the first draft of the KNUST Energy Policy. We also thank Prof. George Y. Obeng (Dean, Faculty of Mechanical and Chemical Engineering), Prof. Francis Kemausuor (Director, The Brew-Hammond Energy Centre), Prof. Robert C. Abaidoo (Former Director, Office of Grants and Research), Prof. Reuben Y. Tamakloe (Department of Physics), Dr. David Ato Quansah (Department of Mechanical Engineering), Dr. Emmanuel Frimpong (KNUST's Electrical Consultant), Mr. Kojo Safo-Kantanka (University Architect) and Mrs. Amanda Owusu-Asare (Secretary to the Committee) for working tirelessly to produce this policy document.

The Heads of various Departments and Units including Dr. Jimmy Nkrumah (Director of Works and Physical Development), Mr. Edward Nketia (Former Director of Procurement) and Prof. Akwasi Acheampong Aning (Chairman, Committee of Hall Administrators), who provided inputs to this policy document are duly appreciated.

Lastly, I wish to appreciate the contribution of all staff of this University who contributed in several ways towards the development and approval of this Policy.

PROFESSOR JERRY JOHN KPONYO
DEAN
QUALITY ASSURANCE AND PLANNING OFFICE
March, 2022

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1.0 INTRODUCTION

1.1 Background

Energy systems around the world are evolving towards cleaner, greener and more sustainable pathways. This has been necessitated by the realisation that current patterns of energy generation and consumption are not only unsustainable, but also emissions from these anthropogenic activities pose severe threat to the earth's climate system. Consequently, a number of global initiatives and actions have been proposed and are currently being implemented to fundamentally transform the manner in which energy is generated, transported and consumed.

One such example is the Sustainable Energy for All (SEforALL) initiative. This initiative seeks to accomplish the triple goals of doubling the rate of improvement in energy efficiency, doubling the share of renewable energy in the global energy mix and achieving universal access to modern energy services by 2030[1]. It is heart-warming to recall the contribution of experts from KNUST[2] to the formulation of this global initiative and also to the development and passage of Ghana's Renewable Energy Law, 2011 (Act 832). More recently, governments around the world have bound themselves to the Sustainable Development Goals (SDGs), by which commitments have been made to accomplish 17 defined goals in advancement of human development and climate change, particularly Goal 13 (Climate Action).

In Ghana, the Strategic National Energy Plan (SNEP) (2020-2030) envisions the provision of "sufficient, viable and efficient energy services for Ghana's economic development". The SNEP foresees a major shift

1 https://www.un.org/millenniumgoals/pdf/SEFA.pdf

2 Prof Abeeku Brew-Hammond of blessed memory served on the UN Secretary General's High-Level Technical Group on Sustainable Energy for All.

towards efficient use of energy through various government policies and other market initiatives. Similarly, Ghana's renewable energy masterplan (REMP) (2020-2030), envisages significant uptake of renewable energy technologies in the country, reaching 1,363.63 MW by 2030[3].

Recognising the global and national trends in the energy sector, KNUST has since 2011 been running dedicated postgraduate programmes in Renewable and Sustainable Energy Technologies to develop human resources for the energy transition. For example, the postgraduate (Masters) programme in Renewable Energy Technologies (MSc. RETs) which is jointly run by The Brew-Hammond Energy Centre and the Department of Mechanical Engineering was the first of its kind in Ghana. Moreover, the University's Strategic Plan (2016 – 2025), clearly took note of the need to act decisively to show the way in the "exploitation of solar energy and other renewable energy resources for electricity". Consequently, the strategic plan commits the University to increasing the proportion of alternative energy sources in its energy mix. Additionally, the strategic plan also seeks to reduce energy consumption by 10%.

The Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, receives its bulk electricity from the Electricity Company of Ghana (ECG) with a contracted demand of 5,396.6 kVA through 11 kV substations located behind Unity Hall. The electricity received is then stepped-down to 415 Volts and distributed to the various buildings and facilities within the University, including the Faculties, Main Administration, Students' Halls of Residence, Lecturers' Bungalows, and other Commercial Facilities. From the ECG bills, the electricity consumption of all these facilities is in the range of 1,172 – 2,210 MWh per month.

In 2017, a preliminary energy audit was conducted in some selected facilities on the KNUST Kumasi campus including the Main Administration, all the six Colleges and their buildings, facilities of essential services and students' halls of residence. The audit report

3 http://www.energycom.gov.gh/files/Renewable-Energy-Masterplan-February-2019.pdf

revealed that about 14% of the University's electricity consumption in these facilities was actually wasted through the use of low energy efficiency appliances and poor energy conservation practices. For air-conditioners used in the offices and auditoria, significant proportions of them were in the low energy efficiency category of 1-star. Using internationally available protocols, it was found out that KNUST's electricity consumption was relatively high and that the general operational standards were below minimum energy performance standards (MEPS).

Drawing on these issues, this policy document presents the first energy policy for KNUST to bring some level of standardisation and optimisation in terms of electricity use in facilities on all KNUST campuses. It focuses on the actions KNUST will take to affect the energy consumption and supply to fulfil the expectation of its staff, students and major stakeholders for quality teaching, training, research and services delivery. This energy policy document is consistent with the energy management system protocols and standards from International Organisation for Standardisation (ISO) 50001. The components of ISO 50001 on Energy Efficiency and Demand-Side Management (EEDSM) were used as the main guide in developing this energy policy. The EEDSM, as applied to KNUST entails the following:

i. Regulating the type of electrical appliances used in all the buildings at the Faculty areas and the Main Administration.

ii. Ensuring that all electrical appliances brought to the University meet the minimum energy performance standards (MEPS) and avoid the use of inefficient appliances that have very high electricity consumption.

iii. Regulating the quantity and type of electrical appliances used at the students' halls of residence. From the KNUST ECG bills, it is estimated that 40-44% (that is, 880-926 MWh/month) of the total electricity consumption of the University is for the students' halls of residence on campus.

iv. Regulating the use of critical electrical appliances like electric cookstoves and electrical irons in the students' halls of residence.

v. Providing periodic workshop training for facility managers and staff of the University on energy conservation.

vi. Sharing energy conservation tips to the general University community from time to time.

vii. Educating all students especially the freshmen admitted into the University, on energy conservation practices at the halls and lecture rooms during the orientation programmes for first year students.

viii. Ensuring that energy management technologies/devices are installed in offices, classrooms and washrooms to manage electricity usage to minimise wastage.

1.2 Guiding Principles of the Policy

The energy policy shall be driven on the principle of reliability, cost-effectiveness, efficiency, conservation, collaboration and partnership. Continuous supply of energy services in the form of electricity and fuels is likely to engender satisfaction of stakeholders, contribute significantly to the management and sustainability of energy service delivery to power the teaching, learning and research activities of KNUST. These principles are to ensure:

a) Provision of reliable supply of energy to all teaching, research and all other facilities to support human resource development.

b) Quality energy management practices by providing access to energy saving devices on all campuses of the University and to implement renewable energy options.

c) Recognision and reward of innovations in energy science and technology research and development, to build capacity and encourage future investment in the energy services infrastructure of the University.

1.3 Aim and Objectives of the Policy

This policy aims to guide the University to sustainably manage energy demand and supply to its facilities, to fulfil the expectation of its staff and students for quality teaching, training, research and service delivery to contribute to national economic growth. The specific objectives of the policy are to provide framework to:

i. Implement energy efficiency and demand-side energy management (EEDSM) measures.

ii. Procure and install standard quality electrical appliances for all facilities of the University.

iii. Regulate the type of electrical appliances used in all buildings.

iv. Build the capacity of faculty, students and staff through training workshops and seminars on energy conservation practices and opportunities.

v. Manage generator sets procured and installed as supplementary power sources.

vi. Explore the research, development and demonstration of alternative and sustainable/renewable energy resources including solar, biogas and biomass to electricity.

vii. Install alternative and sustainable energy systems (solar PV, bioenergy etc.) on campus to progressively attain self-generation of electricity and reduce dependence on the national grid.

Details of these energy efficiency and demand-side energy management (EEDSM) measures to be implemented to optimise electricity use on KNUST campuses are presented in the following sections. In addition, alternative energy and sustainable energy options including solar energy, biogas and biomass to electricity to diversify KNUST's energy portfolio and minimise our dependence on the national grid are presented.

2.0 STRATEGIES TO ACHIEVE OBJECTIVES

2.1 Energy Efficiency and Demand-Side Energy Management Measures

The 2017 preliminary energy audit identified key operational issues relating to electricity use on KNUST campus. Energy management devices (motion/occupancy sensors, key card energy savers, timer switches, etc) which can be used to minimise electricity wastage have not been significantly explored in the offices and facilities across the University. The following key EEDSM measures shall therefore be implemented:

i. **Metering individual buildings at the Colleges, Main Administration, students' halls and facilities of essential services on campus.** This will address issues where the amount of electricity used in a particular building is not known, to warrant energy efficiency measures.

ii. **Banning the procurement of 1 – and 2-star air-conditioners.** The minimum energy performance rating for air-conditioners shall be 3-star. The inverter-type air-conditioners and other technologies with higher energy efficiency rating are preferred.

iii. **Installation of motion sensors in the washrooms at the faculties, halls of residence and the Main Administration.** Motion-sensor lighting systems shall be installed in all the washrooms to minimise electricity wastage.

iv. **Installation of energy management technologies in lecture theatres and classrooms.** Energy management devices shall be installed to automatically control fans, light bulbs and

air-conditioners in the classrooms/conference rooms and auditoria.

v. **Installation of timer switches and/or photocell switches to regulate outdoor lighting systems and streetlights.** Photocells and timer-switches shall be installed to regulate outdoor lighting systems to save energy.

vi. **Installation of keycard energy savers and/or occupancy sensors in offices.** Energy management devices shall be installed in the offices to monitor and reduce electricity wastage.

vii. **The adoption and implementation of a green building code to ensure that all new buildings constructed are designed to have reduced space cooling and artificial lighting requirement[4].** Older buildings shall also be gradually retrofitted to improve their energy performance.

2.2 Procurement, installation and usage of electrical appliances in the University

Procurement of electrical appliances for all Faculties, Colleges, the Main Administration, students' halls, facilities of essential services and all other facilities shall adhere to the following:

i. **Air-conditioners**: The minimum energy performance standard (MEPS) for procurement of all single unit wall-mounted or floor standing air-conditioners shall be 3-star, or preferably inverter-type with higher energy efficiency rating.

ii. **Ventilation/Ceiling fans**: The maximum power consumption of ceiling fans used in the classrooms, laboratories and other places of the University shall be limited to 50-Watt rating. Smaller fans with power ratings not exceeding 40 Watt are to be used in student rooms at the halls.

4 KNUST Corporate Strategic Plan 2016 – 2025 (p.43)

iii. **Light bulbs**: Only light emitting diode (LED) bulbs shall be used in the University. For clarity and guidance see Tables 1 and 2 in the Appendix.

2.3 Regulating the use of electrical appliances at the students' halls of residence

Preliminary energy audit conducted has revealed that the students' halls, on the average, account for 40-44% of KNUST's total electricity consumption. The use of old and inefficient electric cookers, fridges and irons, by students, and their non-adherence to energy conservation measures account for this. The University recognises that to reduce electricity wastage at the students' halls, the type and quantities of electrical appliances used by the students in their rooms would have to be regulated and managed. Learning from best practices in other parts of the world, KNUST shall adopt "Appliance User Fee" approach to manage the type of appliances used by the students in the halls. This implies that the University shall procure the most efficient electrical appliances for use by students who shall pay user fees as they use them. Specific appliances considered under this "Appliance User Fee" are electric cookers, fridges, electric irons, ceiling fans and light bulbs. Computers, laptops and other electrical appliances are NOT part. Table 3 (in Appendix) presents the recommended minimum energy performance standards (MEPS) for the appliances to be used in the students' rooms.

2.4 Training of staff and students on energy conservation practices.

Energy conservation opportunities exist with huge energy consumption reduction potentials at KNUST as far as occupant behaviour is concerned. Energy efficiency awareness creation shall be pursued during staff annual workshops and training programmes.

2.5 Management of diesel generators used as supplementary power sources

In recent times, several standby generators have been procured by various Colleges, Faculties and other Units in the University, to deal with grid power outages. The procurement and running of these generators have been characterised by significant inefficiencies. To properly manage diesel generators on campus, the University shall adopt a "Diesel Genset Power Pool" strategy. Under this strategy, the University will discourage the purchase of standby generators by individual facilities. Rather, various facilities will be hooked onto a single generator, to enhance the operating efficiency of the plants. The cost of operating and maintaining the generators shall be shared by the connected facilities in proportion to their energy consumption. Facility managers of the Colleges involved shall take the responsibility in the planning of this power pool strategy, in consultation with their Provosts or Deans, the Maintenance Engineer, the Electrical Consultant and the Energy Efficiency and Solar Energy Consultant.

2.6 Exploring alternative and sustainable energy resources

There is huge prospect for KNUST to be grid-independent and attain self-generation as far as its electricity demand is concerned. The Brew-Hammond Energy Centre shall liaise with the various Departments and Centres to explore the potential for self-generation of electricity and fuels by the year 2030. The University shall support research that explores the conversion and utilisation of alternative and sustainable energy resources such as solar, biogas, biomass and wind among others.

Solar energy has been determined as one of the most cost-competitive and sustainable energy options for KNUST. From preliminary studies, it has been determined that the total rooftop area of 56,000 square meters of KNUST buildings on campus can accommodate solar PV installation of about 7,800 kWp (7.8 MWp), which can translate to electricity generation of 500–820 MWh/month. The electricity generation from the 7.8 MWp solar PV system can potentially meet

32%– 54% of the total electricity demand at KNUST depending on the month of the year. For the electricity consumptions at the Faculties and the Main Administration buildings, the solar PV electricity generation can meet 85%-100% of the buildings' energy needs depending on the month of the year.

In addition, biomass and biogas energy generation potential from the students' halls, lecturers' bungalows and the faculties shall be converted to electricity. Whilst diesel generators are very helpful during power outages, alternative options including standalone solar PV systems and back-ups for daytime use could potentially be more economically and environmentally advantageous and would be explored.

2.7 Targets and actions on alternative and sustainable energy resources

In view of the information presented above, on the potential opportunities that alternative and sustainable/renewable energy resources present to KNUST, the following targets and actions are recommended:

i. KNUST to attain 20% self-generation of its total electricity consumption by 2025 and at least 50% by 2030 for buildings at the Faculties, Main Administration and the Student's Halls of Residence.

ii. Solar-powered street lighting and electric vehicle charging stations on all KNUST campuses are encouraged.

iii. The electrical wiring of all new buildings to be constructed or renovated on all campuses of the University shall be separated into different load categories as: light and fan loads, air-conditioner loads, and other loads (computers, printers, etc.).

iv. Progressively, existing buildings shall have their electrical wiring separated into different categories as specified above.

v. Provosts, Heads of Departments and Units shall consider solar system back-ups as first option for non-heavy loads, before any consideration of diesel generators.

vi. Rewire the halls of residence and install fuses in all rooms to ensure only appliances with the permitted wattage can be used in the rooms.

The Brew-Hammond Energy Center and other Departments and Centres shall carry out data collection and analysis to inform Management of the University on the investment opportunities to move KNUST to self-generation, exploring all forms of alternative and sustainable/ renewable energy.

3.0 IMPLEMENTATION MECHANISMS

3.1 Coordination of Activities

The University's Energy Efficiency and Solar Energy Consultant shall have the responsibility for coordinating all the activities and guidelines in this policy. S/He shall liaise with all relevant Units of the University in the implementation of the activities contained in this policy. Liaising with the Brew-Hammond Energy Center, other Units and Departments, the University's Energy Efficiency and Solar Energy Consultant shall supervise testing and verification of electrical appliances that will be procured by the University to ensure that they meet the minimum energy performance standards (MEPS). The Consultant shall also be responsible for sensitising all stakeholders (heads of department/units and the general University staff and students) about this policy and the need for adherence.

3.2 Funding for Demonstration Projects

To achieve the targets presented in this policy document, demonstration projects at (e.g. Main Administration, one hall of residence, and one Faculty building) including energy management technologies and systems, solar PV projects, fuel cell technologies, and biomass/biogas technologies shall be rolled out on campus to gain experience in their operations. Lessons learned from the demonstration projects shall be critical in the implementation of full-scale projects. The University through its annual budgetary allocations shall support small-scale demonstration projects that have opportunities to translate into bigger sustainable projects to enable KNUST attain its self-generation targets. These demonstration projects shall also support teaching and research activities in the University.

3.3 Stakeholders Involvement

KNUST recognises that to successfully realise some of the objectives of this Energy Policy, it would have to collaborate with strategic partners and stakeholders including private sector suppliers and companies, financial institutions and banks, donor agencies, other public institutions, the Ghana Tertiary Education Commission (GTEC), Electricity Company of Ghana (ECG), Energy Commission, Ministry of Energy, etc. The Office of the Pro Vice-Chancellor shall lead efforts to solicit for funding for larger scale projects implementation on campus. Sponsors with funding of US$ 200,000 and above shall be recognised with special Sustainable Energy Footprint Awards.

4.0 POLICY ALIGNMENT, VALIDITY AND REVIEW

4.1 Alignment with Other Policies

The Quality Assurance and Planning Office (QAPO) shall be responsible for monitoring the implementation of this policy to ensure that it is in alignment with other policies and strategies of the University. Actions and strategies of this policy should not conflict with other policies of the University.

4.2 Validity of Policy Provisions

This policy does not seek to replace other provisions in the KNUST statutes. In the event of conflict, appropriate measures shall be taken by the Academic Board to address them. The Policy becomes operational after approval by the University Academic Board.

4.3 Review of the Policy

Taking due cognisance of the prevailing electricity consumption situation at KNUST and resource availability to address some of these challenges, it is recommended that the KNUST Energy Policy document be reviewed every five (5) years to address changes in KNUST's energy portfolio. The Quality Assurance and Planning Office (QAPO) shall liaise with the appropriate Units for such policy reviews.

APPENDIX

Table 1: Recommendations of lighting systems

Location	Recommendation
Inside lights for offices	The power rating shall be **limited to maximum 20 Watt per bulb.** The number of holders/fixtures shall be arranged to provide sufficient lighting based on the size of the room. However, it is recommended that office spaces should have fixtures with one bulb per person, with the bulb located directly above the desk/table of the user. In all cases, inside lighting shall meet minimum illumination levels of **250-500 Lux** for office work, measured at the working table.
Corridors, auditoria, laboratories, libraries and classrooms lighting	The bulbs shall be limited to maximum 18-Watt fluorescent LED lamps per fixture. In situations, where there is existing fixture that allows for two fluorescent lamps, two lamps shall be installed. However, sufficient distance should be allowed between such fixtures to avoid over brightness and wastage of electricity in such areas. For corridors and auditoria, lighting levels shall meet minimum illumination of **50-150 Lux**. For libraries, laboratories and classrooms, lighting levels shall meet minimum illumination of **250-500 Lux.**

Streetlights and car park lighting	Progressively, all streetlights on KNUST campuses shall be made solar operated. The University Consultant for Energy Efficiency and Solar Energy, shall periodically advise the Procurement Officer in the purchase and use of streetlights on all campuses of the University. For street-lighting and car park lighting, the illumination levels shall meet minimum specifications of **40-80 Lux** from light source, and up to minimum of **8-15 Lux** at distance of about 5 meters from light source/pole**.**

Table 2: Recommended energy efficiency measure for lighting systems

Incandescent/ CFL Bulb to Replace	Typical LED Replacement	Recommended Lighting Efficacy (Lumens/Watt)
40 Watts	11 – 15 Watts	80 or more
60 Watts	15 – 20 Watts	80 or more
75 Watts	20 – 25 Watts	80 or more
85 – 105 Watts	30 – 40 Watts	80 or more

Table 3: Recommended appliance power ratings for the students' halls

S/N	Appliance type	MEPS
1	Light bulb (LED)	Rating: Maximum of 20 W in the rooms and 11 W in the balcony. Life hours: 25,000 hours (min); Illumination: **250-500 Lux** (minimum).
2	Fan	Rating: 28 – 50 Watt, preferably inverter type
3	Electric iron	Rating: 1200 – 1600 Watt (max.)
4	Electric cooker	Rating: 1200 – 1600 Watt (max.)
5	Refrigerator	Rating: 60 – 80 Watt (max.). Preferably inverter type refrigerators.

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