

## WELCOME ADDRESS

Welcome to yet another exciting edition of the KEEP Bulletin.

This edition highlights research outcomes and innovations of the College of Engineering.

KNUST seeks to deliver high-quality postgraduate courses, conduct and disseminate applied research focused on addressing development challenges related to industrialisation, digital development (ICT), energy systems, renewable energy, manufacturing and the exploration and development of the oil and gas industry.

KEEP is funded by the Government of Ghana as part of the World Bank's Africa Centers of Excellence for Development Impact (ACE Impact) Project hosted by the College of Engineering, KNUST. KNUST has over half a century, maintained its reputation for quality training and has been at the forefront of preparing manpower to support the advancement of technology and engineering in Ghana and the world. A current ranking by Times Higher Education World University Impact Rankings places KNUST as number one in Africa and 14<sup>th</sup> globally in delivering quality education, which is assessed on four main parameters: teaching, research, knowledge transfer and international outlook.

The KNUST College of Engineering Endowment Fund has received Five Hundred Thousand Ghana Cedis (GH¢500,000.00) from Ghana Gas, Fifty Thousand Ghana Cedis (GH¢50,000.00) from the Electricity Company of Ghana (ECG) and One Hundred Thousand

Ghana Cedis (GH¢100,000.00) from the Associated Consultants Company. One Million Ghana Cedis (GH¢1,000,000.00) has also been pledged by GRIDCO of which Five Hundred Thousand (GH¢500,000.00) has been redeemed. An amount of Fifty Thousand dollars (\$50,000.00) has been donated by an alumnus in the United States whose interest is in manufacturing. The Civil Engineering class of 1996, is the first alumni group to donate fifty thousand Ghana Cedis (GH¢50,000.00) to the Endowment Fund. The presentation was made at the 2022 Annual Conference and 52nd Annual General Meeting (AGM) of the Ghana Institution of Engineering (GhIE) held at the La Palm Royal Hotel, Accra, on 30th March 2022.

Contributions are welcome and should be directed to the following bank details:

**Account Name: KNUST COLLEGE OF ENGINEERING ENDOWMENT FUND**

**Account Numbers: 904 000 824 8502 (Cedis Account) OR 904 000 952 7588 (US Dollar)**

**Bank Name: STANBIC BANK**

**Swift Code: SBICGHAC**

**Bank Address: P. O. Box CT 2344 Cantonments, Accra**

**Branch: KNUST**

Donations to the fund can also be made by clicking [here](#)

*The College of Engineering has recruited an Alumni Relations Officer to strengthen and maintain the relationship with its alumni.*



Prof. Kwabena Biritwum  
Nyarko  
(Project Lead, KEEP)

This relationship would help leverage the expertise of our alumni to enhance the realisation of the CoE to become Africa's leading Engineering College by 2025. KEEP sincerely appreciates all alumni who have filled out the alumni google form. If you are yet to do so, please follow the link (<https://forms.gle/xnPSNCJXDC28s7kU8>) to complete the information on your basic biodata; this should not take more than 2 minutes of your time.

We welcome contributions and suggestions from stakeholders and readers to help improve future editions. Please send all such suggestions and enquiries to [keep@knust.edu.gh](mailto:keep@knust.edu.gh)

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# KEEP Hangs Out With Professor Mark Adom-Asamoah, Provost, College of Engineering



as a specialist in Steel Structures, further to my earlier training at SCI.

Upon assumption of duty, I lectured at the Department of Civil Engineering from 1995 to 2000. I was awarded a Commonwealth Fellowship scholarship to pursue a Ph.D. in Earthquake Engineering tenable at the University of Bristol, UK in the year 2000. I resumed duty in early 2005 after my Ph.D. and was promoted to the rank of Senior Lecturer in October 2005. During the period from 2005 to 2012, I served as the Sectional Head of Structural Engineering, Faculty Examination Officer of the Faculty of Civil and Geomatic Engineering, and a non-professorial representative of the College of Engineering on the academic board. I also served as the first Services and Structural Engineering Consultant of the University from the year 2006 to 2012. I was also a visiting lecturer at the National University of Rwanda, Butare, and also a visiting scholar at the University of Bristol. I was awarded a Fulbright Senior Research Fellowship tenable at the Georgia Institute of Technology for the 2012-2013 academic year on sabbatical leave in Atlanta, USA. In addition, I was a visiting scholar at the Arizona State University, the USA in January 2017.

I was promoted to the rank of Associate Professor in October 2012. I was appointed the Head of Department, Petroleum Engineering in August 2015 and

**KEEP:** We're glad to have you spend time with us. Could you please tell us about yourself?

**PROF:** Mark Adom-Asamoah is my name. I had my secondary education at the Opoku Ware School from 1981 to 1988 where I completed my O'level and A'level certificates in 1986 and 1988 respectively.

I then proceeded to the University of Science and Technology, now the Kwame Nkrumah University of Science and Technology (KNUST) in 1989 to pursue a BSc programme in Civil Engineering. I graduated with first-class honors in 1993. I was retained as a Teaching Assistant for my post-degree National Service in the Department of Civil Engineering under the Structural Engineering section where I helped

with laboratory and tutorial sessions for undergraduate students. I was awarded a British Council Scholarship to read a Master's degree programme in Structural Steel Design at the Imperial College of Science, Technology and Medicine, University of London in September 1994. After my MSc programme, I had a 3-month internship at the Steel Construction Institute (SCI) in Berkshire, UK.

I was appointed to the position of a lecturer at the Department of Civil Engineering, KNUST, in November 1995, upon my return to Ghana after my study. The visionary Dean of the then School of Engineering, Prof N.K. Kumapley arranged for me to undertake an internship at the Tema Steel Company Limited as part of my hands-on training

## Production Team

**Editor-in-chief:** Prof. Kwabena B. Nyarko **Managing Editor:** Kwadwo Nyantakyi Marfo

**Content Editor:** Irene Otuba Nunoo **Production Editor:** Francis K. N. Nunoo

later in the same academic year (2015/16) was appointed concurrently the Dean of the Faculty of Civil and Geo-Engineering. I was appointed to the position of the Provost of the College of Engineering in August 2016, and that is the position I have held to date.

**KEEP: Congratulations Sir! So how has the journey been as a Provost?**

**PROF:** Exciting! I came into office as the Provost to advance the strategic vision of the College and I can boldly say that with the help of God and the entire College as a team, we have been able to achieve a number of them.

I will break this discussion into major strategic thrusts of the College's Vision:

#### **A. TEACHING, LEARNING, AND INNOVATION**

##### **1. INTRODUCTION OF NEW UNDERGRADUATE AND POSTGRADUATE PROGRAMMES**

During my tenure, we introduced three (3) new undergraduate programmes: BSc Automobile Engineering, BSc Industrial Engineering, and BSc Marine Engineering. These new programmes have expanded and enriched the scope of undergraduate engineering study at the University. The College has also introduced eight (8) new postgraduate programmes.

##### **2. STATE-OF-THE-ART LABORATORIES AND TEACHING FACILITIES.**

Before leaving office, my predecessor, Prof. S. I. K. Ampadu, procured laboratory equipment worth 5.6 million Euros. I had to refurbish the laboratories to accommodate the equipment procured. We have also procured other laboratory equipment for Telecommunications

Engineering and Automobile Engineering.

##### **3. KNUST/GAMBIA TECHNICAL TRAINING INSTITUTE (GTTI) PROJECT**

The College was selected from among other Engineering Colleges in West Africa by the World Bank to mentor GTTI as an Emerging Centre of Excellence in Engineering Education. The College is mentoring GTTI which has started 3 undergraduate programmes; BSc Civil Engineering, BSc Electrical/Electronic Engineering, and BSc Mechanical Engineering. The mentorship package involves KNUST certifying graduating students, the training of academic staff to acquire PhDs and MScs in addition to establishing administrative and financial offices to conform with tertiary education standards. The College Board has ceded this mentorship responsibility to the KEEP project.

##### **4. THE CYGNUS PROJECT**

The Cygnus project is a programme introduced to train Senior High School (SHS) students during their summer vacation. SHS students from St. Louis Senior High School, Yaa Asantewaa Girls' Senior High School, Opoku Ware Senior High School, KNUST SHS in and outside Kumasi stay on campus to undertake science and engineering innovation projects. With the help of sponsorship from Vodafone Ghana, students from all over the country were brought into the university in the just ended edition, where about 350 to 400 SHS students were in attendance.

##### **5. THE NEEDEY STUDENTS FUND AND STUDENT SCHOLARSHIPS**

This fund was initiated to help needy but brilliant students in the College of Engineering. The Needy Students Fund Committee is in charge of soliciting funding and helping needy students' financially. We were initially distributing

foodstuffs to students during the examination period and could serve over 500 students per period. The model has since been adopted by the entire University and scaled up under the Office of the Dean of Students. The activities at the College of Engineering Needy Student Fund are now in the form of scholarships and bursaries for needy students. We were able to successfully apply for scholarships from GNPC and GETFUND on behalf of selected undergraduate and postgraduate students.

##### **6. STUDENTS' INNOVATION CENTRE**

My vision for students' development affairs led to the establishment of the Students' Innovation Centre, where students are allowed to undertake practical hands-on innovation projects. The Centre has grown, in terms of enrolment and as at last academic year, it had a membership of 1,750 students.

##### **7. STUDENT LEARNING AREAS**

Student learning areas have been conveniently positioned and furnished within the College premises to curtail students having to walk all the way back to their halls and hostels in between lectures. It's the first of its kind in the University. These learning areas serve as convenient places for students' group discussions and personal studies.

##### **8. INCREMENT IN THE STUDENT POPULATION**

The student population in the College, when I took over as Provost, was about 5,000 (300 being postgraduate students). We now have about 12,000 students in total (1,000 being postgraduate students). Per the statistics above, the massive increment in the student population is evident. The strategy for reducing the student: teacher ratio in this respect has been the engagement of more lecturers and part-time lecturers. Virtual lectures/tutorials are also being organized

to increase the contact hours with students.

## **9. INCREMENT IN THE RATE AT WHICH STUDENTS GRADUATE**

The graduation rate of students (undergraduate students who graduated) at the time I took office was about 65% which has increased to about 85%. This was achieved by increasing teaching and learning contact hours by introducing tutorial sessions. The Ghana Engineering Students Association (GESA) executives were of much help in organising tutorial sessions, especially for first-year students who faced difficulty in some of the courses.

## **B. HUMAN RESOURCE**

### **1. STAFF DEVELOPMENT SUPPORT**

The College had about 55% of its lecturers being PhD holders as at 2016. This percentage has increased to about 85% as we speak. This percentage increment was achieved due to the University's policy to employ only PhD holders as lecturers. This automatically made anyone coming into the College of Engineering a lecturer, and a Ph.D. holder. Nonetheless, the College made some funds available which enabled lecturers already in the system without PhD to obtain their terminal degrees. The College now boasts of over 25% of the teaching staff in the professorial rank.

### **2. SENIOR AND JUNIOR STAFF**

The Senior and Junior staff who are the Administrators and Technicians of the College have the opportunity annually to partake in capacity-building courses and workshops organised by the College.

## **C. FUNDING**

When I came into office, the period of most research funds and grants in the College was coming to an end, and we had to bring in more grants. We established thematic

research teams to undertake grant writing. According to the KNUST Office of Grants and Research, 30 projects have been established amounting to \$24million in grants awarded since 2016. Inclusive are three World Bank Africa Centres of Excellence projects worth \$17.4 million which are:

1. The KNUST Engineering Education Project (KEEP), \$5.5 million.
2. The Regional Water and Environmental Sanitation Centre, Kumasi (RWESCK), \$5.5 million.
3. The Transport Research and Educational Centre, Kumasi (TRECK), \$6.4 million.

The College of Engineering has a very strong partnership with the industry which has also brought in some funds. The Ghana National Petroleum Corporation (GNPC) has donated One Million dollars (\$1,000,000.00), Tullow Oil has donated Three Hundred and Fifty Thousand dollars (\$350,000.00) and Ghana Gas has also donated Fifty Thousand dollars (\$50,000.00) to the College of Engineering, KNUST. The Ghana Grid Company (GRIDCO), the Electricity Company of Ghana (ECG), and the Volta River Authority (VRA) donated Four Hundred and Fifty Thousand Ghana cedis (GH¢450,000.00) for the College laboratories to be re-roofed.

### **THE COLLEGE OF ENGINEERING ENDOWMENT FUND**

I led the establishment of the College of Engineering Endowment Fund to provide stable and predictable funding for the College to become an internationally acknowledged Centre of Excellence in Engineering education, producing high caliber graduates with knowledge and expertise to support the industrial and socio-economic development of Ghana and Africa. An amount of fifty thousand dollars (\$50,000.00)

has been donated by an alumnus in the United States whose interest is in manufacturing. We have also received Five Hundred Thousand Ghana Cedis (GH¢500,000.00) from Ghana Gas, Fifty Thousand Ghana cedis (GH¢50,000.00) from Electricity Company of Ghana (ECG), One Hundred Thousand Ghana cedis (GH¢100,000.00) from the Associated Consultants Limited, and One Million Ghana cedis (GH¢1,000,000.00) has been pledged by GRIDCO of which Five Hundred Thousand Ghana cedis (GH¢500,000.00) has been redeemed. The Civil Engineering class of 1996, an alumni class of the College of Engineering, is the first alumni class to donate Fifty Thousand Ghana cedis (GH¢50,000.00) to the Endowment Fund. The College of Engineering and Volta River Authority (VRA) is in the final stages of securing the establishment of three professorial chairs in VRA. This partnership is bringing in Nine Hundred Thousand dollars (\$900,000.00) for three years. The professorial chairs will be in Civil Engineering, Mechanical Engineering and Electrical Engineering. We are also in discussions with National Communications Authority (NCA) for the establishment of a Telecommunications Laboratory

## **D. INFRASTRUCTURE**

On behalf of the University, I had discussions with GetFund pertaining to the construction of lecture rooms for the College to reduce overcrowding due to the large undergraduate student numbers. As I speak, we have cabinet approval for the construction of a 36-million-cedi classroom complex for the College of Engineering. The first phase which is made up of one 4-storey block out of three 4-storey blocks is over 70% complete. A 3-storey postgraduate block for the KEEP project is over 80% complete, the second phase of the RWESCK office complex is over 90%

complete while the pre-contract process for a 3-storey postgraduate block for TRECK is complete with the contractor about to start construction.

### E. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

All lecture rooms in the College have state-of-the-art audio-visual teaching setups made up of a variety of the following: touch screens, projectors, monitor screens, video stations, cameras, and network microphones. These audiovisuals for teaching and learning are all internet-enabled. We have also created an E-learning section in the College Library for student learning activities.

**KEEP:** You mentioned on record during the GhIE annual conference in 2021 that Ghana needs to train 30,000 engineers every year, if we want to accelerate national socio-economic development. How well are we doing now?

**PROF:** Five (5) traditional public universities and ten (10) technical universities together graduate about 6000 students in engineering programmes (BSc, BTech and HND) every year. KNUST graduates approximately 25-30% of that number each year. However, according to GTEC records for the year 2020, KNUST College of Engineering trains 60% of all BSc Engineering students of the public universities in Ghana.

Only ten (10) senior high schools have contributed two-thirds (67%) of all undergraduate students that have been enrolled at the KNUST College of Engineering from 2004 to date. Eight (8) out of the top ten (10) are boys' schools, one is a mixed-school and one is a girls' school. The fact that there's only one mixed and one girls' schools account for the low female

student numbers of about 18% at the College. The schools with the highest contribution ranked from 1-10 are; Mfantsipim, Legon Presec, Opoku Ware, Prempeh, St Augustine's, GSTS, St Peter's, Adisadel, Achimota and Wesley Girls (Cape Coast). Therefore, Mfantsipim is the highest ranked boys' school, Achimota is the highest ranked mixed school at 9th place overall and Wesley Girls' High is the highest ranked girls' school but as the 10th overall ranked. The top 25 Senior High Schools that contribute students to the KNUST College of Engineering account for 92% of all students who have enrolled since 2004. There are only 5 girls schools in the top 25. These

are; Wesley Girls High School, St Louis SHS, Holy Child SHS, St Rose's and Aburi Girls' SHS. It is therefore important that we reach out to the girls' and mixed-schools concerning engineering programmes. *We need to intensify advocacy in all Senior High Schools on the importance of training engineers through outreach programmes by both the universities and professional engineering bodies.* This is the only way by which we can produce the target 30,000 number of engineers. It is also important that a government policy is introduced to ensure that all government agencies on infrastructure, industry and engineering services create positions for employment.

CUMULATIVE FOR TOP 25 SHS (2004-2021)		
SHS	Sum of Students	Rank
MFANTSIPIIM SCHOOL	1668	1
PRESBY BOYS' SNR. HIGH SCHOOL	1548	2
OPOKU WARE SCHOOL	1294	3
PREMPEH COLLEGE	1159	4
ST. AUGUSTINE'S COLLEGE	1057	5
GHANA SNR HIGH/TECHNICAL SCH.	803	6
ST. PETER'S SNR HIGH SCHOOL	771	7
ADISADEL COLLEGE	575	8
ACHIMOTA SCHOOL	560	9
WESLEY GIRLS' HIGH SCHOOL	423	10
POPE JOHN SNR HIGH SCHOOL	394	11
ST JAMES SEMINARY SNR HIGH SCH	380	12
ACCRA ACADEMY	345	13
ANGLICAN SNR HIGH SCHOOL	343	14
KOFORIDUA SNR HIGH/TECH. SCH	301	15
ST. LOUIS SNR HIGH SCHOOL	286	16
KNUST SENIOR HIGH SCHOOL	276	17
GHANA NATIONAL COLLEGE	222	18
KETA SNR HIGH SCHOOL	195	19
HOLY CHILD SNR HIGH SCHOOL	175	20
ST. ROSE'S SNR HIGH SCHOOL	173	21
ABURI GIRLS SNR HIGH SCHOOL	168	22
ST. JOHN'S SNR HIGH SCHOOL	164	23
ST. THOMAS AQUINAS SNR. HIGH SCHOOL	146	24
KUMASI HIGH SCHOOL	139	25

**KEEP: What values helped you get this far?**

**PROF:** *My utmost value is a culture of excellence, integrity and stewardship, firmness and fairness;* I make sure I excel in anything I do. I am a resilient person; when I decide on doing something, I always make sure to achieve it. I may modify the approach along the line in the face of obstacles but I still hold on to it till it's achieved. Also, I am a man of integrity. As the Provost of the College, I believe that I am just a steward. In every financial decision I make, I ask myself, "Will I be comfortable with this decision if it was to be paid from my personal resources?" If I cannot answer this question, I won't take that step. Finally, I strive to be fair to everybody and firm in implementing collective decisions made.

**KEEP: Do you think enough is being done to encourage postgraduate education in Engineering?**

**PROF:** Postgraduate education is part of my vision and I believe my team and I have excelled in it. All the African Center of Excellence (ACE) Impact projects were established to improve postgraduate engineering education in the College and this is one of the reasons for the increase in postgraduate students' statistics from 300 to 1000 postgraduate students at the moment.

1. The Regional Water and Environmental Sanitation Center, Kumasi (RWESCK) trains postgraduate students in water and environmental sanitation. The Centre hosts the underlisted programmes:
  - MSc in Water Resources Engineering and Management
  - MSc in Water Supply and Environmental Sanitation

- MSc in Water and Sanitation Policy and Governance\*
  - PhD in Water Resources Engineering and Management
  - PhD in Water Supply and Treatment Technologies
  - PhD in Environmental Sanitation and Waste Management
2. The Transport Research and Educational Centre, Kumasi (TRECK) trains postgraduates in transport and logistics. The Centre hosts the underlisted programmes:
    - MSc. Road and Transportation Engineering
    - MSc. Transportation Planning
    - MSc. Air Transport Management
    - PhD Highway and Transportation Engineering
    - PhD in Transport Systems\*
    - PhD in Transport Logistics and Finance\*
    - PhD in Transport Leadership\*

(Programmes marked (\*) are coming soon)

3. The KNUST Engineering Education Project (KEEP) seeks to deliver high-quality postgraduate courses, conduct and disseminate applied research focused on addressing developmental challenges related to industrialisation, digital development (ICT), energy systems, renewable energy, manufacturing, exploration, and development of the oil and gas industry. The Centre hosts the underlisted programmes:
  - MPhil Computer Engineering
  - MPhil/MSc Cybersecurity and digital forensics

- MPhil/MSc Materials Engineering
- MPhil/MSc Power Systems Engineering
- MPhil/MSc Renewable Energies Technologies
- MPhil/MSc Telecommunication Engineering
- PhD Bioenergy Engineering
- PhD Computer Engineering
- PhD Materials Engineering
- PhD Electrical Engineering
- PhD Scientific Computing and Industrial Modelling
- PhD Sustainable Energy Technologies
- PhD Telecommunication Engineering

One point worth noting is that postgraduate training thrives on funding. A lot of people are not able to enrol in postgraduate education due to financial constraints and there must be funding to assist them.

**KEEP: What are your thoughts on research commercialisation into start-ups?**

**PROF:** Commercialisation goes through different stages. Initially, we have the creativity stage (when one creates something) but the fact that one has created something does not mean it's an innovation. The item created should have a business model, then it becomes an innovation. The process between creation and it becoming an innovation is quite problematic, considering the incubation process and how long it takes at times. But if we talk about research uptake, then there are various approaches. One can use social media, digital platforms, and conferences to promote a research idea. However, we must look at the diffusion of research. This deals

with the nature and pace at which one can disseminate research information. One of the best ways of diffusion is through students by using the research ideas discovered in teaching them. When it comes to the commercialization of start-ups, we need to use Innovation centres and Business Incubators in our Universities. We need to involve students and invite the private sector to inject capital.

**KEEP: How far has the relationship between industry and academia gone?**

**PROF:** The industry-academia relationship has been strengthened through the establishment of students and faculty internships. My predecessors introduced internships as a compulsory part of undergraduate study, thus one cannot graduate without undertaking an internship in industry. The College also organises an

annual Industry and Student Awards Ceremony, Career Fair, and College Exhibitions which bring industry to interact with the students and give them work opportunities. Internships at the postgraduate level have also been introduced during my tenure. All postgraduate students go on internships as part of their studies. We have also introduced internships for lecturers, where they are attached to the industry to understudy the activities of the industry.

**KEEP: Do you believe research should be driven by industry?**

**PROF:** That is the way to go. I tasked the KNUST Engineering Education Project (KEEP) team to organise an industry-academia meeting with the Association of Ghana Industries (AGI). This engagement was geared towards strengthening the relationship between industry and academia in terms of

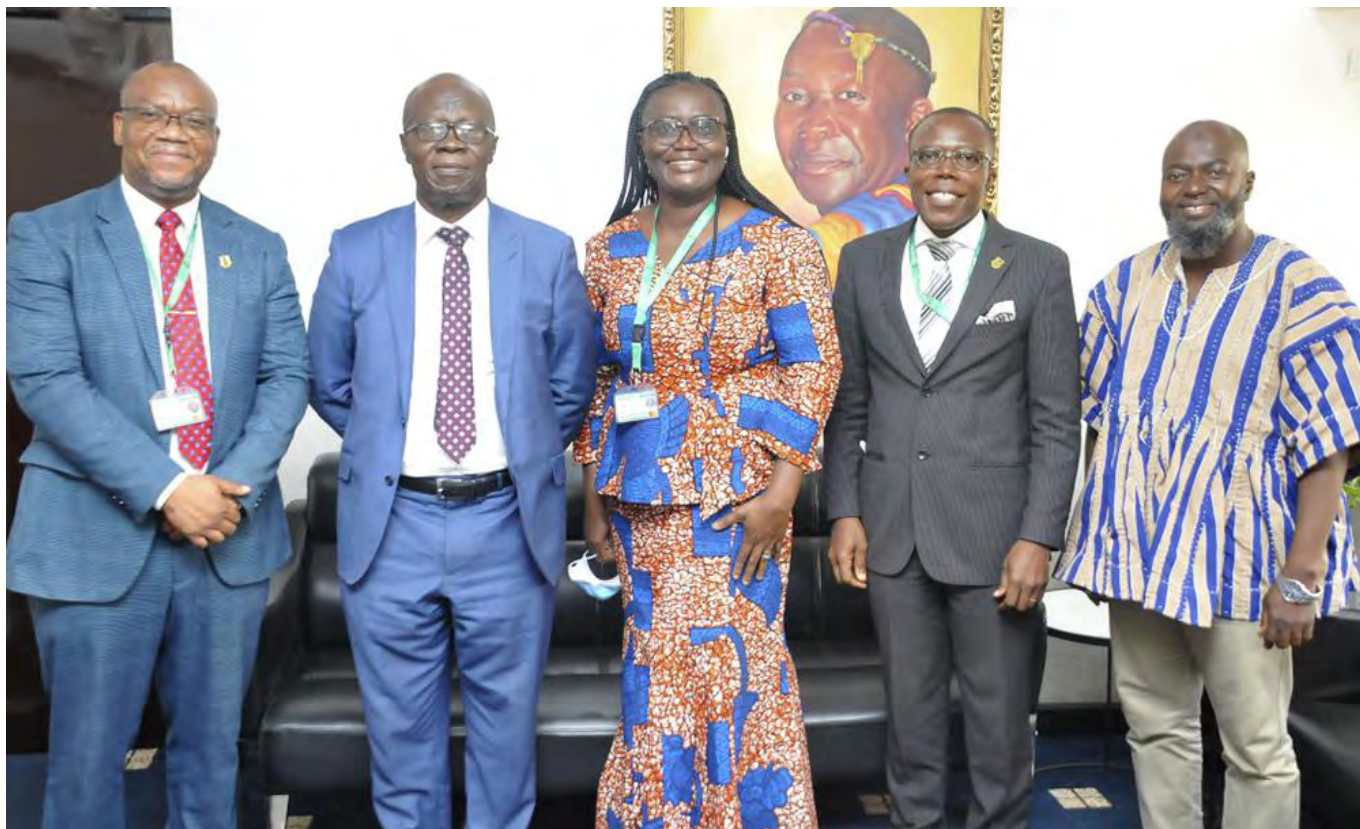
research. The industry bared their problems and the College used research to help solve some industrial problems. The research idea on the characterisation of Palm Kernel Shell Ash (PKSA) generated from a furnace at Juaben Oil Mills was birthed from this industry-academia engagement. The College of Engineering also organised an energy audit exercise at the Vester Oil Mills Limited in 2021 to ascertain their energy efficiency situation and propose measures to reduce their energy consumption and cost. These activities prove that research becomes impactful and relevant when it is driven by industry.

**KEEP: Thank you for your dedication and commitment to the growth and development of the College of Engineering.**

**PROF:** The pleasure is mine.



# A 1 Million Canadian Dollar Grant awarded to the College of Engineering to establish a Multidisciplinary Responsible Artificial Intelligence Lab



*The Vice-Chancellor of KNUST, Prof. (Mrs.) Rita Akosua Dickson (in the middle) with the Pro-Vice-Chancellor of KNUST, Prof. Ellis Owusu-Dabo (2nd from the right), the Dean of Faculty of Electrical and Computer Engineering, Prof. Abdu- Rahman Ahmed (right), the Provost of the College of Engineering, Prof. Mark Adom-Asamoah (2<sup>nd</sup> from the left) and the Principal Investigator and Scientific Director for RAIL, Prof. Jerry John Kponyo (left)*

The Kwame Nkrumah University of Science and Technology (KNUST) has been awarded a grant to fund the establishment of a Responsible Artificial Intelligence Lab (RAIL) under the AI4D Africa Multidisciplinary Labs project initiated by the International Development Research Centre (IDRC). RAIL has been envisioned as a Maker Space that would develop talents in Data Science and Machine Learning to help bridge the widening skills gap needed to champion Ghana's Digital Economic Transformation agenda

and that of the Sub-Saharan Region as well.

The activities in this Innovation Centre are expressly set to promote the digitalisation of products, processes, and services via innovative toolbox development for Renewable Energy, Health, Agriculture and Climate Change, using cases in close collaboration with local small and medium-sized enterprises (SMEs) and governmental bodies.

The laboratory would be networked centrally and its operations

decentralised to allow intelligent, flexible, and future-oriented collaboration across multiple sites using standard IT equipment. The Faculty of Electrical and Computer Engineering would host this centrally networked laboratory infrastructure, which would provide computing, research, training, and expertise transfer to Université Alioune Diop de Bambey (Senegal), the University of Cape Verde, and the Gambia Technical Training Institute.



In announcing the news of the grant award to management, Prof. Jerry John Kponyo, who is the Principal Investigator (PI) and the Scientific Director of RAIL, was grateful to IDRC and the GIZ for jointly funding the setup of RAIL. He stressed the need to adopt collaborative and a multidisciplinary approach to solving the peculiar challenges in the sub-region. He believes that ***Artificial Intelligence holds the key to leveraging technologies to unlock the potential of highly talented young innovators in the sub-region.*** The PI also sees the funding as a mustard seed through which multiple initiatives could be developed to realise the African dream.

The Dean of the Faculty of Electrical and Computer Engineering, Prof. Abdul-Rahman Ahmed, was also happy that the team he constituted to respond to the funding call with the help of the Office of Grants and Research (OGR) had worked diligently to make the RAIL project a reality. He further indicated that the RAIL project reinforces the faculty's

vision of developing strategic collaborations between academia, SMES, and government actors to enable transfer-oriented cooperation between applied research, skills development, regional industry, entrepreneurs, and service providers to empower more players to engage in technology-based innovations in the sub-region.

The Provost of the College of Engineering, Prof. Mark Adom-Asamoah, was excited about the prospects of the RAIL. He encouraged all key actors in the project implementation to work together to realise its ultimate objectives.

In congratulating the team, the Vice-Chancellor of KNUST, Prof. (Mrs.) Rita Akosua Dickson indicated that the grant had come at an opportune time and she urged the team to keep working hard to win more grants.

The project team is made up of Prof. Jerry John Kponyo (PI), Dr. Isaac Acquah (Department of Computer Engineering), Dr. James Dzisi Gadze (HoD of

Telecommunications Engineering), Dr. Eric Tutu Tchao (Department of Computer Engineering), Mr. Andrew Selasi Agbemenu (Department of Computer Engineering), Mrs. Christiana Selorm Aggor (Faculty of Electrical and Computer Engineering), Dr. Mrs. Eunice Akyereko Adjei (Department of Mechanical Engineering), Dr. Henry Nunoo-Mensah (Department of Computer Engineering), Mr. Benjamin Kommey (Department of Computer Engineering), Prof. Francis Kemausuor (Department of Agric & Biosystems Engineering), and Dr. Dr. Seth Christopher Yaw Appiah (Department of Sociology and Social Work).

The Lab will aid in the running of short courses in disruptive technologies and mount postgraduate programmes in Data Science and Machine Learning. RAIL would also provide research support for doctoral studies, advisory and extension services, policy formulation, and agenda-setting around Responsible Artificial Intelligence use.



# KEEP Presents An Energy Audit Report To VESTER OIL MILLS LIMITED, Kumasi



*Dr. Richard Opoku, the Energy Consultants for KNUST (in the middle) with Mr. Kwasi Nyamekye, the Manager of Vester Oil Mills (third from left) and the team at Vester Oil Mills Limited, Kumasi.*

The Government of Ghana, as part of its Nationally Determined Contributions (NDCs) towards climate change mitigation and adaptation, has set a target to increase energy efficiency in the industrial sector by 20% by the year 2030. This 20% target is also to increase productivity and achieve improved energy intensities and economic development in the sector. Recognising the need to support industries to achieve this national agenda, the KNUST College of Engineering KEEP programme has initiated activities with industries in Ghana regarding energy audit services. The technical team, therefore, conducted an investment grade energy audit in 2021 at Vester Oil Mills Limited to ascertain their energy efficiency situation and propose measures to reduce their energy consumption and cost. A report on the outcome of the audit was presented to the management of Vester Oil Mills Limited.

The Investment Grade Energy Audit meeting with Vester Oil Mills (a processor of soya bean seeds into oil) was led by Dr. Richard Opoku, a certified Sustainable Energy Management Professional from the College of Engineering, KNUST on 20<sup>th</sup> January 2022 at Vester Oil Mills, Kumasi.

The meeting was held to discuss the outcome of the energy audit conducted at Vester Oil Mills, and to roll out the Energy Performance Improvement Action Plans (EPIAPs).

The main energy supply to the facility is electricity and biomass fuel

(wood fuel and palm kernel shells). The EPIAPs were put together after the audit team investigated the electrical energy consumption rates of the facility and the cost implications. The recommendations captured in the EPIAPs include:

- Installation of an economiser to recover waste heat from the flue gas from the boiler plant.
- Installation of a boiler automation system (Oxygen Trimming/ Excess Air Control).
- Installation of solar water heating system to preheat the feed water.
- Replacement of damaged insulation on steam distribution pipes.
- Replacement of old inefficient motors with energy-efficient motors with variable speed drives.
- Installation of solar PV panels to generate power as an alternative power supply.

The Managing Director of Vester Oil Mills, Mr. Kwasi Nyamekye, said in response to recommendations reported in an earlier investigation by the KEEP team in 2021, that the company had already installed a 100 kWp solar PV and intends to add more to achieve a near 100% solar energy use by the company. ***Upon further discussions, both teams agreed on the high prospects solar PVs present in generating affordable, efficient and sustainable electrical power.*** A next step to this would be for the company to develop an in-house Energy Management System (EMS) that measures and monitors their energy supply and demand. The EMS will thus help identify and eliminate energy wastage in the company.



*Dr. Richard Opoku making a presentation during the energy audit meeting with Vester Oil Mills Limited, Kumasi.*



*Dr. Richard Opoku assessing the efficiency of the machines at the facility.*



*A 100 kWp solar PV system installed at Vester Oil Mills Limited.*

# GRIDCo visits the College of Engineering, KNUST



*Ing Ebenezer Essienyi (seated on the left) and Prof. Mark Adom-Asamoah (seated in the middle) with the GRIDCo team.*

The CEO of the Ghana Grid Company Limited (GRIDCo), Ing Ebenezer Essienyi and his team paid a courtesy call on the Provost of the College of Engineering, Prof. Mark Adom-Asamoah on 26<sup>th</sup> January, 2022. As part of the visit, the GRIDCo team visited the KNUST Engineering Education Project (KEEP) postgraduate building to inspect progress of the facility having made an earlier commitment to the College to equip the Power Systems Laboratory with state-of-the-art equipment. They also inspected the building designs and the laboratory space.

Later in a meeting, Prof Adom-Asamoah congratulated Ing Essienyi on his appointment as the CEO of GRIDCo and expressed the College's gratitude for the internship slots provided for engineering students from KNUST every year. He reiterated that internships are

a core mandate of the College in bridging the gap between industry and academia, and appealed for more internship and placement opportunities. He emphasised that *collaboration with industry is essential to the success of Engineering Education in Ghana and the sub-region.*

He touched briefly on the Endowment Fund established by the College of Engineering to promote postgraduate Engineering Education in Ghana and solicited the support of GRIDCo towards the fund.



*A cross-section of participants at the meeting.*

# The Department of Mechanical Engineering Sustainable Energy Laboratory goes Solar



*Dr. Richard Opoku explaining how solar panels work.*

The Sustainable Energy Laboratory (SEL) of the Department of Mechanical Engineering, College of Engineering, KNUST, has successfully migrated the source of its energy consumption and usage to solar energy. The solar installation will efficiently power the lighting systems, ventilation, and power outlets for other electrical gadgets and equipment used in the SEL. The SEL has the capacity to host 20 postgraduate and undergraduate students at a time. The migration of the SEL onto solar energy is in line with the University's Energy Policy to attain 20% renewable energy integration by the year 2025.

Dr. Richard Opoku, a Senior Lecturer at the Department of Mechanical Engineering, who doubles as the University's Energy Efficiency and Solar Consultant indicated that *this migration has helped to eliminate the effect of power outages on*

*research activities and laboratory experiments.* He explained that other laboratories and offices can also migrate onto solar energy with the system cost being dependent on the types of electrical appliances used. Commenting on the prospect of solar energy for the whole

University, he emphasised that since the Faculties and Colleges of the University operate in the day-time, solar energy with minimum battery storage presents the most cost-effective energy supply.



*The installed solar panels*

# The College of Engineering commemorates WORLD ENGINEERING DAY



*Prof. Mark Adom-Asamoah, Provost of the College of Engineering with students from the Yaa Asantewaa Girls Senior High School.*

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) established the World Engineering Day for Sustainable Development in 2019 to celebrate the engineering profession and the contribution of the world's engineers to a better and more sustainable world.

As part of commemorating the day, the College of Engineering at Kwame Nkrumah University of Science and Technology organised a seminar on 4<sup>th</sup> March 2022 at the Kumapley Auditorium with the theme, “Build Back Wiser – Engineering the Future”.

The Provost, Registrar, Deans, Faculty members and students of the College of Engineering were present as well as students from Opoku Ware School, St. Louis Girls

Senior High School, KNUST Senior High School, Yaa Asantewaa Girls Senior High School and Juaben Senior High School participated.

Prof Mark Adom-Asamoah, Provost of the College of Engineering in his opening remarks highlighted the role of engineering in all spheres of human endeavour and the contribution of KNUST College of Engineering in training engineers for Ghana and other nations in Africa. **“KNUST remains, by far, the single largest contributor to engineering education in Ghana”**, he said. He stated that the theme “Build Back Wiser – Engineering the Future”, enjoins engineers to reimagine the future of the nation and of the world. He said engineering is a problem-solving career, and young people are uniquely placed to think outside the box, bring

fresh perspectives and innovative solutions. He urged the Senior High School students present to consider careers in engineering as it specially empowers them to serve humanity with their talents. He further encouraged them to participate in the career guidance sessions of the programme fully.

In her speech, Mrs Ama Serwah Nerquaye-Tetteh, the Secretary-General of Ghana Commission for UNESCO encouraged females in the College of Engineering and the Senior High Schools to take up initiatives in Science, Technology, Engineering and Mathematics (STEM) education.

Mr. Maxwell Wonkyi, the President of the Ghana Engineering Students Association (GESA), in his closing remarks encouraged Senior High

School students to consider pursuing careers in STEM.

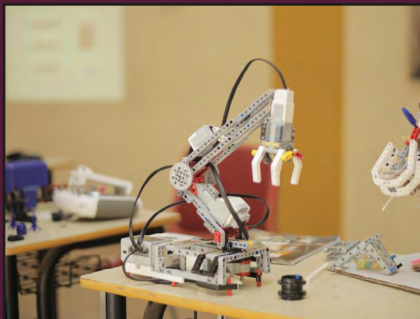
The College of Engineering's Innovation Centre held an exhibition during the programme.



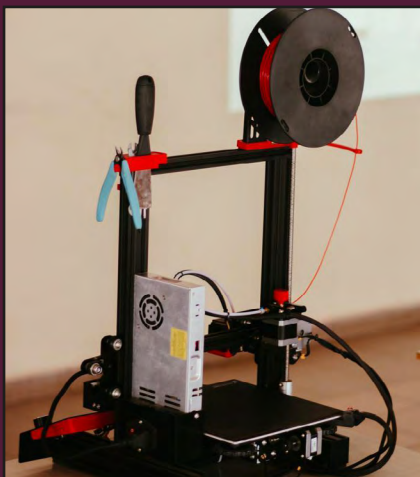
*An FDM 3D printer with polymer filament*



*A surveying drone with 3D printed case*



*A Robotic arm built from the Lego ev3 kit*



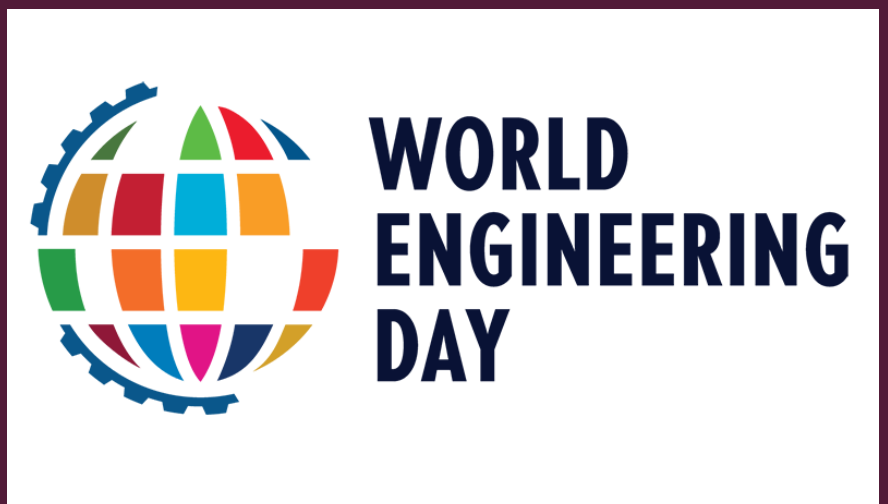
*An FDM 3D printer*



*Prof. Mark Adom-Asamoah, Provost of the College of Engineering with students from Opoku Ware School.*



*Prof. Mark Adom-Asamoah, Provost College of Engineering, Mrs Ama Serwah Nerquaye-Tetteh, the Secretary-General for Ghana Commission for UNESCO with the GESA executives.*



# The Civil Engineering Class of 1996 is the First Alumni Class to Donate Gh₵50,000.00 to the KNUST COLLEGE OF ENGINEERING ENDOWMENT FUND



*Prof. Mark Adom-Asamoah, Provost, College of Engineering (3<sup>rd</sup> from right) and Ing. Asare-Yeboah, Chairman of Board of Trustees (2<sup>nd</sup> from right) receiving the donation from the Civil Engineering class of 1996.*

The Civil Engineering class of 1996, an alumni class of the College of Engineering, KNUST donated fifty thousand Ghana cedis (GH₵50,000.00) to the Endowment Fund at the 2022 Annual Conference and 52<sup>nd</sup> Annual General Meeting (AGM) of the Ghana Institution of Engineering (GhIE) held at the La Palm Royal Hotel, Accra on 30<sup>th</sup> March 2022.

The class was led by Ing. Harold Esseku, a former Vice-President of the Ghana Institution of Engineering. He stated during the

presentation that the class had decided to support their Alma Mater by contributing to the University's 70<sup>th</sup> anniversary celebrations. He indicated that the class wants to support innovations and the use of ICT in the training of engineers in the premier engineering institution in Ghana. He urged all alumni of the College of Engineering to support the endowment fund as it is one of the key ways many universities are funded.

Ing. Akwasi Asamoah, one of the members of the class, indicated that it is important for different

classes to come together to support the University. He mentioned that it takes much encouragement from some dedicated individuals to contact their classmates who are located worldwide to achieve the desired results.

The KNUST College of Engineering Endowment Fund was established in June 2021 to provide stable and predictable funding for the College of Engineering to enable it to become an internationally acknowledged Centre of Excellence in Engineering education, producing high calibre graduates with



knowledge and expertise to support the industrial and socio-economic development of Ghana and Africa.

The specific objectives are to:

- Improve the quality of post-graduate programmes.
- Expand access to postgraduate programmes.
- Provide scholarships to attract brilliant postgraduate students and needy undergraduate students.
- Improve infrastructure to support teaching and learning.

Prof Mark Adom-Asamoah, Provost of the College of Engineering, thanked the Class of 1996 for their kind gesture. He indicated that a

board of trustees made up of industrial partners had been established as custodians of the fund. ***He urged organisations, independent bodies, alumni and individuals to donate to the fund.***

Ing. Asare Yeboah, Chairman of the KNUST Engineering Education Project (KEEP) Industrial Advisory Board, who doubles as the Chairman of the Board of Trustees for the Endowment Fund, assured that monies donated to the fund would be used for their intended purpose. He intimated that he was awestruck by the generous gesture and encouraged many more alumni to follow the example of the Civil Engineering class of 1996.

Prof. Charles Anum Adams, President of the Ghana Institution of Engineering, also the Head of Transport Research and Education Centre, Kumasi (TRECK) in the College of Engineering, urged alumni of KNUST and the College of Engineering to support the Endowment Fund. He stated that most lecturers are alumni who have decided to remain in the University to help train the engineering workforce necessary to develop the nation.

To donate to the fund, please click **here**. (<https://kceef.knust.edu.gh/donate-to-knust-coe-endowment-fund>)



Ing. Harold Esseku (left), Prof. Emmanuel Donkor (2nd from left), Ing. Gabriel Engmann (3rd from left), Ing. Akwasi Asamoah (middle), Prof. Mark Adom-Asamoah (3<sup>rd</sup> from right), Ing Asare-Yeboah (2<sup>nd</sup> from right) and Prof. Charles Anum Adams (right).

# THE DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING AT KNUST DEVELOPS K-SWITCH DEVICE



The KNUST-Switch (K-Switch), an automated street and outdoor lights switching device which uses a unique SMS-timing based concept has been invented by Ing. John Kusi, a laboratory technician in the Department of Electrical and Electronic Engineering under the College of Engineering at KNUST.

Ing. John Kusi presented the K-Switch innovation at Otumfuo's Innovation Exhibition organised in April 2019 to mark the 20<sup>th</sup> Anniversary of the KNUST Chancellor's ascension to the

Asante throne. The celebration was under the theme; Promoting Culture, Innovation and Technology: 20 years of Otumfuo's Dynamism. Ing John Kusi won the best KNUST Innovative Student 2019 award with the K-Switch innovation as a BSc Electrical and Electronic Engineering student graduating at the time.

The K-Switch device was successfully piloted on twenty-nine streetlights on KNUST campus. *The device automatically turns the streetlights on and off at preset*



*times.* The SMS feature of the device that enables overrides of the switch's on and off times was also successfully tested. Hitherto, the streetlights were manually controlled which resulted in significant energy wastage. Furthermore, several man-hours were wasted when the switch required someone having to switch the streetlights on and off. K-Switch completely takes away the need for manual switching.

Prof. Emmanuel Frimpong, Head of the Electrical and Electronics Engineering Department in an interview said a grant from the KNUST research fund has been received to expand the project. Additional piloting will also be done in the Kumasi Metropolis and then scaled up nationally to help curb electrical energy wastage translating into money loss.



*Ing, John Kusi fixing the K-Switch device*

# The KNUST College of Engineering Innovation Centre Designs the **BMI and Intellicart Projects**

Students at the College of Engineering Innovation Centre in KNUST designed the Body Mass Index (BMI) and Intellicart projects. The team that created the intellicart comprised a group of four final year students including William A. P. Dadzie-Rhule, Project lead, (Department of Computer Engineering), Mirabel Mensah (Department of Electrical Engineering), Lydia Asare (Department of Electrical Engineering), and Jeffery Asiedu (Department of Electrical Engineering) all students and interns. Two other students, Collins Sam Ayipeh (Department of Biomedical Engineering) and Beatrice Kpornyo (Department of Materials Engineering) created the Body Mass Index (BMI) device.



## **THE BODY MASS INDEX (BMI) PROJECT**

The BMI device determines the body mass index of a person (whether one is underweight or overweight) by calculating one's height in relation to their weight.

Unlike the normal weight checker, the BMI determines how healthy one is by checking the weight

relative to one's height to determine whether one is underweight or overweight.



An LCD screen and light indicators show the person's weight. The height rule measures one's height and the load cell, the weight. After measuring the height and weight, it calculates and indicates with a red light if one is underweight. The information is displayed on the LCD screen as well. If one's weight in relation to their height is normal, the green light indicates it. The yellow light indicates that one is overweight and must take measures to have a normal weight.

## **THE INTELICART PROJECT**



The Intellicart device has an LCD screen and a Radio Frequency Identification (RFID) model, which acts electromagnetically. The RFID chips can be scanned at once, unlike a barcode scanned one after the other. The Intellicart device system scans all RFID chips, detects and calculates the number of products and sums the total cost or price, making shopping experiences informative and easier.



A customer shopping can use the Intellicart on their shopping cart, to scan items as and when they pick it to determine the actual price of things and how much all items picked will cost in sum even before getting to the cashier.

Mr. Dadzie Rhule mentioned an additional feature of the LCD screen as giving information on what the product contains. "There is a YES or NO button to aid the purchaser to add on to the list of items purchased or take an item off the list respectively".

He further indicated that the Intellicart helps a person to foresee their total shopping cost and make any necessary adjustments before getting to the counter. He further noted that cashiers at payment points would also have an Intellicart device linked to the cashier's system to avoid queues due to calculating each item one after the other.

He mentioned that companies could advertise their products with Intellicart. The LCD screen gives adequate information on the product's uses and benefits, which is not primarily seen on the product label. He added that the Intellicart device also stores data that will help companies track the number of purchases made over time.

He appealed for funding to scale production and commercialise this device to make shopping experiences informative and easier.

# KEEP Hangs out with God'sable Sitsofe Koku Aidam, a KEEP Scholar



**KEEP:** Please tell us about yourself

**GOD'SABLE:** God'sable Sitsofe Koku Aidam is my name. I hail from the Volta Region, but I was born and raised in Northern Ghana. I attended Mawuli Senior High School. I completed my MPhil education in Renewable Energy Technologies in November 2021 after a Bachelor of Science Degree in Aerospace Engineering at Kwame Nkrumah University of Science and Technology in June 2018. I am an aircraft enthusiast.

**KEEP:** Could you tell us about your postgraduate studies?

**GOD'SABLE:** With a background in Aerospace Engineering, my postgraduate research was in sustainability in aviation. I sought to analyse the potential of Ghana's biomass resource potential for aviation biofuel production. Biomass is plant and animal-based resources, and biofuels are fuels obtained from biomass feedstocks. I analysed the aviation biofuel potential of some biomass feedstocks in Ghana considering the various conversion technologies, extracted and analysed rubber seed oil for aviation biofuel production, simulated the aviation biofuel production process and conducted cost estimations using ASPEN Plus, as well as Life Cycle Analysis with

GREET, and by God's grace, it was successful.

**KEEP:** What motivated you to study the course you read?

**GOD'SABLE:** I have an interest in sustainable aviation technologies. This motivated my MPhil research in the analysis of the potential and integration of liquid biofuel in the Aviation industry. Renewable Energy is multifaceted, and the Aviation industry is incorporating Renewable Energy Technologies to reduce carbon emissions following the Paris agreement. In Africa, there is little work done in alternative aviation. This motivated my research to study the production of biofuels in Ghana. Even though

there are other options, such as solar and wind, with regards to aircraft, the only feasible option to achieve significant reductions in aviation emissions by 2050 is through liquid biofuel fuels. Other technologies will take more time to be implemented commercially.

**KEEP: What was the outcome of your research?**

**GOD'SABLE:** The study revealed that by 2030, the aviation sector in Ghana will utilise averagely 295.16 KTOE of aviation fuel annually. Cumulatively, the available feedstocks can produce 4085.11 KTOE for the country's aviation fuel demand by 2030 using the approved ASTM conversion processes. Rubber seed oil was derived at a yield of 30 wt% and possessed HHV of 23.75 MJ/kg, with the potential of producing 43.9% aviation biofuel, 28.3% green diesel and 8.3% Naphtha, estimated to have a total capital cost of \$12,607,232.96 and a total of operation cost of \$671,697.86. A well-to-tank life cycle analysis of the production process showed a total of 1.39 kg CO<sub>2</sub>eq is emitted in the production of 1 kg of renewable jet fuel showing less emissions in the production process as compared to other energy crops such as Jatropha and palm oil. The findings of this study established that Ghana's biomass stock has the potential to produce alternative aviation fuel and reduce aviation-related CO<sub>2</sub> emissions.

**KEEP: What is the significance of the research?**

**GOD'SABLE:** This research sought to promote innovation in biofuel solutions for the aviation industry by generating comprehensive and relevant knowledge for

well-informed decision making and the development of strategies for adopting novel renewable energy technologies in Ghana and West Africa as a whole which contributes to the achievement of the Sustainable Development Goals (SDGs). It also highlights alternative biofuel sources such as rubber seed oil as an attractive feedstock for aviation biofuel production considering the existing scale of rubber plantations under cultivation. Hence, it serves as a secondary product that will prevent competition with food crops for land space and lower the price of feedstock acquisition.

**KEEP: Do you think there are many opportunities for undergraduates to read postgraduate Engineering courses?**

**GOD'SABLE:** I believe KNUST runs engineering programs that are competitive globally. However, what limits postgraduate Engineering education aside from the fees are the limited resources available in the form of laboratories and research support. But *thanks to the KNUST Engineering Education Project (KEEP), students are supported with scholarships and research grants and facilities are made available for students to use.* I believe if many such opportunities are made available, there will be increased interest in postgraduate engineering education in Ghana.

**KEEP: How has KEEP impacted your life?**

**GOD'SABLE:** Besides sponsoring my Postgraduate education, which I could not have afforded, KEEP gave me industrial exposure, through industrial visits and an internship with Kumasi Hive where

I acquired knowledge in designing and manufacturing of solar-powered generators for households and small-scale enterprises. I was supported with research funds for my thesis and won a research grant by the College of Engineering Innovation Challenge. I also had the opportunity to present at the maiden WASEND symposium and participated in seminars and capacity building workshops which added to my knowledge and experience as a postgraduate student.

**KEEP: Are there any mentors you would like to appreciate?**

**GOD'SABLE:** I am grateful to my supervisors, Dr. Eunice Ayereko Adjei, Dr. Richard Opoku and Dr. Martina Baidoo, who were very instrumental in my research and Dr. E. W. Ramde for his advice and support. I am also grateful to the management of KEEP, especially Mr. Kwadwo Nyantakyi Marfo, for his support and fatherly care.

**KEEP: Any final words?**

**GOD'SABLE:** My postgraduate education was successful, thanks to KEEP, and I look forward to bigger and greater opportunities.

**KEEP: Thank you for your time**

**GOD'SABLE:** Thank you too for having me.



## RESEARCH CORNER

# Characterisation of Palm Kernel Shell Ash (PKSA) Generated from a Furnace at Juaben Oil Mills



By Dr. Martina Francisca Baidoo,  
Department of Chemical  
Engineering.

### Introduction

Any combustible organic material gives off solid waste after burning. The organic components burn and evaporate into the air and turn into heat energy for heat processes and power generation. A team from the KNUST Engineering Education Project (KEEP) visited the Juaben Oil Mills Limited on a tour to strengthen the relationship between academia and industry, and in the discussions, some problems faced by the company were enumerated. The enlisted problems were given to researchers to find solutions to them, by which this

research topic was birthed. This research process commenced in April 2021. The first step was for the researcher, Dr. Martina Francisca Baidoo, to go for an internship at the Juaben Oil Mills Limited to study the nature of the problem and to gain hands-on knowledge of the situation. The opportunity was also used to gather the PKSA samples for the research.

### Research Background

Palm kernel shells, fiber and empty fruit bunches are used as fuel for steam generation in a water tube boiler at the Juaben Oil Mills Limited. It was observed that the combustion of palm kernel shells yields porous solid ash (Palm Kernel Shell Ash), which accumulates in the furnace. Accumulation of the ash could lead to a decrease in furnace efficiency, an increase in maintenance cost or reduce the lifespan of the system. Juaben Oil Mills Limited had no use for the Palm Kernel Shell Ash (PKSA) and therefore disposed of it at a designated waste disposal site where the local folks used it as a filling material for potholes. There was a need to manage this waste properly to reduce environmental pollution. *This research investigated the chemical components and usefulness of PKSA in the areas of water purification, concrete reinforcement additives, energy storage, mineral supplement in*

*livestock nutrition, supercapacitor electrodes, bio-fertiliser, advanced materials among others.*

### Research Objectives

The objectives of the research were:

- To estimate the quantity of PKSA generated by Juaben Oil Mills per annum.
- To determine the physico-chemical properties of PKSA
- To assess the potential applications of PKSA based on the physico-chemical properties of PKSA.

### Research Outcomes

*Quantity of Pksa generated by Juaben Oil Mills per annum.,*

Based on the average daily Palm Kernel Shell (PKS) used as fuel, the average number of days in operation in a year, and proximate analysis of PKS, the annual PKSA generated per annum was estimated to be 413.952 tonnes.

*The physio-chemical properties of PKSA*

The X-ray Diffraction (XRD) technique was used to determine the chemical constituents and structural arrangement of the PKSA. The Fourier Transform Infrared Spectroscopy (FTIR) technique confirmed its chemical structure and thermogravimetric analysis

was used to determine the thermal stability of the PKSA. Atomic Absorption Spectroscopy (AAS) showed its chemical analysis and composition. The N<sub>2</sub> Adsorption and Desorption technique analysed the textural properties (thus, pore size, pore volume and total surface area).

### Results of chemical analysis

The X-ray diffractogram of PKSA showed that crystalline metal oxides are present in PKSA. The Atomic Absorption Spectroscopy (AAS) was used to determine the concentration of impurities. Calcium was found to be the highest in concentration, followed by aluminum, iron, magnesium and potassium.

The thermogravimetric analysis was used to ascertain the thermal properties of the PKSA. The change in the weight of the PKSA was not significant and implies that there is low moisture in the ash which confirms its resistance to heat.

### Conclusion

Based on the results shown above, it can be concluded that PKSA could potentially be applied in the purification of water, used as concrete reinforcement additive, and as asphalt. The active metal oxide could be extracted and applied in storing energy as a mineral supplement in livestock nutrition, a supercapacitor electrode, bio-fertiliser, and advanced materials, among others.

### Recommendations

Further research should be undertaken to:

- Explore the application of PKSA in the building and construction and the petroleum industries.
- Extract and purify the most abundant metal oxide in PKSA which potentially has myriads of applications across several industries.

**Welcome**

**ALUMNI**

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KNUST, Kumasi, Ghana

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## KEEP Info

**Location:** KEEP in Room 304 on the 3rd floor of the Petroleum Building at the College of Engineering.

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