The Institution of Engineers of Kenya
Founded 1972

Engineering in KENYA

ISSUE 018

PUBLISHED BY THE INSTITUTION OF ENGINEERS OF KENYA | July 2024

ISSN : 2710-3951

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In this Issue

Engineering in KENYA

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Call for Papers

Engineering in Kenya Magazine - Issue 019

The Institution of Engineers of Kenya (IEK) publishes Engineering in Kenya magazine, whose target audience includes engineering professionals, practitioners, policymakers, researchers, educators and other stakeholders in engineering and related fields. The publication is distributed to its target readers free of charge through hard and soft copies.

IEK invites you to contribute articles for our next and future editions. Articles should reach the Editor not later than 20th September, 2024 for our next issue, whose theme shall be "Mining Engineering" and related sub-themes, across all engineering disciplines. An article can range from engineering projects to processes, machinery, management, innovation, news and academic research.

The articles must be well researched and written to appeal to our high-end readers in Kenya and beyond. The IEK Editorial Board reserves the right to edit and publish all articles submitted, in line with standing editorial policy. All articles should be in Word document format, 500-700 words, font type Times New Roman and font size 12.

Send your article today, and get a chance to feature in the magazine!

Send your article to: editor@iekenya.org

Message from the Editor

Eng. Prof. Lawrence Gumbe

Engineering is responsible for the creation, improvement and protection of the environment, providing facilities for living, industry and transportation, including large buildings, roads, bridges, canals and railways, water supply systems, dams, irrigation, harbours, docks, aqueducts, tunnels and other infrastructure and systems.

The current crisis in governance of Kenya provides the opportunity to re-engineer the national economy for the benefit of the nation. This can enable the political economy to tackle challenges such as unemployment, poverty, security, inadequate access to quality food, housing and sanitation, education and healthcare.

National planning is key to development. Engineers are uniquely qualified to lead the national planning process because their education and training enables them to visualize complex systems, breakdown the same into components and re-integrate the same into a judicious whole. Kenya has a national government and 47 county governments. All the 48 governments have a planning role. We are, therefore, urging the national and county governments to involve engineers in their planning roles. An engineer as the Cabinet Secretary for planning would be ideal! Engineers as County Executive Committee Members in charge of planning would also be ideal! Engineering educators, researchers and practitioners respond to needs in history and geography to develop systems which advance human civilisation.

We are glad to note that there has been fruitful dialogue between the Commission for University Education (CUE), Engineers Board of Kenya (EBK), the Institution of Engineers of Kenya (IEK) and universities to solve the recent difficulties on the recognition and accreditation of university courses. Our new government should lead dialogue so that statutory entities may exist harmoniously. This may need review of legislation and administration instruments.

Engineering research is key to our industrialisation and achievement of Vison 2030 and the Africa Union's Agenda 2063. We urge our new government to move fast to implement funding of the research at the level of the Science Technology and Innovation Act. The government should thereafter give priority to engineering research funding.

A few years ago country comparison of the number of persons served by an engineer were, in part, as follows: Kenya, 6,300; South Africa, 3,166; Korea, 285; UK; 311; Brazil, 227; and China, 130. We see from the figures that level of industrialisation, economic development and affluence have a direct relationship to the quantity of engineers in a country. Hence Kenya must strive to expeditiously increase its quantity and quality engineers. The number of graduates of engineering programmes has increased.

As discussed above, the number should actually increase rapidly in the near future. The process of licensing, registration, of engineers should also be modernised and streamlined so that the pending and future candidates are processed efficiently and effectively. Again, we may learn from other countries such as the USA.

We are happy to note that the scale of fees for engineers was recently operationalized by the government. This is good for the profession. Medical doctors, and others, who are in the public service are paid non practice. Engineers are not paid this allowance. We urge the new government to pay non practice allowance to engineers in the public service.Work in the factory, farm, office, hospital or transport system is dependent on access to reliable and affordable energy, especially electricity. An analysis of the national energy shows heavy dependency on petroleum 22%, electricity 9%, others account for 1%. Electricity access in Kenya is low despite the government's ambitious target to increase electricity connectivity to at least 65% by the end of the year 2022.

To achieve Vision 2030, the country's electricity generation, transmission and distribution needs to be developed in order to attain a consumption rate of 3,000 kWh/ capita from the current level of about 164 kWh/capita. We must be ambitious and innovative in developing our energy sector in Kenya. This sector is a necessary condition for our industrialisation, economic security and transformation. We urge the new government to give energy the necessary priority.

Engineering inputs in agriculture are effected through agricultural mechanisation. Agricultural mechanisation aims at increasing the power inputs to farming activities hence intensified production and enhanced value addition resulting to decreased cost of production and reduction of drudgery in farming activities.

The degradation of the environment during production is a serious challenge in modern times. Climate change and its adverse effect can be directly attributed to lack of respect for prudent environmental management through responsible production in agriculture, extractive industries, transport and manufacturing. We urge our government to dialogue with engineers on the future of industrialising our agriculture and protecting our environment.

Roads have contributed immensely to economic development and growth in the modern world. They have brought

important social benefits to society. They are of vital importance in order to make a nation grow and develop. In addition, roads provide access to employment, social, health and education. Therefore, the road network is crucial in fighting against poverty. Structured dialogue between our government and engineers should continue so as to advance this crucialsector.

The Covid-19 pandemic demonstrated the importance of information and telecommunication engineering to the world. In education, universities and schools were variously forced to discontinue physical instruction and revert to virtual learning which could not have been possible without information and communication engineering, ITE. The primary actors in the ITE sector are engineers. Engineers are playing a leading role and will continue. The new government should engage the engineering community in order to develop this crucial sector.

Historically, the manufacturing sector has played an important role in driving economic development by stimulating and sustaining high productive growth, boosting employment opportunities for semi-skilled labour and building country competitiveness through exports. The path to industrialisation, economic transformation and increased human welfare has been through an enhanced manufacturing sector. Engineers play a lead role in manufacturing. Engineers are available for dialogue with the new overnment on the development of manufacturing in Kenya.

Biomedical engineering is the application of the science and art of engineering to the planning, design and management of systems for health care of human beings. It combines expertise in engineering with expertise in medicine and human biology to develop technologies and techniques for healthcare and patient care. This field includes: Biotechnology; Health Care Systems; Amenity; Human Biology; Pharmaceutical industries; and The Environment. Kenya must hasten its capacity to address disease from the perspectives of prevention, diagnosis and treatment. Thisimplies the capacity to develop environmental and public health systems and hospital.

Also crucial are the development of capacity in research and human resource development through education and training. The building of hospitals and manufacture, installation, operation and maintenance of equipment and machinery for disease diagnosis and treatment need the participation of engineers. Engineers are excited and expectant that we can all enter a new dawn with our in Kenya.

Through the leadership of the Institution of Engineers of Kenya, we are ready to dialogue and participate effectively in national development of Kenya.

Message from the President

Eng. Shammah Kiteme, CE, FIEK

By definition engineering brings an element of ingenuity, creativity and bringing forth something often times from nothing. In the etymology of the word are active words like creating, designing or building. When we conceived of engineering Kenya as the theme for this issue, several ideas came to mind. One among them is the status of engineering in Kenya. Another fact is that in an age of global connectedness what is happening here in Kenya also reflects on what is happening beyond our borders.

For this reason, and for the foreseeable future the state of engineering in Kenya will remain at the heart of the progress of the country. All progress is literally engineering and this will remain the status of issues going forward.

The application of engineering standards that are global has created an opportunity for engineers practicing in Kenya to work on projects together with their counterparts across the borders. IEK has continued to host delegations from other engineering associations in forums where we exchange ideas and explore opportunities mutually available for our engineers across the borders.

This continues to be a key focus as we try to get opportunities for engineers in other countries from students to practicing engineers the intercourse adds value to our members. The opportunity offered by the Africa Continental Free Trade Area (AfCFTA) under trade in services is specifically targeting cross border practicing. This is being enabled by Mutual Recognition Agreements (MRAs) and definitely the efforts to join the Washington Accord are much welcome.

Through a strong representation at World Federation of Engineering Organisations (WFEO) and Federation of Africa Engineering Organizations' (FAEO) the place of Kenya's Engineering at the global level will continue to be showcased. Indeed, in the World Engineering Convention (WEC) last year Kenya was strongly represented through paper presentations and the number of delegates attending.

As one former President of Kenya often used to say, bad politics will yield bad quality of life, Engineering in Kenya will continue to be affected by decisions in the political space. As such, IEK has taken a key step to engage policy makers in all the levels of the National and County Governments. These engagements are beginning to bear fruit as we now have Eng. Eric Murithi Muuga as a nominee for the position of Cabinet Secretary for Water, Sanitation and Irrigation.

Our advocacy efforts are geared towards engineers taking the lead in conversations that will lead to the transformation of the economy of this country. For this reason, IEK has taken a leading role in sustaining the conversation on pending bills. We believe this conversation is necessary with many projects stalled because of lack of financing. At the policy space, we have also aligned our engagement along the government development priorities. These include Agriculture, Micro Small and Medium Enterprise Economy, Housing and Settlement, Healthcare and Digital Superhighway and Creative Economy. Engineering is central to the realisation of these priority sectors of the 5th Administration.

Through active policy formulation and engagement in influencing policies around these areas, IEK is placing the Engineer at the center of the development of this country. It is for this reason that Engineering Kenya as is the theme for this issue is about transforming this country economically but also creating opportunities for Engineers. Engineering Kenya is also creating an environment for doing business because infrastructure is a key enabler for doing business.

To bring down the cost of living requires a rebirth of manufacturing in our country. We have realised that we have an immense potential in manufacturing in all the counties. Eradicating hunger has a lot of Engineering as Agricultural Engineering and Irrigation will be key in delivering this priority. Growth must be inclusive and opportunities availed for all. IEK is at the forefront of advocating for this inclusive growth that does not leave any part of the country underdeveloped.

Engineering Kenya also means that we must embrace sustainability in all our development. For this reason, we have invested in training to pass on the skills that we will require to continue to transform all the sectors of our economy. Engineers are particularly involved with power generation and transmission, water and sanitation as well as irrigation, all infrastructure from hardware to digital infrastructure. Sustainability in all these will involve developing the best knowledge and resources to ensure Kenya is leading in all these sectors while passing on the skills to locally retain the best human resources. Reliability and safety are also very key in our infrastructure and they must be integral considerations of Engineers as we take the lead in Engineering Kenya.

PICTORIAL

IEK President, Eng. Shammah Kiteme, along with a delegation from the Institution of Engineers of Kenya, during a courtesy visit to the Doshi Group of Companies.

Eng. Annette Ingaiza Murambi, FLC Chair, leads the Institution of Engineers of Kenya Future Leaders in mentoring young girls at Plateau Girls High School, emphasizing the importance of choosing an excellent career path in engineering.

IEK welcomed a delegation from the Royal Academy of Engineering to discuss the implementation of IEK's Africa Catalyst Phase 5 project, Engineering Excellence Alliance: Strength-ening Engineering Professionalism, Capacity, and Growing Engineering Talents for Sustainable Development in Sub-Saharan Africa.

The IEK South Rift Branch, in partnership with the Women in Engineering Committee, celebrated International Women in Engineering Day at Toniok Girls Secondary School, focusing on capacity building and empowerment for young students.

The IEK Council led by President Eng. Shammah Kiteme during a courtesy call to KPLC MD, Eng. Dr. Joseph Siror.

Message from the Honorary Secretary

Eng. Jacton. A. Mwembe, PE, MIEK

Members, Colleagues and All Our Readers,

It is with great pleasure and pride that I introduce to you the 18th edition of Engineering in Kenya publication. This publication embodies the spirit of innovation, transformation, and progress in our beloved nation. As we navigate the dynamic landscape of the 21st century, the theme of this issue, "Engineering Kenya", resonates deeply with our collective vision to propel Kenya towards a future marked by sustainable development, technological advancement, and professional excellence.

In this issue, we present a rich collection of articles that explore the pivotal areas influencing the engineering profession and its societal impact. The IEK Council, offers a thorough memorandum to the government, detailing our strategic priorities for advancing engineering in Kenya

This edition addresses the critical matter of future engineering, empowerment of engineering services, emphasizing the challenges we've faced and the progress we've achieved in maintaining accountability and professional integrity within our community.

We are privileged to feature insights from esteemed contributors across various sectors which includes, Agricultural Development, Manufacturing, Structural Development and Engineering Education.

The Institution of Engineers of Kenya (IEK) remains steadfast in its commitment to the professional development of our members. We advocate for continuous growth through regular training sessions, workshops, and mentorship programs. By fostering a culture of lifelong learning, we aim to equip engineers with the latest knowledge and skills required to excel in their respective fields. Our collaborative efforts with the Engineers Board of Kenya (EBK) reflect our shared vision of advancing the engineering profession in Kenya. Through mentorship for professional development, IEK underscores the importance of robust educational frameworks and targeted initiatives to bridge the gap between academic training and industry requirements.

We take this opportunity to acknowledge the initiatives led by the IEK Future Leaders Committee. Their efforts in mentoring young and prospective engineers through engagements and participation in mentorship programs are commendable.

The IEK Council will continue to support and organize career days in learning institutions, as this will not only inspire the next generation but also ensure that the profession remains dynamic and forward-looking. The synergy between IEK and EBK exemplifies our collective dedication to cultivating a vibrant engineering community, poised to tackle future challenges and drive national development.

In this issue, we shine a spotlight on Sustainable Energy Solutions, highlighting advances in solar, wind, and geothermal energy projects. To drive the adoption of these solutions, Kenyan Government should prioritise integration of renewable energy sources into the national grid, develop innovative technologies for energy storage and distribution, advocate for supportive policies, collaborate with international partners, and initiate public awareness campaigns. The Kenyan Government must ensure that all agencies within the energy sector persist in promoting green energy adoption. The efforts of these stakeholders are vital in fulfilling Kenya's energy requirements and advancing the engineering profession through sustainable energy initiatives.

Through dynamic engagement and forward-thinking initiatives, the IEK council strive to inspire our members, young engineers and future leaders to join us in crafting a brighter, more sustainable future for Kenya.

As you read through the articles in this issue, I invite you to embrace the spirit of collaboration, innovation, and hope that permeates every page. Together, we can achieve the visionary goals of the IEK and make a lasting impact on our nation. Let us continue to work hand in hand, fostering a culture of inclusivity, excellence, and professionalism in all our endeavours.

I encourage you to uphold the virtues of engineering standards and practices highlighted in this publication. By adhering to these principles, we can ensure that our engineering solutions not only meet the highest levels of quality and safety but also contribute to a sustainable and prosperous future for Kenya. Let us remain dedicated to advancing our profession, mentoring the next generation of engineers, and driving forward the transformative changes that will shape our nation for the better.

IEK's Proposal to the Government: Priorities for Engineering Advancement

'Increasing the number of registered Professional Engineers from the current 3,500 to about 15,000 by the year 2027 calls for Engineering stakeholders' engagement as well as consultation from across all stakeholders.'

Eng. Shammah Kiteme recently spoke on #InsideGovernment on The Future of Engineering.

Three months into the office, what have you discovered?

Well, there is a lot of work and consultation to be done and it almost feels like nothing has been happening before, while in reality, I am aware there is so much that has been happening. However, we are up to the challenge. We are giving it our best shot and we are making steps and positive steps.

You have been an engineer for the last 15 years. What would you identify as the biggest challenge facing this industry?

To begin with, the Society still does not seem to appreciate the place of the engineer and that translates into their involvement in key infrastructure undertakings and mega projects. This also translates to their compensation and so there's a general way in which the compensation for engineers is not well appreciated right from salaries all the way to consultancy and that remains a big conversation within the fraternity and something we are looking into. You will recall that in 2022 there was an engineer scale of fees that was enacted. At the moment, it is a law and that has helped to make Engineers have a reference point. For instance, you know lawyers and advocates have a remuneration order too. So, for the first time in 2022, we had something that Engineers would refer to. Currently, we are fighting for a unified scheme of service for engineers because it is really a disadvantage to Engineers who spend five years in the university and when they are employed under public service, their work entry grade is job Group K, equivalent to someone who went to do anthropology in the University. This is quite against the career guidelines for Public Service Commission which dictate that for a five-year course, the entry grade should be job group L. The job exit for Engineers is lower than the other professions and so we are fighting for the unified scheme of service for engineers to improve compensation. We are having engagements with Public Service Commission and soon with SRC because we do believe that Engineers need to be compensated well, just like other professions that enjoy risk allowance and practicing allowance, which Engineers do not and so we consider it an injustice to the engineers and it is a matter we are pursuing aggressively with the Public Service Commission.

Why has it taken too long to start appreciating the role of engineers in our nation?

I do believe there is a time of economic law for this country and I think pretty much in the '90s and there was no much infrastructure happening. You do recall that after 2002, the NARC Kenya government was very aggressive into infrastructure and that is the time we started seeing the place of the engineer more critically than we used to. As a matter of fact, previously in those years of economic law, Engineers were even opting to go to work in audit firms. However, post 2002, we saw aggressive investment in infrastructure by the NARC government and there has been that intention. I remember one presidential candidate saying their agenda for economic transformation is infrastructure, so this kind of focus on infrastructure has brought to the fore the space of Engineers and of course we have seen legal reforms that have created in Authorities like KENHA, KERRA and KURA. That has created more space for engineers in terms of taking lead in implementation of infrastructure and I believe this is a contributor but we are still pushing so that the various Acts created in Authorities such as KPLC and KenGen have Engineers at the top positions of leadership because if an organization's core function is engineering, then naturally we should have Engineers leading those kinds of organizations. It is not right to have people who are not technically capable of reasoning with the majority of the workforce taking the top leadership. It does mean that they do not have the technical competency to deal with the matters that the organization deals with and so that is really a point we are making very strongly as the Institution of Engineers of Kenya.

The proposal on Engineers taking leadership roles in certain organizations is facing a lot of backlashes from people who are arguing that it is arcing to setting up positions for exclusively some people. Isn't this likely to be challenged in a court of law?

Well let us take a look at any Hospital in this country. They can be owned by an NGO, by a church organization and even by the state. However, the frontline care providers in that hospital have to be doctors, nurses, clinicians et cetera. In a similar manner, anyone can own any business even legal business however the dispensers of Legal Services must be lawyers. In the same way, we need to have engineers at the forefront of providing Engineering Services whether it's in construction, whether it is design and supervision and whether it's in operations; For example, if you have an entity whose core function is power generation, something which is largely Engineering, in nature roads and infrastructure, water and waste water irrigation and all that those are Engineering co-functions. Why do you want to entrust people who are not technically suitable in terms of experience and knowledge to lead those organizations? It means then, that the people at the top handling those institutions are reporters of what they get from their juniors. For instance, if you are a Cabinet Secretary and you are getting advice from that kind of a person, then you are getting second hand information. You can only get that best advice from a technically competent person and a professional in that field and so we believe our argument makes sense. Let me tell you, those countries that have invested in proper engineering, let's take an example of China where all the way from the head of state to about 70% of the government are Engineers, the country is literally transformed because Engineers are creative. They think systems, they are problem solvers and that is what we advocating for by saying space needs to be given to the engineers. The priority of the government has been largely engineering issues, whether you are talking of Agriculture, universal healthcare, whether you're talking of housing, all those are core engineering healthcare whether you're talking of um housing all those are core engineering provided.

You're talking about transforming this country to get to where China is, in terms of infrastructural development as well as Innovation but you're talking about a country that is still grappling with a huge deficit of professional and qualified Engineers. You're talking about less than 3,500 against a population of almost 60 million people and that translates to a very small number.

No, *look, this country has trained about 37,000 Engineers since we have been around. Some are deceased and others are not even involved in engineering at all. We have a lot of infrastructure projects going on whether from the private sector or the public sector. Making sure that for every project that we undertake we create an opportunity to create attachment/internship opportunities for engineers so that we can train them and pass skills to the Next Generation. Every profession learning is through apprenticeship so you learn from experts or the Masters to become a master or an expert yourself. Countries like China are where they are because deliberate and conscious decision making is involved in technical competency. They invested in training, making sure that they industrialize. As a matter of fact, they took the extra step of learning through the process of industrialization and reverse engineering where they get the existing systems, they learn from them so that they can manufacture. I have been moving across Africa and even further and everywhere I landed, China is present everywhere. Many of the airports works in this continent are being done by China because they had a deliberate and calculated plan on how to transform the economy. They invested in engineering and technology and I can tell you within 30 years, that country changed from poverty to be a giant we see today. This country can do similarly if we give space to engineers and we believe the policy makers and decision makers will take this kind of advice from us because we have the ability to transform this country through industrialization. We have the ability to invest the kind of infrastructure that is needed to enable the economy grow and I believe this is the kind of conversation we need to have as a country*

Innovation and technology are driving change around engineering. What are you doing to ensure that Institutions of Higher Learning are populated with younger Engineers so that they can bring in new ideas, come up with new Innovations and can drive technology?

Regarding what I talked about earlier on economic law where we are not churning out qualified Engineers because there are very few projects. There was that kind of um engineers in their eighties taking places of leadership, and some universities where we have had quite senior Deans and we know annually we produce about 2,500 Graduate Engineers from all the universities that we have in the country. Universities have gradually been offering opportunities for scholarships and we seeing more young University Deans.

I have colleagues teaching the universities. There's that general trend whereby the young Engineers are taking over however and we must be very categorical. The biggest malice and problem we are dealing with is opportunities for engineers and the projects where they are going to get exposure to get compensation. We have talked about a very big monkey in this country called pending bills, which is so because we made our comments during the finance bill that was rejected and highlighted the fact that pending bills is a very big factor of our economy doing well or not well because we have projects that are put on hold because money has not been given to the project that translates into Engineers who have gone for up to twelve months without pay in their salaries. It also translates into consultancy firms that have not been given money to continue supervising those projects. Well, what does that mean? It means they are sending Engineers home as they do not have work. This is a big conversation that we need to have on pending bills which will create opportunities for engineers and these Engineers getting well equipped, trained and experienced?

How much is owned to the engineers by the government

I do not have the exact figure but to be honest, we have had the a Cabinet Secretary from the recently dissolved Cabinet quoting a figure like 600 billion of pending bills and I can tell you I will not dispute that because I know a number of Roads while seated here that are not going on because the contractor has not been paid the consulting I receive messages from Engineers who are telling me that it has been 12 months since they were last paid. One of the things that cause us to raise eyebrows and make noise about the Finance Bill is that and the budget statement is that we had almost zero allocation for pending bills and that is literally killing the engineering industry in this country and so we hope that even as His Excellency the President dissolves the Cabinet, this issue of pending bills is given enough weight.

The government has been very clear that here are more than 100 infrastructure projects that are pending in different parts of the country. How has this impacted the profession of engineering?

When we talk about over hundreds of projects that are stalled, let me explain to you what that means. It means there was mobilization, there was a Contractor on site, there was a consulting firm, there were engineers employed, and this renders all those people jobless as long as that project is stalled but that is not all. The fact that that the project is stalled means there are costs that the government is incurring because of idle labour due to idle plant and equipment. The question is, when we are conceiving a project, are we thoughtful that we have the budget or do we know that we have the resources to run the project up to the end because then, the moment you sign under the dotted line and in a contractual phase with the different players if you do not deliver your obligation, you will incur consequences. There will be costs and you will pay penalties and so we ask ourselves then, where is integrity of the public servants involved in conceiving these projects? This is because we are paying hefty sums and I think you have seen court cases whereby entities have been awarded billions of monies because of this kind of scenario.

Sometimes in the past, Engineers have also raised these concerns regarding delayed payments, forcing some of them to move to work in the East and West. How bad is the situation?

We have lost some of the best brains in this country. I know colleagues who leave key Engineering positions in this country and going to for example, Germany. I know several of my friends in Australia, the UK, Saudi Arabia, and all over the world. We regret that we lose some of the best brains because this country still needs those brains who understand our national grid. We do not need to lose them, however the situation with our economy is so bad. We have so many young Engineers who are jobless and we have actually been involved in conversations about what we can do to help get opportunities out there for them and I appreciate the current government which has been trying to get opportunities in Germany. We have interacted with our colleagues from Jordanian Association of Engineers, Danish Association of Engineers and we are deliberate to interact with more this year. Around September this year, the Institution of Engineers of Kenya is organizing an international tour to Italy and Germany just so that we can continue exposing our members in the kind of practicing environment we have globally and build those partnerships that can create exchange programs and if possible, members getting opportunities across the border. We have recently created an association or coming together of Engineers who are in US and Canada to come together and we have exchange of information. We have our colleagues working at Lockheed Martin in Boeing and we want that kind of exchange of ideas so that if there are opportunities for more engineers, they can make our colleagues here aware of them and they can take them up but the issue of unemployment for engineers is huge and it's an animal. We are trying to resolve it and hope that soon we will be able to get more opportunities because of more infrastructure opportunities coming up and then we can stem the brain drain because we still need the top brains in this country.

I have also alluded to lack of training opportunities and lack of projects for engineers to be involved in and when you talk about 25,000 in total number of Engineers, the huge number of these are graduate Engineers who are looking for opportunities for work to be involved in projects because the engineering professionals go through a five year training in the University then you go through a three-year period of learning and registered. On professional development, when you graduate, you are expected to have acquired what you call graduate attributes to be able to get into engineering profession

Additionally, based on our act, a minimum 3 years of actual experience where you are you get exposure in design, contract management, supervision and you're able to develop a project that you can use to register. With the situation whereby graduate Engineers are not getting opportunities to train, this basically means they lack opportunities to train, yet they need to prepare themselves for registration and so then we are seeing a situation whereby just above 3,000 Engineers are able to register either as a Professional Engineers or Consulting Engineers and the bigger chunk of about 23,000 graduate Engineers remain jobless causing some of them deviate to do other things. However, what we are advocating for and especially as IEK is that every time there's a project, is to set aside some amount of money even 1% and you can imagine if you set aside 1% of 3 billion set aside some amount then that amount should be for training for internship/attachment for engineering students and graduate engineers. This will translate into opportunities for engineering students and graduate engineers and when they are exposed to this, then they are able to get the experience and need to be able to register and this country is going to grow in number of Engineers. Any economy that has been transformed has invested heavily in engineering. Countries like America, Russia, China, Iran have been deliberate in investing in engineering and technology that has been a trigger to the economic transformation in those countries and for us we must also go that line.

The number of registered engineers has notably improved. Talking of figures moving from as slow as 100 to the current about 500 per year is significant and of course I know the goal is to register 10,000 engineers in the next couple of years because it is in the strategic plan for the engineering regulator, Engineers Board of Kenya, where I happen to be a board member. We want to aim to ensure that for every project that is registered in this country, we know the engineer involved and that the compensation for engineers is strictly adhered to. We want to see to it that we are not bringing in foreign Engineers to carry out projects that local Engineers are able to do. We are aware that the space for internation mobility of our Engineers has been made possible, through the Washington Accord, which I hope we will be able to accede to next year.

Empowerment and Professional Development In Kenyan Engineering

Insights From The President IEK

Eng. Shammah Kiteme, CE, FIEK
IEK President

i. Gender Parity in Engineering

Eng. Shammah Kiteme discussed the significant strides the Institution of Engineers of Kenya (IEK) has made in bridging the gender gap within the engineering field. He acknowledged that although women constitute only 13% of the IEK's overall membership, they hold a substantial 41% of the leadership roles. This discrepancy illustrates IEK's commitment to empowering female engineers and creating a more inclusive environment. The IEK President emphasized ongoing efforts, such as outreach programs in schools to inspire young girls to pursue careers in engineering and STEM fields. He shared a recent instance where he personally visited a girls' school to encourage students, highlighting the concerted effort of the Women Engineers Committee in conducting similar activities.

"We have 13% of our members being lady Engineers. We definitely have in our leadership about 41%. That tells you proportionately we have more ladies in the leadership compared to men... We are deliberate on empowering women Engineers every time we have an opportunity."

ii. Transition to Professional Engineers

With the increase in graduate engineers in Kenya voicing concerns about the protracted and bureaucratic process required to transition to corporate membership within IEK, Eng. Shammah acknowledged these grievances, explaining that there was a time when it seemed as though some individuals deliberately hindered this progression. However, he assured that concerted efforts are now in place to facilitate a smoother transition. He highlighted the Graduate Engineers Internship Program (GEIP), which aims to provide structured, paid internships lasting at least three years. This program is designed to ensure that graduate engineers receive the necessary professional development and training to qualify for corporate membership. Eng. Kiteme pointed out that while some engineers have successfully transitioned within three years, the IEK continues to work on further streamlining of the process.

iii. Impact of the Graduate Engineers Internship Program

Positively speaking about the Graduate Engineers Internship Program (GEIP), the IEK President stated that it has had a notable impact on the professional development of young engineers. He noted that the program, now in its fourth cohort, has successfully helped many graduate engineers transition to professional engineers within a timely manner. The success of the program has also led to calls for its expansion, aiming to accommodate more participants in the coming years. However, he highlighted a significant challenge: The low stipends provided to interns. This financial inadequacy often forces families to support their children during the internship period. He urged for greater investment in the program to ensure that interns are adequately compensated, thereby making the program more sustainable and attractive.

iv. Kenya's Accession to the Washington Accord

There have been concerns and optimism regarding Kenya's bid to join the Washington Accord by 2025, an agreement that facilitates the global recognition of engineering qualifications. The President outlined the necessary steps and resources required, including the accreditation of university programs by the Engineers Board of Kenya, the enhancement of training facilities, and the need for more registered engineers to serve as mentors and educators. Eng. Kiteme reported that the country is making significant progress, supported by mentorship from countries like Pakistan and Malaysia. He conveyed his hope that during his term as President, Kenya would successfully accede to the Washington Accord, a goal he had campaigned on.

Eng. Shammah acknowledged the challenges, such as the need for adequate human resources and proper training facilities, but highlighted the ongoing efforts and trainings to address these issues. He hoped that during his tenure, Kenya would successfully join the Accord, fulfilling a key promise of his campaign.

v. Unity within IEK Post-Election

Following a fiercely contested election, Eng. Shammah Kiteme emphasized the importance of unity within the Institution of Engineers of Kenya (IEK). Despite

the competition, he underscored that IEK is a unified body that serves all its members equally. Eng. Kiteme recounted his commitment to advancing a unity of purpose within the institution. He ensured that members who opposed his election still had opportunities to contribute and serve in various committees. Eng. Kiteme reiterated that the IEK is not divided into factions; rather, it is a single institution working towards the common goal of advancing the engineering profession in Kenya. He stressed that all engineers, regardless of their stance during the election, are part of one family and should work together for the betterment of the profession. He assured that despite the competitive nature of the elections, IEK remains a unified institution. He also added that there are no factions within IEK and that all members, regardless of their voting choices, have equal opportunities to contribute to the institution's activities.

vi. Kenyan Engineers' Competence

Addressing the perception that Kenyan engineers are not well-qualified, President Eng. Kiteme strongly refuted these claims. He cited numerous examples of Kenyan engineers excelling in international projects and working with top global companies like Boeing and Lockheed Martin. Eng. Kiteme attributed the preference for foreign firms in local projects to decisions made at higher levels, which often disadvantage local talent. He argued that Kenyan engineers possess the necessary skills and expertise to handle major projects, but are often sidelined by policy and decision-makers. Eng. Kiteme called for the enforcement of local content laws and policies to ensure that Kenyan engineers are given fair opportunities to participate in significant infrastructure projects.

He said, *"We have some of the top engineering brains in this country... It is because someone at the decision-making table decides to disadvantage our own citizens."*

He profoundly highlighted that the perception of Kenyan engineers being underqualified is far from the truth. He mentioned that many Kenyan engineers are working on high-profile projects internationally and possess the necessary expertise. He pointed out that the preference for foreign firms in local projects often stems from decisions made by policymakers, rather than a lack of local capability. Eng. Kiteme called for fairer opportunities for Kenyan engineers in major infrastructure projects.

Picture: Courtesy

A Vision For Kenya: The Political Economy of Transformation

By an Economist

Picture: Courtesy

A Vision for Kenya: The Political Economy of Transformation

The economy of Kenya is long overdue for fundamental transformation, reconstruction and development so that it can fulfil the aspirations of the founding fathers to build an economy that will enable us to eradicate poverty, ignorance and disease so that our people can live in dignity.

It is for this reason that in 2008 the country enunciated a bold and ambitious new development blueprint the Kenya Vision 2030 (KV2030) whose aim is to create "a globally competitive and prosperous country with a high quality of life by 2030".

Kenya Vision 2030 aims to transform Kenya into "a newly-industrializing, middle income country providing a high quality of life to all its citizens in a clean and secure environment".

Central to the Vision, (as articulated in Sessional Paper No 9 of 2012), is for the country to be the leading industrialized nation in Africa, with a robust, diversified and globally competitive manufacturing sector for the generation of wealth and employment. The journey of industrialising a country is largely an engineering project and therefore the engineering community in Kenya is bound to play a leading role in re-engineering our national development agenda and priorities.

Economic Transformation Journey

At independence our founding fathers set out to eradicate poverty, ignorance and disease. This entailed that KANU would build an independent state with an equally independent modern integrated and self-reliant industrialising economy in which the needs of all sectors and all people would be met. Unfortunately the departing colonialists managed the transition to install an alliance of local political forces sympathetic to foreign interests.

Sessional Paper No 10: Roots of A Dependent Economy

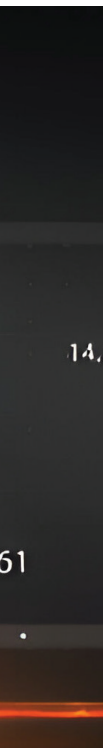
In 1965 KANU produced the Sessional Paper No 10 on African Socialism and it's Application to Planning in Kenya. Instead of this Sessional Paper charting a bold new path to a modern, prosperous and egalitarian industrialised future it instead sought to reproduce the skewed and uneven racist colonial patterns. Accordingly public investment was to continued being directed to the so-called high potential areas that are the former White Highlands whose potential was actually a result of the unjust racist colonial development policy that favoured white settlers at the expense of the colonised indigenous African people who were relegated to the so-called native reserves. Critics observed that this sessional paper was neither African nor Socialist.

This blueprint set postcolonial Kenya on a dependent economic development path that has denied us the ability to break loose from foreign domination.

Meanwhile to consolidate their stranglehold on power the postcolonial ruling elite was soon being accused of abuse of office as corruption in the public service became a nagging concern especially after the Ndegwa Commission Report allowed civil servants to engage in running business enterprises while still in office.

Ethical Leadership in Transformation

Ethical commited leadership is crucial for the task of transformation of nations. Abuse of power to serve narrow private ends and the pursuit of misguided dependent economic strategy has contributed largely to compromising the ability of the state to develop a national economy for the benefit of the majority. Consequently even though the economy grew steadily in the first ten years of independence the policies gave rise to a dependent economy which produces what it does not



consume and consumes what it does not produce thus catering essentially for foreign interests and rendering the Kenyan economy an appendage and largely a lucrative market for foreign goods and services. This was not the inevitable consequence of decolonisation but simply the result of a leadership challenge in postcolonial Kenya.

Frantz Fanon aptly captured the tragedy of dependent ruling elites when he said of the African leaders who took over from the colonialists as follows:

"They are not geared to production, invention, creation or work. Networking and scheming seem to be their underlying vocation... They have the psychology of a businessman, not that of a captain of industry." He was concerned with the ability of the leadership of the newly decolonising African nations to break loose from their erstwhile colonial masters and to help develop independent industrial national economies as a material basis for exercising their sovereignty.

Perhaps the commission agent mentality of deal-makers of yesteryears rather than the captain of industry mentality is probably what distinguished the paths taken in South Korea, Malaysia, and Singapore to the trajectory Kenya took. The former soared to the sky while the Kenya lagged far behind. This may be illustrated by comparing the growth of the GDP per capita of some of these countries to that of Kenya over the same period.

It is instructive to note that in 1965 the Gross Domestic Product (GDP) per capita of South Korea was US$ 108 and Kenya's was US$ 104, while in 2020, the GDP per capita of South Korea had risen to US$ 31,489 as against Kenya's to US$ 1,838 only! Part of the explanation for this difference can be traced to differences in investment on education especially that of engineers.

Comparing the number of people per engineer for selected countries in 2011 shows that Kenya had 6300 people per engineer, whilst South Africa had 3166, China had 130, India 157, Brazil 227, Korea 285, UK 311, USA 389 and Malaysia 543. It is also due to the seriousness with which they tackle accountability and corruption in the public service.

The Evolution of Postcolonial Industrial Policy in Kenya

The economy in post-independence Kenya consisted of large scale and smallholder peasant agriculture, Import Substition Industries (ISIs) largely producing consumer goods, and the services sector including tourism, transport and retail and wholesale trade. Little effort was directed at producing intermediate and producer goods. Agriculture exported primary unprocessed products and was dependent on imported industrial inputs. The manufacturing industry that produced consumer goods was also heavily dependent on imported inputs.

The entry of Africans into occupations in the bureaucracy and in the commercial sector previously held by Europeans and Asians gave rise to a feeling of progress among a small segment of the society even as many grumbled that Kenya was evolving into a "man eat man society"of ten millionaires and ten million paupers that the late J.M. Kariuki used to talk about in the 1970s Kenya.

Manufacturing Industry in postcolonial Kenya

Post-colonial Kenya pursued a policy of import substition industrialisation (ISI) strategy in which government provided direct support and tariff protection for the sector. This was a continuation of a policy began in the colonial period to produce previously imported consumer goods for local consumption and some for export especially to the neighbouring countries. These industries were expected to provide employment and save the country foreign exchange and improve the balance of payments.

Between 1963 and 1970 the manufacturing sector grew at a rate of 8% growing faster than the rest of the Kenyan economy and also faster than the industrial sector in the rest of Sub-Sahara Africa (SSA). These industries included food processing, leather tanning, footwear, paper, textiles, apparels, garments and tobaccp manufacturing.

The performance of the manufacturing sector faced serious shocks and decline in the 1970s even though the government increased its participation in the sector through increased financing of new industrial projects. Industrial production for export slowed down due to a number of adverse factors including the collapse of the lucrative East African Community market and deterioration in the external terms of trade due to the the oil shocks of the 1970s.

This ISI strategy failed to create adequate employment to meet the rising needs of a rapidly growing and increasingly educated population of young people aspiring for better paying and quality jobs in the modern sectors of the economy that would assure them of better standards and quality of life. Additionally because most of these industries were not well integrated into the local economy they lacked forward and backward linkages and had high import content that also put pressure on balance of payments. which are among the problems the strategy was meant to resolve.

As the unemployment pressures intensified the GoK requested the International Labour Organisation (ILO) to study the problem and recommend solutions in 1971. Their Report on Employment Incomes and Equality that was published at the end of 1972 saw the mainstreaming of the informal artisinal manufacturing sector (also known as "jua kali" because it was largely carried out in the open spaces under the hot sun without even the benefit of shades) into official industrial statistics. This sector consists of artisans repairing vehicles, fabricating metal household and farm tools, furniture welding windows, doors, grills and a myriad of other hand made items. The proposition was that this sector would create employment, reduce inequality and spur industrial growth and equitable economic development. This promise has remained a dream.

The ISIs in the formal sector benefited from state subsidies and market protection at the expense of the rest of the economy which bore the higher costs of their expensive products. Meanwhile little or no public investment or support has been made in the jua kali sector to encourage and enable those in the sector to graduate into the formal industrial sector with potential for enhancing productivity and improving working conditions and incomes for those labouring in that sector.

Export Oriented Industrialization (EOI) SAPs and De-Industrialisation

Moi succeeded Kenyatta in 1978.and was to preside over the tumultuous economic and political shocks of the 1980s and 1990s. This is the period in which Keynesianism collapsed in the capitalist world and socialism and the Soviet Union also collapsed bringing the cold war between the Soviet Union and the USA, to an end. This period also witnessed the rise of globalisation and neoliberalism and that of a global power structure dominated by the USA.

Neoliberalism dictated the imposition of austerity measures that required reduction in government spending and increasing taxation as well as imposition of policies such as elimination of price controls, deregulation of capital markets, removing trade barriers, and privatisation of state assets. It also involves removal of subsidies to both consumers and domestic producers, withdrawal of funding to social services and laying off of workers in the public sector as was carried in Kenya when many employees in parastatals were given early retirement. It also involves weakening of trade unions and abolition statutory minimum wages policies. We are presently observing the return of the rabid austerity programmes of the IMF and Kenyans are not taking the bitter pills lying down. There is fierce resistance online and on the streets of Kenya as we write.

Neoliberal policies are a calculated assault on any social and economic benefits states guaranteed to workers and the poor and vulnerable under the Keynesianisian policies in capitalist economies. Essentially liberalism has no problem with state involvement and intervention in the economy as long as it benefits the owners of capital or investors. The problem is with the state appearing to assist the working people and the poor and vulnerable.

Moi and Structrural Adjustment Programmes

It is during the period Moi ruled that the IMF and the World Bank literally took over the running of the country. In the 1980s and 1990s the World Bank and International Monetary Fund (IMF) imposed punitive foreign financing conditionalities that forced the GoK to adopt and introduce Structrural Adjustment Programmes (SAPs) through the publication of Sessional Paper No. 2 of 1986 known as Economic Management For Renewed Growth.

Through this Sessional Paper government undertook to completely remove protective import licencing and tariffs, remove price controls, liberalise imports through removal of import and foreign exchange licencing and remove of subsidies to local producers.

Even though those measures were promoted and rationalised on the basis that they would enhance competitiveness and spur and stimulate Export Oriented Industrialization (EOI) they led to the dismantling of the protective fiscal regime around our nascent industrial sector leading to massive de-indistrislisation of our economy, job losses and unemployment, escalating inflation, rising cost of living and declining standards of life. Kenya became a mitumba economy and a dumping ground for foreign goods.

This problem of dumping of second hand goods and items as well as the dumping of expired, substandard, counterfeit and hazardous goods and waste products continues to bedevil our industrialisation efforts to date. In fact it appears that some international trade agreements and protocols require free movement of such dubious goods.

Moi's twenty four years rule was thus not only politically repressive but also an economic disaster. Tribalism also thrived under Moi as he replaced the Kenyatta era Kiambu Mafia with a newly minted Rift Valley Mafia which looted and pillaged the public coffers and resources with relish. By the time Moi was leaving office almost all public land previously set aside for public use in urban areas had been irregularly disposed off. The country was on it's knees and was suffering a negative two percentage growth rate!

Kibaki and Economic Revival

The departure of Moi and arrival of Kibaki in 2003 was celebrated by Kenyans in a manner only comparable to the coming of independence in 1963.

Kibaki rode to office on the crest of an ecstatic and overwhelming popular democratic coalition National Rainbow Coalition (NARC). It was the culmination of years of painful struggles and valiant sacrifices by many Kenyans. He promised that under him corruption will cease to be a way of life and that the era of roadside declarations was over. Sadly like his predecessors before the ink dried on his promises he had thrown coalition partners overboard as he now surrounded himself with an ethnic cabal at the heart of the state.

Kibaki had the best opportunity to tackle and eradicate the twin problems of ethnic politics and corruption that have sabotaged our efforts at building a united, prosperous, just, equitable and inclusive Kenya in which everyone feels at home. Tragically he blew up the chance at the onset of his reign. According to John Githongo, who was the Permanent Secretary in charge of Ethics in the Office of the President, the Mount Kenya Mafia then sorrounding Kibaki declared that "it is our time to eat".

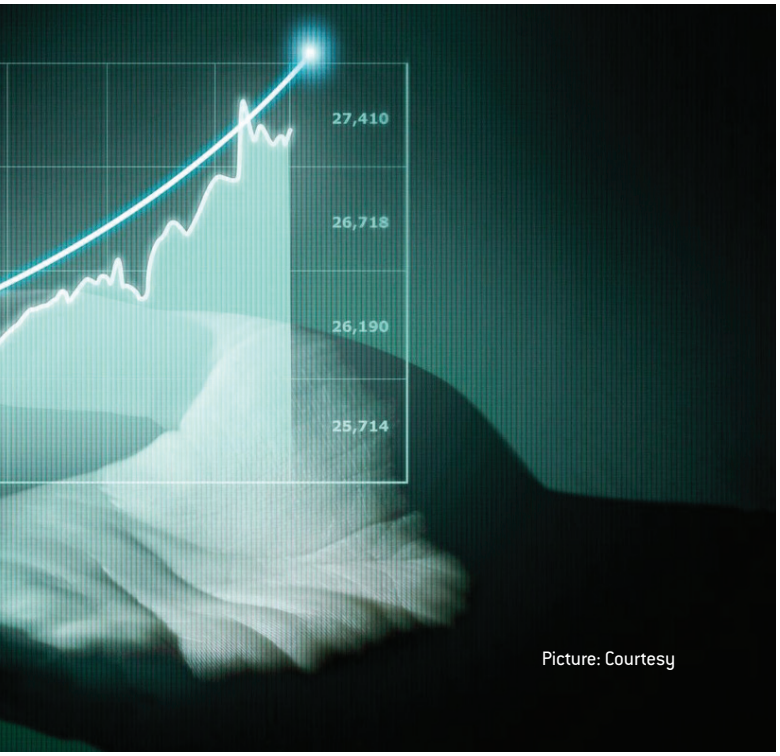
This left the country so badly wounded that in the 2007 elections Kibaki was believed to have lost but was secretly sworn into office at dusk throwing the country into unprecedented post-election violence that left over 1300 Kenyans dead and many more wounded and displaced.

Kenya was pulled from the precipice of a complete breakdown and civil war by concerted mediation efforts of the international community. This period saw the formation of a government of national unity.

Very commendable economic performance and growth was registered during this period. It is also under this government that the Kenya Vision 2030(KV2030) and the CoK 2010 were launched and promulgated respectively..

Vision for A Just, Industrialised and Prosperous Kenya

The KV2030, launched in 2008, proposes to build an industrialised and prosperous middle income country by the year 2030 while the CoK 2010 was a culmination of the protracted struggles for a democratic Kenya in which all feel at home and leadership is defined by selflessness and integrity. Unfortunately, an examination of our political and economic experience since 2013 shows that there is more to good governance than promulgating a good economic blue print and a good constitution.



Picture: Courtesy

Jubilee and Declining Economic Fortunes

The Jubilee government elected in the 2013 general elections appears to have not only abandoned the implementation of the KV2030 immediately they came to office but also went on a borrowing spree. They claimed that the loans were to be invested in numerous infrastructure projects. Some critics have complained the projects were unduly overpriced while others have argued that some of the debts are dubious and odious. The Auditor General Nancy Gathungu has also recently reported that the government can not explain how over Kshs 1.3 trillion has been spent. These debts have left Kenya reeling under the weight of unsustainable debt and pressures to increase taxes to pay the suspect debts.

Under their watch the economy took a thorough beating as both domestic and foreign investors began to vote with their feet moving to other more attractive jurisdictions. Consequently employment opportunities dwindled as unemployment has risen to unparalleled heights. In the last decade most graduates of the education sector have simply joined the growing army of the unemployed and underemployed.

The IMF, Debt and Economic Crisis

The economic model promoted by the Kenya Kwanza (KK) government appears to be cracking under the weight of the debt crisis and is therefore unable to transform the economy through industrialisation. Moreover if complaints by the Kenya Association of Manufacturers (KAM) are to be believed it appears that government policies are turning investors away and frustrating existing investors in industry.

A Vision for Kenya

Kenya must industrialise if we desire to deliver the independence promise of eradicating poverty, disease and ignorance. We must build an integrated self-reliant industrialising national economy which is able to deliver dignified livelihoods and lives.

To catch up with our contemporaries such as Korea we must invest heavily in quality education and particularly in the production of many more engineers than we currently produce. The task of re-enginnering Kenya and the realisation of Vision 2030 is an engineering project.

To achieve the dream the government must fulfill it's commitment to mobilise 2% of the GDP annually for research and innovation which is the engine of industrialisation. More importantly it is clear that leadership matters. We must therefore identify patriotic, progressive, ethical and selfless leaders who are willing to commit to the task of re-re-enginnering and building the nation. Engineers have what is required for the task and must therefore come forth to actively participate in this national endeavour.

Taxation Policies and Their Impact on Kenya's Development

By EiK Correspondent

Taxation Policies and Their Impact On Kenya's Development

The intense political controversies in the country surrounding the processing of Finance Bills in recent times have brought taxation and tax policies into sharp focus. Even though the present crisis has been triggered by the controversial Finance Bill 2024/2025 the question is not just about how to raise taxes to spend from year to year but is generally about the broader question of the management of our public finances.

Public Finance Management concerns the determination of how and where to spend public funds and how and from where to raise the taxes and funds from other potential sources such as levies and fees charged for services rendered by government departments and institutions as well as borrowing. This involves identifying, justifying and prioritising needs to be funded in any financial year and not just how to raise taxes to spend.

The Power To Tax

The state and its tax imposition authority in a democratic society is a social contract that must continuously be negotiated between citizens and the state. The taxation and spending powers bestowed upon the state must therefore be justified on an ongoing basis, and governments must quantify what services the taxes are going to pay for and must provide proof that the promised public services were faithfully delivered as agreed before seeking and obtaining another authority to levy taxes anew. That is why finance bills and budgets have to be submitted for the approval of parliament annually and public participation is mandatory for the legislation of the bills into acts of parliament.

What is Tax?

The term ' tax' means statutory payment to be made by the public and imposed by the government. Tax is therefore a compulsory payment by a person or a business to the government to raise revenue for funding government services. Taxes can be levied on what you earn, what you buy or what you own.

Why Taxes Are Unpopular

Even though it is common knowledge that governments rely on the revenue they raise through taxation to provide the services they render to society taxes are universally unpopular as they reduce the ability of the taxpayers to determine how to spend their own incomes. For this reason governments must approach the process of deciding how to carry out taxation with alot of care and must convince taxpayers that the funds are being used prudently for their benefit.

This requires formulation of a prudent tax policy that will enable government to raise revenues to fulfill it's mandate and obligations while simultaneously stimulating economic development that benefits the majority especially the vulnerable.

Tax Policy

The formulation of a tax policy is both a political and economic decision making process. It is very important because it has significant implications for the fortunes of the economy in general and for the fate of different sectors of the economy and specifically for groups such as households and firms playing different roles in the economy and society.

Progressive vs Regressive Tax Policies

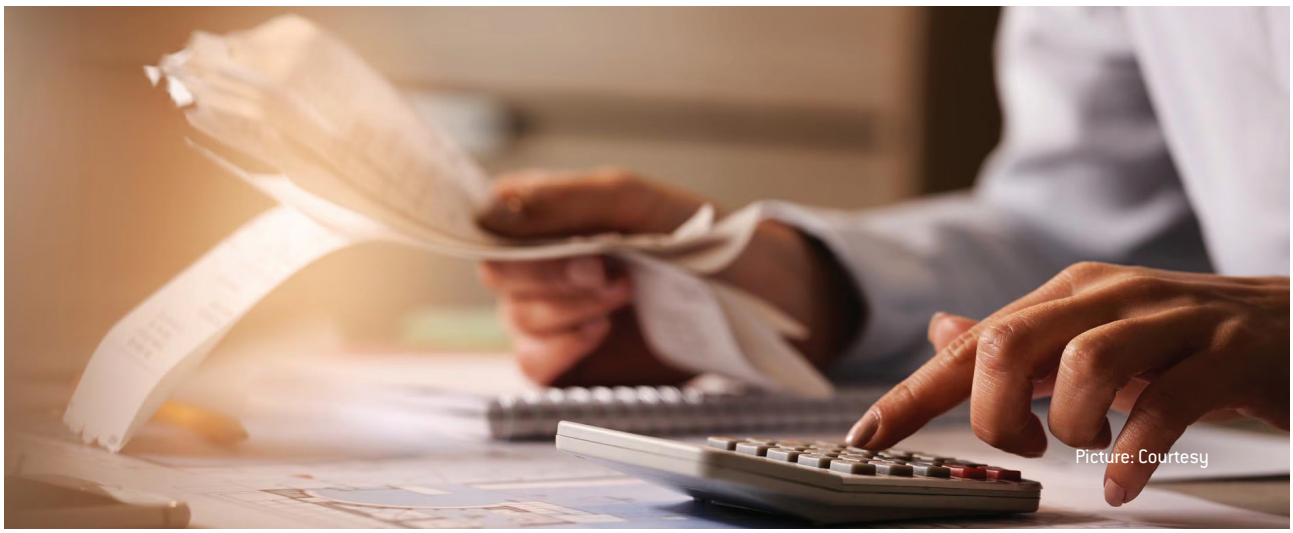
Tax policy refers to the guidelines and principles established by a government for the imposition and collection of taxes. Taxes can be viewed as being either progressive or regressive. Progressive taxation policies seek to promote equity in society by having tax rates that are higher for those who have higher incomes and therefore a higher ability to pay and lower rates for those with lower incomes and therefore lower ability to pay. This type of policy is contested by the rich and powerful in society. Regressive taxes tend to have uniform rates that shift a higher burden of funding public services to the poor with the least ability to bear the burden.

Taxation Policies and Economic Development

Taxation has micro-economic and macro-economic dimensions with the former focusing on issues of fairness and efficiency in tax collection, and the latter focusing on the overall quantity of taxes to be collected and its impact on economic activity.

Taxation policy should ensure that government raises revenue adequate to fund public goods and services, without compromising the usefulness of taxation as a tool to achieve public policy goals and objectives such as redistribution of wealth, reduction of income inequality in society and stimulation of desired changes in the composition and direction of the economy. Finding the right balance between these competing objectives is critical for promoting economic growth and ensuring citizens' well-being.

In crafting tax measures authorities often intend to promote economic growth; however, there is significant debate among economists about the most effective ways to achieve this because different tax policies will have different effects on different sectors in the economy and different groups in society. The taxation framework of a country is therefore considered a crucial instrument for influencing the country's economy but is also a highly contested political terrain with far-reaching political consequences if not managed prudently as has been seen in Kenya.


Picture: Courtesy

When taxation is intended to promote economic growth the policy may require a qualitative restructuring of the tax system for example, the substitution of taxes on consumption for taxes on income or special tax advantages to stimulate desired behaviour such as saving, labour mobility, research and development, and so on. Under such circumstances tax incentives can also be used in promoting economic development of specific sectors of the economy such as agriculture and industries or regions.

Taxation may be used to influence allocation of resources in market economies but some free market proponents have expressed fears and concerns that they may distort the large sets of possible choices available, or they can change the efficiency or create disequilibria in free markets within such economies, all with short- and long-term development consequences. However, tax measures may fail to achieve the stated goals and objectives and the desired effects and outcomes. Under such circumstances the taxes may achieve unintended consequences.

Excessive taxation for instance may stifle economic growth, deter investment and entrepreneurship, and reduce overall tax revenue due to diminishing returns. An emphasis on economic growth therefore implies the need to avoid high marginal tax rates and the tax-induced diversion of resources into relatively unproductive activities.

Principles of Taxation

Taxation policies are largely influenced by canons of Equity, Certainty, Convenience, and Economy first elaborated by Adam Smith. According to the Canon of Equity, the burden of taxation must be distributed equally or equitably among taxpayers. According to the Canon of Certainty, an individual's tax should be certain and not arbitrary. According to the Canon of Convenience, every tax should be levied in such a way and at such a time that it provides the greatest convenience to the taxpayer. According to the Canon of Economy, tax collection costs should be kept as low as possible. Any tax with a high administrative cost and an unusual delay in assessment and collection should be avoided at all costs

Lessons For Kenya

The state and public officers responsible for tax policies and tax administration must be reminded that people don't work to pay taxes but for their own sustenance and prosperity. Taxes are just a result of people agreeing to live together in a social arrangement where they delegate some of their own sovereign authority to the state and its organs to be exercised by state and public officers. Citizens can exercise such delegated authority directly and so they retain the right to recall that delegated authority from the delegates if and when they deem it necessary. The government must therefore justify its existence and justify why it needs revenue raised through taxation. It is for that reason that public participation is a central feature of the public policy process in Kenya. It is meant to ensure continuous engagement for transparency, accountability and securing the consent of the governed and in the case of taxation the taxpayers.

If the government is committed to prudent management of our public finances and resources it should seal the leakages in the revenue raising and spending chain in government to secure sufficient resources. Probably then government could actually come up with a Finance Bill that reduces taxes and increases the disposable incomes available to both firms and households.

The government needs to remember that the primary duty of government in managing the economy is to create an environment conducive to doing business, to lower the cost of living and to improve the quality of life and living standards of everyone, particularly the poor and disadvantaged rather than merely increasing government tax revenues. They ought to realize that people work to improve their lot and not to pay taxes to the government. Taxes should, therefore, be levied only to do those things we agree are best offered collectively by the state and especially those which will enhance the productivity of most people in the economy.

The government should let people make spending, saving, and investment decisions at the household and firms level since governments have a tendency to squander public funds, thus starving the economy of funds and resources needed for broad-based development that benefits everyone rather than a privileged tiny minority.

The government should also commit to eliminating the widespread waste of public funds regularly reported by the Auditor General and to reconstruct the national economy, restore people's lives and livelihoods, and restore our dignity so that the people of Kenya can enjoy economic prosperity.

Settling Pending Bills

By EiK Correspondent


Picture: Courtesy

In the midst of the unfolding economic and political crisis engulfing the country the ever-rising Pending Bills challenge is not getting the attention it deserves and yet a resolution of this challenge should top the list of the extremely urgent things to do to revive the struggling economy. The government must urgently find ways and means of immediately discharging it's obligations to contractors, suppliers and service providers.

Many of these entities are local are small micro and medium enterprises (SMSEs). A 2018 World Bank Enterprise Survey for Kenya report shows that most firms that secured government contracts were small firms at 40% followed by medium firms at 35% and large firms at 25%. It also reported that 9% of the firms with government contracts were for youth, women and for persons living with disabilities under the affirmative platforms.

What Are Pending bills?

A special audit on pending bills done by the Office of this Auditor General (OAG) on the status of Pending bills in Kenya as at 30th June 2018 categorized pending bills into:

a. eligible pending bills, and

b. ineligible pending bills.

Eligible pending bills are unsettled financial obligations that occur at the end of a financial year as a result of failure to pay for goods and services that have been properly procured. Ineligible pending on the other hand are those with audit queries and lack proper documentation to support the delivery of goods and services by firms.

How Serious is The Pending Bill Problem?

In this special audit the report showed that as at that date County Governments had higher eligible pending bills at 57.5% while the National Government had only 25.8% of the total pending bills, categorized as eligible pending bills.

It is interesting to note that as at the time of that audit the ineligible pending bills were

more prevelant in the national governmentwhere 74.2% of the total value of the pending bills compared to 42.5% at the county level.

According to a 2019 World Bank report on the state of the economy in Kenya pending bills had increased from 0.9% to 1.6% in the 2017/2018 financial year. Pending Bills in counties increased by 59.38% to 153.02 billion in the 2021/2022 financial year from 96 billion in 2020/2021. According to the CoB as at December 31st, 2022 counties reported a rise in pending bills to 157.87 billion.

This implies that there is a growing buildup of pending bills in the economy over time as a result of delayed payment by the government.

According to recent media reports, the National Treasury estimates that the National Government owes businesses an accumulated figure of over Ksh 650 billion while the Controller of Budget also estimates that county governments owe suppliers and businesses about Sh159.9 billion as of June 2023. Chris Kiptoo the Principal Secretary to the National Treasury was reported in the Star newspaper of 1st February 2024 to have observed that: "The accumulated pending bills have led to reduction of profitability of enterprises by negatively impacting the value of payment due to the time variation which has led to most firms being bankrupt."

The Principal Secretary was reported to have promised that government would begin clearing pending bills in March 2024. Despite the call, a review by the Controller of Budget covering the first quarter of the current financial year revealed that no pending bills were settled.

In spite of government acknowledgement of the severity of the pending bills crisis the Business Daily newspaper of 11th June 2024 carried a story on pending bills with the headline:

"Pending Bills nightmare as State allocates zero budget."

Moreover the prevelance of ineligible pending bills should be of grave concern because it implies that firms with such bills categorized as ineligible pending bills face the risk of not being paid at all for the goods and services they delivered to the government.

Pending Bills and Corruption

The problem of rising pending bills and especially the notion of ineligible pending bills is complicated by the perception that some of the claims are fraudulent and are a result of criminal collusion between officials in the government procuring entities and corrupt individuals and business entities. The CoB has accused counties for example of manipulating approved requisitions by making fictitious or discriminatory payments. The government must move with speed to resolve the issue by separating any fraudulent claims from genuine claims so that honest businesses are paid speedily. In fact it is to be assumed that is the reason government set up a Pending Bills Verification Committee.

Pending Bills Verification

Under Gazette No. 13355 of 30th June 2023, the Cabinet Secretary, the National Treasury and Economic Planning appointed a Pending Bills Verification Committee to carry out a thorough analysis of the stock of pending bills that had accumulated from June 2006 to June 2022.

The mandates of the committee included:

a) scrutinising analysing existing National Government pending bills that have accumulated between June 2005 and June 2022 and make recommendations on the government on settlement of the same;

b) establish a clear criteria for detailed examination of and analysis of such pending bills or claims with a view to determining the genuineness of each or otherwise;

c) make recommendations to the National Treasury on the necessary actions to be taken for satisfactory disposal or settlement of identified pending bills or claims;

d) identify any cases where there may have been corrupt, fraudulent and false claims against the government and make appropriate commendations to the relevant government agencies;

e) develop reforms or measures that will ensure future accumulation of pending bills is avoided;

f) perform any other function incidental to the foregoing.

Even though the committee has not completed the assignment creditors owed by government have been anxiously waiting for the government to clear the bills that were reported to have been cleared as eligible for payment and yet there are no signs of payment because no adequate provisions were made in the 2024/2025 budget for the national government.

Why Are Pending Bills Rising?

According to the Controller of Budget (CoB) pending bills in counties are due to:

a) Delays by the National Treasury disbursing funds to spending entities on a timely basis leading to outstanding payments at the end of the financial year.

b) Diversion of the funds meant to pay the bills to other purposes

c) Underperformance of Own Source Revenue leading to Budget deficits and unfunded commitments

d) Failure by the spending entities to align their procurement plans to cash flow plans and approved budgets

e) Delays in approving Supplementary Budgets and Failure to adopt previous year's pending bills in the revised budget lead to settlement delays

f) IFMIS related challenges where the system is also frequently closed to prevent procurement.

The CoB also complained that Office of the CoB adequately oversight role to verify settlement of approved bills because they can not access county banking records.

Pending Bills Is Impunity

The existence of an increasing pending bills phenomenon at both levels of government in the country is a sign of impunity and gross financial mismanagement by those in charge of the management of public finances and affairs.

This is particularly worrisome because there is a legal framework to prevent the proliferation of pending bills.

It is an offence under section 74 of the PFMA (2012) for Accounting Officers to implement activities without approved budgets and or failing to pay for legally incurred expenditures that is responsible for the continued accumulation of pending bills.

Additionally section 53(8) of the Public Procurement and Disposal Act (PPDA) directs all accounting officers not to commence any procurement proceedings until they are satisfied that sufficient funds to meet the obligations of the resulting contract are in the approved budget estimates.

What Must Be Done

The government must urgently find ways to clear the pending claims and put in place measures to prevent further accumulation of new pending bills to enhance the survival of the private sector. It doesn't make sense that the government bends backwards to pay debts owed to foreign and local banks and financiers while completely ignoring local businesses.

To prevent further accumulation of pending bills Kenya Private Sector Alliance (KEPSA) proposed to the President that the PFM Act be amended to provide for payment of goods and services supplied to government within 30 to 60 days and to government and officers liable for the delays in payment beyond the stipulated period criminally liable. In addition an ammendment should provide for interest payable on all bills after the lapse of sixty days.

A study done by the Kenya Institute of Public Policy Research and Analysis (KIPPRA) entitled: "Pending Bills: Will the Private Sector Survive?" published on 29th July 2020 has suggested that Kenya could benefit from experience of Italy and Spain.

Faced with increases in pending bills the Italian government announced a major programme to a tune of EUR 40 billion to clear pending bills arrears within a period of two years. This programme was expanded to EUR 66 billion and by October 2014 about 49% of pending bills had been cleared. To eliminate administrative bottlenecks the Italian government also introduced electronic invoicing and the online publication of all the data in the electronic invoices to enhance transparency and accountability.

Spain on the other hand introduced syndicated guaranteed loans worth EUR 30 billion in 2012 to help regional and local governments to clear pending bills.

It has also been suggested the government should consider shifting its budgeting from the current cash basis to an accrual basis. Accrual accounting is preferable and beneficial because it prioritises payment of trade debts and arrears in all budget allocations and will therefore reduce pending bills.

When this government came to office in 2022 they promised to prioritize the resolution of pending bills to facilitate economic growth by proposing securitization of the pending bills so that the pending bills were to be transformed into securities that can be sold in the market to raise cash for payment. The government was therefore reported to be considering hiring a transactional advisor to assist with the issuance of a Sh500 billion bond aimed at lessening the burden of these bills on annual government budget allocations.

However it is said that the government opted to abandon the securitization plan because of the country's declining ability to borrow.

In spite of that challenge the government issued a three-year bond in June 2023 to pay off the Sh45.8 billion debt owed to oil marketers resulting from the discontinued fuel subsidy scheme.

Securitization would have enabled the government to access immediate capital to pay off the creditors. Such a move would relieve the crisis facing those businesses and the economy in general. It would also enhance cash flow management for suppliers by ensuring predictable income.

If government is willing and able to borrow to pay the public debt it should also find ways to clear the pending bills. Otherwise the impression is created that the government is willing to strangulate local businesses to serve foreign interests.

Picture: Courtesy

Strategies for Transformation of Kenyan Agriculture.

By Eng. Prof. Lawrence O. Gumbe

Eng. Prof. Lawrence O. Gumbe

1 Introduction

The modern world has largely been an engineering project. The structures, machines, processes and organisation, which have led to increased affluence, increased life expectancy, comfort and enlightenment are all largely due to engineering efforts.

Kenya's Vision 2030, which aims to transform the country into a newly industrialised, middle- income country economy, providing high quality of life to all its citizens by the year 2030, is largely an engineering project. This vision recognises agriculture as a key sector.

1.1 Engineering in Agriculture

Engineering inputs in agriculture are effected through agricultural mechanisation. Agricultural mechanisation aims at increasing the power inputs to farming activities hence intensified production and enhanced value addition resulting to decreased cost of production and reduction of drudgery in farming activities.

The different sources of agricultural power available include human, animal, mechanical, electrical, and renewable energy. Use of farm machinery and equipment is determined by the production systems which include farm size and availability of power. For successful agricultural mechanization planning and implementation, a holistic approach should be used to encompass private sector involvement, economic profitability and creation of an enabling environment.

1.2 Industrialisation

Industrialisation is the process by which a country builds its capacity to process raw materials for consumption or further production[1]. Involves the mechanization of manufacturing and an increase in the importance of manufacturing in the overall economy. Typically, it occurs in economies previously dominated by agriculture and usually involves important changes in food production as well[2].

Industrialisation offer us a unique scope for learning, improvement and transformation especially in science, technology and innovation. Historically, countries have travelled different routes to industrialise. However, it is instructive to note that research and innovation has been a key feature especially in newly industrialising countries which have had to adopt catch-up strategies.

1.3 Agricultural Mechanisation in the World.

According to Hans Binswanger[3], between the 16th century and the mid-19th century, the now developed country like Great Britain saw a massive increase in agricultural productivity and net output. New agricultural practices like enclosure, mechanization, four-field crop rotation and selective breeding enabled an unprecedented population growth, freeing up a significant percentage of the workforce, and thereby helped drive the Industrial Revolution.

Picture: Courtesy

1 Michael P. Todaro (1989): Economic development in the Third World. London; 4th Edition. New York: Longman

2 John Hinshaw and Peter N. Stearns (2013): Industrialization in the Modern World

3 Hans Binswanger, (1986): Agricultural Mechanization: A Comparative Historical Perspective. *The World Bank Research Observer*. Vol. 1, No. 1 (Jan., 1986), pp. 27-56

In 1900 farmers represented 38 percent of the U.S. labour force. By the end of the century that number had plunged to 3 percent- dramatic evidence of the revolution in agriculture brought about by mechanization. Beginning with the internal combustion engine and moving on to rubber tires that kept machinery from sinking in muddy soil, mechanization also improved the farm implements designed for planting, harvesting, and reaping. The advent of the combine, for example, introduced an economically efficient way to harvest and separate grain.

As the century closed, "precision agriculture" became the practice, combining the farmer's down-to-earth know-how with space-based technology. **1902,** First U.S. factory for tractors driven by an internal combustion engine. **1966**, Electronic monitoring devices allowed farmers to plant crops more efficiently. Attached to mechanical planters and air seeders, the devices monitor the number and spacing of seeds being planted. The devices monitor the planting of up to 96 rows at a time. During the **1990s**, similar devices are used at harvest time for yield mapping, or measuring and displaying the quality and quantity of a harvest as the combine moves through the field. **1994**, Farmers begin using Global Positioning System (GPS) receivers. Ushering in the new "precision agriculture," farmers begin using Global Positioning System (GPS) receivers to record precise locations on their farms to determine which areas need particular quantities of water, fertilizer, and pesticides. The information can be stored on a card and transferred to a home computer. Farmers can now combine such data with yield information, weather forecasts, and soil analysis to create spreadsheets. These tools enable even greater efficiency in food production.

In the 21th century, agricultural mechanisation is changing, Precision agriculture to ensure efficiency of inputs such as water and fertilizer application, and to maximize productivity, quality, and yield, tractor performance, soil type and soil tests and other equipment's by use of satellite imagery, GIS tool and GPS devices, use of Internet of Things (IoT), driverless tractor

African countries have an economy strongly dominated by the agriculture sector. Agriculture generates up to 50 percent of gross domestic product (GDP), contributing more than 80 percent of trade in value and more than 50 percent of raw materials to industries. It provides employment for the majority of Africa's people[4]. In Kenya, agriculture contributes approximately 26 percent of the Gross Domestic Product (GDP), 60 percent of the export earnings and employs 75 percent of the national labour force[5]. Given its importance, the performance of the sector therefore directly impacts on the whole economy. Despite this domination and the fact that agriculture is backed with good policy documents and statements, investment in the sector is still grossly underdeveloped in most African countries.

2.0 Agricultural Production Systems in Kenya

Agricultural production consists of crops, livestock and fisheries systems. These require mechanization to increase productivity and tap the enormous existing potential.

2.1 Crop Production Systems

Crop production systems consist of small, medium and large-scale farms averaging 0.2 to 5, 5 to 100 and over 100 hectares, respectively. Small-scale farmers are predominant in the high and medium rainfall areas that produce over 75 percent of agricultural production. Use of machinery on small-scale systems is very low in relation to the medium and large-scale agricultural production systems.

2.2 Livestock Production Systems

Most of the livestock is raised in extensive systems with communal grazing and free ranging of rain-fed rangelands. Intensive production is practiced in the high rainfall areas, semi-intensive systems are found in semi-arid lands and extensively in arid areas. Use of mechanized livestock production systems is very low. However, potential for mechanization is high to meet the growing demand for livestock and livestock products.

2.3 Fisheries Production Systems

Fisheries production systems include capture which takes place in the marine waters, inland waters and aquaculture which can be land based in ponds or water based in cages. Production systems in capture fisheries are categorized into artisanal fishing and semi-industrial fishing. Aquaculture systems are categorized as semi-intensive, intensive and extensive depending on the inputs and production system. However, adoption of mechanized production system is low.

3.0 Agriculture and Employment

It is often argued that as agriculture employs the vast majority of our labour force, it is therefore our most significant economic sector. Implicit in this statement is that this state of the affairs has to be maintained, at least for the foreseeable future. What is the validity of this argument?

As stated above, the primary objective of agriculture is to provide food and other raw materials. This process must obviously be carried out in the' most efficient and cost- effective manner. Employment is created in this sector because we require human labour intervention in the production process. Mechanisation leads to more labour and process efficiency, resulting in better energy utilization and lower production costs. In an industrializing economy, labour requirements are reduced in various industries as production systems are progressively mechanised. The workers displaced in such industries are absorbed in other industries where they are required. In fact, the lowest unemployment rates are in the most industrialized countries which have the highest levels of agricultural mechanisation[6].

Mechanising our agriculture will displace some labour from the sector. This is actually desirable in a modem industrialising economy. In such an economy, labour is required in many other areas.

4 Food and Agriculture Organization of the United Nations (2008): *Agricultural mechanization in Africa*. Planning investment for enhanced agricultural productivity Report. Rome

5 Republic of Kenya, Ministry (2017): *Agricultural Mechanization Policy.* Ministry of Agriculture, Livestock and Fisheries

6 Mrema, G.C, D. Baker and D. Kahan (2008). *Agricultural Mechanisation in Sub- Saharan Africa*: Time for a new look. FAO Rome

4.0 Challenges in Agricultural Mechanisation

The challenges facing agricultural mechanisation in Kenya include: Inadequate machinery, Inadequate staff; plant operators and mechanics, Inadequate mechanization extension, Inadequate access to mechanization technologies, Lack of adequate credit and finance to farmers and private contractors, Inadequate after sales and service back-up, Decreasing land sizes, Enterprises that does not support mechanization business model, Vast area of coverage for the Government mechanization stations, In adequate resources/ funding for stations, Gender and youth imbalance in agriculture, Aged farming citizens among others.

5.0 The Way Forward

The basic approach to economic development trough agriculture that we should take should be that of a nation based on modem industry. That is: We should industrialise.

1. **Reform and transform agricultural mechanization**. This is the only way that we can expand the production of food and capital equipment to satisfy the basic needs of our people. Industries using modem large scale methods have to be supplemented by small industries which may be particularly suited for better utilization of local resources, and for achievement of local self-sufficiency in respect of certain types of essential consumer goods like food, cloth and agricultural implements.

   For the small-scale industries to survive and thrive, they have to be supplied with a number of factors including: Cheap raw materials; cheap, efficient and reliable power; technical advice; organized marketing of produce; and where necessary, safeguards against intensive competition from imports.

2. The perverse position that, in modem times, that we must permanently run an economy in which a significant sector is engaged in agricultural production using rudimentary hand tools, animal powered technologies and manual machines such as oil presses should be opposed.

3. Agriculture, really, like all production processes, is a thermodynamic process. There must be a minimum energy input into the system to achieve meaningful production.

4. **Investments in Agricultural Mechanization**.

   For us to industrialize and mechanise our agriculture, we need to have meaningful investment in science and technology research and consultancy. This should include the nurturing of a patriotic community of researchers and consultants in agriculture, engineering and other related areas of science and technology.

   The funding of research should be carried out primarily by our government. Most foreign research funders actually know what results they want. They just want their positions reinforced by local researchers. Our researchers must be paid meaningful salaries; they cannot be expected to do any useful work if they are constantly hustling to keep alive. Worse still, the low pay entices them into the hands of foreign agencies; they become consultants for these agencies locally or they leave the country altogether to affect the same.

6.0 Conclusion

Industrialization and agricultural mechanisation will only be possible through enlightened political leadership. The government must reconcile apparently opposing sides in: production and consumption; agriculture and industry; heavy and light industry; and large scale and small scale agriculture[7] [8] [9]

The government should involve our local experts in clearly defining our industrialization and agricultural mechanisation objectives. Correctly defined strategic programmes should be implemented by competent professionals who are deft at tactical management.

Where necessary, the private sector should be motivated and nurtured to provide a useful input in our agricultural mechanisation efforts. However, the government bears the ultimate responsibility for economic development.

For economic development, and to ensure our very survival we must industrialize our economy and mechanise our agriculture using modern methods. There is no other way.


Picture: Courtesy

7 Gumbe, L. (1996): *Agricultural Mechanisation for Development*. Chairman's speech. Eight International Conference. Kenya Society of Agricultural Engineers. 4 September, 1996 Milimani Hotel. Nairobi

8 G.C. Mrema, L.O.Gumbe, H.J. Chepete and J.O.Agullo. (2011): *Rural Structures in the Tropics*. Engineering Design and Development. FAO. Rome. Italy. ISBN 978-92-5-107047-5

9 McRota, HJ. And L.O. Gumbe (2000): *Mechanisation of Small-Scale Farms*: A Partial Solution to Poverty and Food Security in Kenya

The Role of Kenyan Engineers In Infrastructure Development

Challenges, Achievements and Future Prospects

By. Eng. Jane Mutulili, CE

Eng. Jane Mutulili, CE
Chairperson, ACEK

Overview of the current state of infrastructure development in Kenya and the role of Kenyan Engineers

The recent floods have caused extensive damage to various infrastructure, bringing to light the urgent need for reconstruction and rehabilitation. Before the floods, the infrastructure might not have been optimal, but the recent situation demands immediate action to restore usability. For instance, the bridge towards Garissa was completely destroyed by the floods, underscoring the vulnerability of infrastructure to natural calamities. During drought, many water infrastructure projects, like water pans and wells, are also rendered unusable as they dry up.

Engineers are actively involved in various sectors including water, roads, and power, working towards assessing and restoring infrastructure.

The Association of Consulting Engineers of Kenya (ACEK) has proposed collaborating with relevant authorities to assess the state of infrastructure and to offer immediate interventions to restore usability. Moving on, ACEK is proposing designs and construction of climate-resilient infrastructure so that the vagaries of the weather do not render total shut down. This involves using previous data to monitor which structures are still functional and which need urgent repairs.

Significant infrastructure projects led by Kenyan Engineers in the last decade

Significance of infrastructure project can be very relative. What may look very significant to a driver in Nairobi may have little value to a farmer in Kieni whereas the access road from Pura to Endarasha in Kieni, which has little value to many people may be the most important infrastructure for the users there. REREC, mandated to power remote areas in Kenya has done significant works in supplying power to many rural area, especially renewable energy while KeRRA and county governments have connected many rural areas with roads. Water supply projects, though not significantly expensive, and have made major impacts in the social fabrics especially on women and children.

Having said that, some of the nationally significant infrastructure projects in the recent years, some complete and some ongoing include:-

- The Standard Gauge Railway (SGR) which is a major railway project in improving transportation and logistics across the country.
- Dongo Kundu Bypass: This project enhances connectivity and reduces congestion in the coastal region.
- Nairobi Expressway: This has actively facilitated smoother traffic flow in Nairobi, reducing travel time significantly and the amount spent fuel.
- LAPSSET Corridor: A multi-faceted project aimed at enhancing regional integration and economic growth, still on going
- Northern Corridor: This has improved trade routes and accessibility to neighboring countries.
- Kenol-Makutano Road: Is enhancing local and regional connectivity, boosting economic activities.
- Access roads are also vital for connecting remote areas to major infrastructure as they improve accessibility.
- Thwake Dam: 2nd largest after Masinga Dam, will provide water supply for domestic, livestock, irrigation, hydropower and even industrial activities in the Kitui, Makueni and Embu Counties.
- Karemenu Dam: The dam serves Gatundu, Ruiru, Juja, Tatu City, Githurai and parts of Nairobi.
- Kimuka sub-station – which will play a crucial role in strengthening the existing power distribution network and positively impact over 600,000 people

Ensuring Continuous Professional Development for ACEK members

i. The upcoming 3rd annual conference will focus on *"Engineering and Engineered Materials and Equipment."* It serves as a platform for showcasing new technologies and encouraging innovation.

"We have traditional equipment and materials used and also have the ones engineered to suit the

current technology. We have one of our exhibitors for the upcoming conference who is going to give us an alternative to steel, which has been used since time immemorial. Others exhibitors are coming to show case recent innovations and improvements to traditional materials which will make infrastructure projects cheaper and more resilient. This is a platform for engineers and other stakeholders to showcase new technologies and encourage innovation in the industry," says Eng. Mutulili.

ii. FIDIC Trainings offers training on project management to help engineers address various project-related issues.

iii. Regular webinars, including topics like Public-Private Partnerships, provide ongoing education and discussion forums for Engineers.

iv. Specific Training, eg. Ongoing Infrastructure Management Training: ACEK recently had a training session focused on effective infrastructure management practices.

v. Bespoke Training: ACEK holds customized training programs offering exposure to international expertise. Encourages members to participate in professional training with EBK and IEK for comprehensive development.

vi. Hands-on learning experiences for engineers through visits to industrial sites provides a bridge between theoretical knowledge and practical application.

vii. Software trainings led by the Future Leaders ACEK members: These trainings aim to equip young engineers with the latest software tools and technologies used in the engineering field. This aids in technical skills enhancement and ensuring engineers are up-to-date with industry standards.

The evolving role of Kenyan Engineers in the next decade

According Chairperson ACEK, Kenya needs to be accountable for it's resource management. There is too much misuse, pilferage and generally waste of resources, which are not adequate in the first instance

She says, "It is until this is curbed, or at least reduced significantly, that we shall make greater steps on matters infrastructural development. With this, so much can be achieved with the same resources, even without too much adjustment of the current budget for infrastructural development.

We also need to cut down on costs for materials and equipment by finding alternatives that are less costly but with the same effectiveness in engineering works. This can easily be achieved by increasing manufacturing and industry, but the government has to give incentives for the same. We applaud the government on the thoughts of industrial parks within the counties and if these are realized, then we shall devolve many services, create jobs within the counties and generally improve livelihoods.

In the next decade, I honestly envision devolved development. There is absolutely no remote area that will be left behind. I also see more engineers deployed in the counties as opposed to the current state where a majority of the Consulting Engineers are based in Nairobi."

Message of the Chairperson, ACEK, to Young Engineers aspiring to take up leadership roles

First of all is to commend the young people for not only acknowledging when things are going wrong, but deciding to take actions on the same. They have seen better and believe things can be better. They have called everyone to attention to incompetence, corruption, accountability, irresponsible citizenry and all vices that afflict our nation. Sometimes when things have been done so continuously, they seem to be the norm, and therefore I thank them for realizing and telling us that that cannot be the normal! Specifically to our young engineers:-

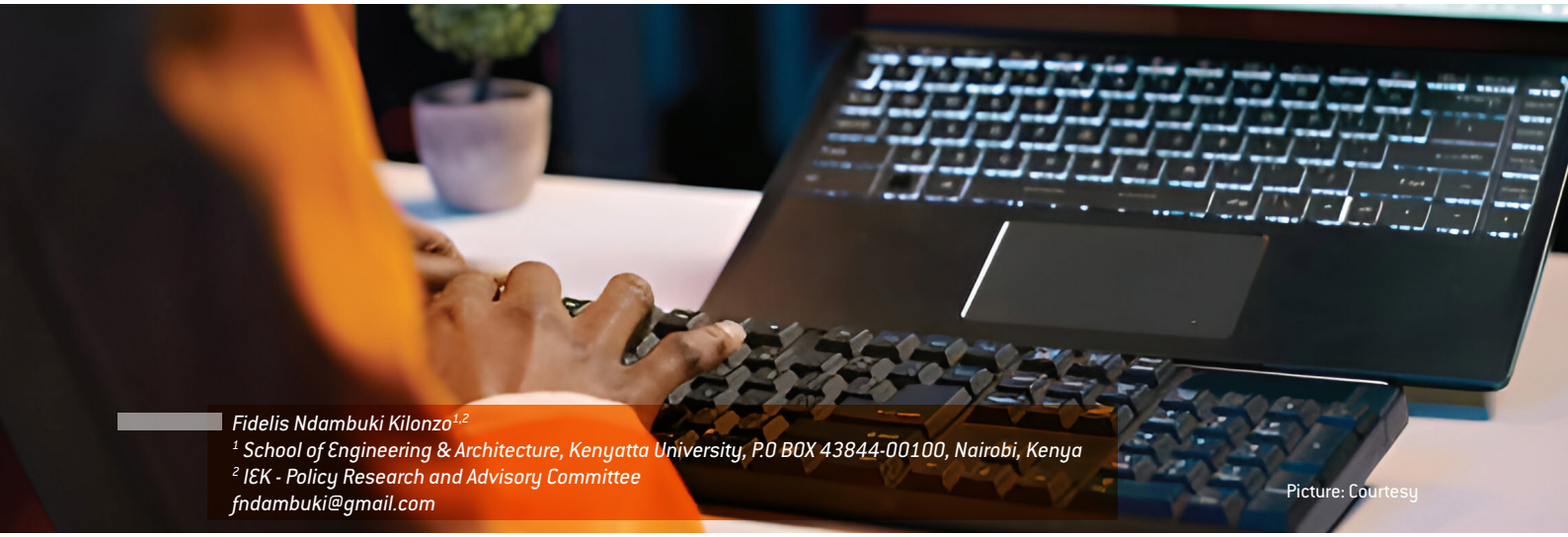
- Have a good grip of Your Area of Specialization: Leadership entails significant responsibilities and requires a deep understanding of one's area of specialization to build competence and credibility and effectiveness in leadership. It also gives you confidence in engagements
- Do not be driven by popularity and stand by the truth. This reflects on the importance of making decisions based on solid data, research, and thorough analysis rather than on what is popular. Also, maintain integrity and ethical standards in all professional activities for long-term benefits.
- Registration in professional bodies and active participation: It is important to register with professional bodies like EBK, ACEK and IEK to gain formal recognition and credibility in the engineering community.
- Senior Engineers do not gatekeep: ACEK advocates for an inclusive and supportive environment, ensuring that all engineers have equal opportunities to contribute and grow. There are not enough engineers to undertake all the works that need to be done in this country and therefore the more registered engineers the better for the professional and for the country

Parting shot

- Eng. Mutulili encourages more engineers, especially women, to pursue consulting roles to bridge the existing gender gap in the engineering field.


Picture: Courtesy

The Triple Blessings of Competency Based Education, Washighton Accord and Artificial Intelligence in Engineering Education in Kenya.



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Picture: Courtesy

1 Introduction

The Kenyan education system is undergoing a paradigm shift from "learner- taught to learner assisted". Whereas the 8.4.4 system introduced in 1985 is a teacher-centered system that focuses on academic achievement, the Competency based education CBE is a learner-centered system that focuses on developing competencies. Though implementation of the CBE started in 2017, the transition from middle school (grade 6) to junior secondary (grade 7) has been marred by chaos, indecision and infrastructural and logistic challenges subjecting learners to anxiety and frustrations while leaving many learners in rural and poor families grossly disadvantaged and disenfranchised. The preparations for transition from junior to senior secondary are lackluster with nothing existing for the receiving of the learners for tertiary education. The Kenyan Government through the Kenya Institute of Curriculum development has developed the framework for the CBE for basic education with clear progression from Early Years Education to Senior School at Grade 12 (KICD, 2017). The idea is to develop a framework for engineering education from scratch using beacons provided for in the guidelines from the accreditation and professional regulators, since the framework for university tertiary education is unavailable and unclear, despite the expected onboarding of Learners under the new system to join university in 2029.

In the rapidly expanding landscape of higher education in Kenya, the engineering education sector faces multifaceted challenges that hinder its ability to produce a diverse and competent workforce. Despite a proliferation of colleges and campuses, there persists a concerning apathy towards STEM fields, particularly among female students, exacerbated by gender biases, stereotypes, and social prejudices (Mbirianjau, 2018). This has created a 'leaky pipeline' effect (Bickerstaff, 2006) resulting in a significant loss of potential engineers. Furthermore, the sector grapples with the lack of pre-study industry exposure for would be engineering students, limited practical learning opportunities due to overwhelming student numbers, and an absence of essential soft skills development, such as teamwork and effective communication, largely attributed to the transition to blended/online learning modalities. Additionally, the inadequate support structures for internships and the absence of robust academia-industry partnerships compound the challenges faced by engineering education in Kenya.

This complex set of issues demands immediate attention and comprehensive solutions to ensure the development of a competent and inclusive engineering workforce that can meet the nation's growing demands. Fortunately, three unrelated but mutually beneficial and inevitable happening are going to enormously favor the engineering fraternity in Kenya if well harnessed and utilized. The mainstream use of Artificial Intelligence in day to day life catalyzed by the use of large language models in 2003, the acceding to the Washington accord, 2005, and the transition to the competency based education in 2009. Firstly, the use of AI as a brainstorming partner in curriculum development where there is no existing local benchmark is a creative and unconventional approach to the development of engineering education framework in Kenya that will meet international engineering education standards. Secondly, with reinforcement training using the 5-year engineering curriculum the system would be expected to generate a model/template engineering curriculum that adequately meets the competencies expected by the professional standards as guided by the Washington Accord of the international engineering alliance. Finally, the basic education curriculum for the CBE has a clearly defined Science, Technology, Engineering and Mathematics (STEM) pathway that underscore the competence in readiness for the University Engineering programme.

2 Settings

The study looked at the education landscape in Kenya in as far as engineering is concerned. It explored through a purposive literature review methodology the main challenges facing the engineering education sector, the root causes for these challenges. With the advent of the Competency-Based Education and Outcome-Based Education, the study looks major aspects the two approaches as will be shaped by leveraging on the mainstream use of AI. There are 12 public and one private universities in the country with a faculty of engineering. In total there are 148 engineering programmes offered in Kenya. All Engineering Schools in Kenya without exceptions are faced with two big challenges, namely Lack of qualified motivated staff and poor teaching facilities. The study will evaluate the possibility of using AI to scale the engineering education workspace by empowering learners and making faculty more engaged by bringing new insights to the lecture hall. The study will also determine the idea of leveraging on AI to be used to augment physical laboratory with Virtual (reality) laboratories and workshops to support the new curriculum that will be developed under CBE/OBE.

3 Results

The democratization of education, the advent of knowledge economy, and the introduction free compulsory basic education (Muema 2020) lead to the high enrollment for University leading to the massification (Mohammedhai, 2008) of University education. This mass demand for higher education led to the conversion of tertiary and technical institutions to Universities, and the mushrooming of campuses all-over the country. According to Irungu and Kamencu 2016, the demand for higher education opened up opportunities for individuals, organizations, and other investors to open up colleges and universities to meet the demand and fill the gap that public institutions have been unable to meet. As a result of these expansions, facilities were limited or nonexistent, and teaching staff was spread thinly leading to deterioration in the quality of education. According to Muema and Lavery, 2018, the consequences of massification caused Juakalization in higher education. They defined Juakalization as "the dilution and conversion of high quality university education to assume an artisan nature of mass production of low quality and unstandardized educational products".

Despite and inspite of this momentous growth in the higher education enrollment, the percentage of women in the Science, Technology, Engineering and Mathematics (STEM) pathway has remained low. This is despite the gains in high number girls of exiting the secondary school level and the relatively good performance of girls in the university entrance examination (KCSE). Table 1 shows the percentage of the top 15 Overall students as announced by the Ministry of education for the different years from 2016-2021.

Table 1: Percentage by gender of 15 top overall KCSE students in different years

	Year					
Gender	**2016***	**2017**	**2018**	**2019****	**2020**	**2021**
Male, %	20	33	73	50	60	67
Female,%	80	67	27	50	40	33
	*	top 20 overall				
	**	top 10 overall				

The number of female students qualifying for University education is comparable or even outnumber those of male students as shown in table 2 below for 2016.

Table 2: University qualifying examination- 2016

Overall National University qualifying grade -2016								
Gender	A	A-	B+	B	B-	C+	Total	%
Female	58	2685	6581	10204	13649	17238	50415	57
Male	83	1960	4394	7012	10096	14969	38514	43
						Total	88929	100

The specific implementation of OBE or CBE may vary based on regional policies, educational philosophies, and industry demands. The key comparative difference between OBE and CBE are summarized in table 3 below.

Table 3: Comparison of the two student-centric education systems due to launch in Kenya in 2025 and 2029

Aspect	Competency-Based Education (CBE)	Outcome-Based Education (OBE)
Focus	Emphasis on specific skills and competencies.	Emphasis on desired learning outcomes and skills.
Goal	Demonstration of mastery in specific areas.	Achievement of defined learning objectives.
Learning Approach	Student-centered, focused on learner progress.	Student-centered, focused on meeting outcomes.
Assessment	Continuous assessment of individual competencies.	Assessment based on achievement of outcomes.
Industry Alignment	Aligns with industry demands for specific skills.	Ensures graduates meet industry requirements.
Student Engagement	Promotes active engagement and self-directed learning.	Encourages active participation in achieving outcomes.
Emphasis on Knowledge	Balances knowledge, skills, and application.	Prioritizes application of knowledge in practice.
Evaluation of Learning	Based on demonstrated mastery of specific skills.	Based on achievement of predetermined outcomes.

4 Discussions

Both Competency-Based Education and Outcome-Based Education have their own strengths and may be implemented in various ways across different educational institutions and programs. The development of the specification of consensus graduate attribute competency profiles for the accords (Washington Accord, Dublin Accord and Sydney Accord) in 2001 brought about a paradigm shift in the pedagogy of engineering educations (Qadir et al., 2020), from teacher-centric to learner-centric learning (ie content-centered to outcome-centered). The Outcome Based Engineering Education (OBEE) is an approach

to education in which decisions about the Curriculum are driven by the outcomes the students should display by the end of the course rather than on the educational process (Deepak and Venishri, 2018). OBEE involves the formulation of the program educational objectives, the program outcomes and the course outcomes that are steered to ensure the professional knowledge, skills, abilities, values and attitudes of the learners and graduates reflect the professional expectations of the Industry who are key partners and stakeholders in the project (Sawant, 2017). The Washington Accord sits under the IEA alongside the Sydney and Dublin Accords. Quality engineers are developed with an accord-recognized degree or equivalent, through experience after graduation to develop both professional and personal maturity, and by meeting an agreed competence typically measured by evaluation against 13 elements (Graduate Attributes). As per IEA, 2023 records, there are 23 signatories with full rights of participation in the accord ie the Qualifications accredited or recognized by other signatories are recognized by each signatory as being substantially equivalent to accredited or recognized qualifications within its own jurisdiction. Further there are 7 provisional signatories who are recognized as having appropriate systems and processes in place to develop towards becoming a full signatory.

According to Rao, 2013, the benefits of OBE include; help faculty members take a more holistic view of the student's educational experiences, select course content and decide on how much time to allocate to each topic, create relevant assignments to make the students practice their learnings in the class; and design relevant tests to assess their learnings. Further, when students have a clear understanding of what is expected of them, it may help them to prepare themselves better and meet the expectations help assess learning and teaching methods and establish feedback mechanisms. The use of Artificial intelligence (AI) has the potential to revolutionize education by empowering learners in many ways. Some of these ways include; AI can be used to tailor instruction to the individual needs of each learner, identifying their strengths and weaknesses and providing them with the most relevant content and activities. This can help learners to learn more effectively and efficiently. AI can be used to adapt the difficulty of the content and activities to the learner's progress, ensuring that they are challenged but not overwhelmed. This can help learners to stay motivated and engaged in their learning. AI can be used to add a game-like element to learning, making it more fun and engaging for learners. This can help learners to stay motivated and focused on their learning goals. AI can be used to create VR and AR experiences that allow learners to interact with the content in a more immersive and engaging way. This can help learners to better understand and remember the content.And finally, AI can be used to create chatbots that can answer learners' questions and provide them with support. This can help learners to get the help they need when they need it, without having to wait for a human instructor.

Likewise, there are many ways that AI can be leveraged to enhance faculty engagement including: AI-powered systems can analyze individual student data and suggest personalized learning paths, allowing faculty to tailor their teaching methods to better suit each student's needs. AI can handle administrative tasks like grading, scheduling, and managing course materials. This frees up faculty members to focus on teaching and interacting with students. AI can provide faculty with detailed insights into student performance, highlighting areas of strength and weakness. This allows instructors to adjust their teaching strategies accordingly. AI algorithms can recommend supplementary materials, resources, or activities that align with the curriculum, enriching the learning experience. AI-enabled tools can provide instant feedback on assignments and assessments, allowing faculty to address misconceptions or areas needing improvement promptly. AI-powered discussion platforms can help facilitate online discussions by suggesting relevant questions or topics based on the course content and student interactions. AI can create adaptive assessments that adjust the difficulty level based on the student's performance. This ensures that students are appropriately challenged and engaged. AI-powered chatbots or virtual assistants can answer common student queries, offer resources, and provide support, allowing faculty to focus on more complex interactions. AI systems can analyze student sentiment and engagement levels based on their interactions with digital content. This information can be used to adapt teaching strategies. AI can assist in creating accessible content for students with disabilities, ensuring that all students have equal access to the material.

5 Conclusions

The amalgamation of Competency-Based Education (CBE) and Outcome-Based Education (OBE), coupled with harnessing the vast potential of Artificial Intelligence (AI), holds immense promise for engineering education in Kenya. The fusion of these approaches stands to revolutionize the learning landscape, equipping students with practical skills and knowledge that align seamlessly with industry requirements. However, to bring this vision to fruition, a critical need arises for open and candid dialogues between the realms of academia and industry. This mutual exchange of insights and perspectives will be instrumental in shaping curricula that are not only dynamic but also responsive to the evolving demands of the engineering sector.

Furthermore, realizing the full potential of this transformation requires concerted efforts. Collaborative endeavors between educational institutions and industry stakeholders are paramount. By pooling resources, expertise, and experiences, these partnerships can collectively address the challenges that currently hinder the realization of this vision. Additionally, investing in robust research and development initiatives is imperative. This investment will pave the way for innovations in pedagogy, instructional technology, and AI applications, ensuring that engineering education remains at the forefront of global advancements.

In essence, the journey towards a more dynamic and industry-relevant engineering education system in Kenya is contingent on the commitment and concerted actions of all stakeholders. Through dialogue, collaboration, and strategic investments, we can unlock the full potential of CBE, OBE, and AI, ushering in a new era of excellence in engineering education.

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PICTORIAL

Inspiring Future Engineers: The IEK President, Eng. Shammah Kiteme, and Future Leaders Committee Chair, Eng. Annette Ingaiza Murambi, inspired and mentored students at Riara Girls' High School during Career Day, encouraging them to pursue exciting careers in engineer-ing.

PICTORIAL

International Women in Engineering Day Celebration, Event held on 21st , June ,2024 :venue Golden Tulip, Westlands Nairobi












Alternative Dispute Resolution (ADR) Mechanism for Engineering Contracts, opportunities and challenges for Engineers.

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Introduction

Alternative Dispute Resolution was conceived of as a dispute resolution mechanism outside the court of law established[1] by the Sovereign or the State. ADR is described as a process or mechanisms that parties can use to resolve disputes rather than bringing a claim through the formal court structure.[2] The biggest stepping stone in the field of international ADR is the adoption of UNCITRAL (United Nations Commission on International Trade Law) model law on international commercial arbitration. An important feature of the said model is that it has harmonised the concept of arbitration and conciliation in order to designate it for universal application. Many international treaties and conventions have been enacted for establishing ADR worldwide. Some of the important international conventions on arbitration[3] are:

- The Geneva Protocol on Arbitration clauses of 1923.
- The Geneva Convention on the execution of foreign award, 1927.
- The New York Convention of 1958 on the recognition and enforcement of foreign arbitral award.

In Kenya, The Constitution of Kenya, 2010, in Article 159 (2) provides that:

2) In exercising judicial authority, the courts and tribunals shall be guided by the following principles—

(a) justice shall be done to all, irrespective of status;

(b) justice shall not be delayed;

(c) alternative forms of dispute resolution including reconciliation, mediation, arbitration and traditional dispute resolution mechanisms shall be promoted, subject to clause (3);

Since the enactment of the constitution of Kenya 2010, there have been a shift in the judicial system and the courts including Tribunal has been mandated to promote other forms of alternative mechanisms to resolve dispute including reconciliation, mediation, arbitration and traditional dispute resolution mechanism.[4] As a result ADR has slowly been embraced by the courts which however, though this has not gone without some obstacles despite being a step in the right direction making the access to justice very convenient by the general public.[5]

"The new landscape will have the following features: Litigation will be avoided wherever possible. (a) People will be encouraged to start court proceedings to resolve disputes only as a last resort, and after using other more appropriate means when these are available. (b) Information on sources of alternative dispute resolution will be provided at all civil courts" **Lord Woolf 1995.**

Globally, construction industry is one of the major parameters for economic and industrial growth for any country,[6] and Kenya is not an exception. Construction projects are multi-disciplinary engagements with so many parties playing different role, with varying level of experience, diverse educational background, culture with competing interest that at time makes it a dispute prone industry.[7] The advancement in technology in terms of the artificial intelligence, internet of things in the industry has made the situation more complex. Not surprisingly, the number of reported disputes, conflicts and construction claims globally has been in the increase in the recent past.[8] Construction contract give rise to very unusual difficult and complex disputes that prove very hard to evaluate compared to normal litigation process. The performance of many construction contracts run over much longer periods than most other forms of commercial contract, with potential scope for disagreement and financial disagreement arising constantly during the construction period, and with large sums of money and cash flow pressures concerned on both sides. There is plenty chances of disputes or difference of opinion from the very inception of entering into the contract and commencing the work because consistently both the parties have to meet with reciprocal obligations on either side one after the other and a single case of default is

1 Fiadjoe, A. (1999) p. 200
2 Rao, P.C et al (2011)
3 Sinha, S.N.P and Mishra, Dr. P.N, 2004
4 Constitution of Kenya 2010, Article 159 (2) (c), Government Printer, Nairobi
5 K. Muigua, "Settling Disputes Through Arbitration in Kenya," 4th Edition March, 2022, pp 3- 8
6 Sakate, P., & Dhawale, A. W. (2017). Analysis of Claims and Dispute in Construction Industry. International Journal of Engineering Sciences & Research Technology, 6(5), 523-535. doi:10.5281/zenodo.400838
7 10.1061/(ASCE)LA.1943-4170.0000111. © 2013 American Society of Civil 12 Engineers.
8 Makarem et al. 2012.

satisfactory to upset the balancing pendulum[9] and the whole development, programming enhances targeted schedule of completion of work.

This paper.

The dynamic and the high level of sensitivity of the parameters in the industry therefore necessitated an adequate research before drafting of the contracts are done. Parameters such as cost and time are always major resources in a project and any external or internal exigencies that are likely to affect the environment in which these two operates in cannot be taken lightly. This piece gives a wide approach to the built environment practitioners information on potential disputes areas in the industry and further information on how, should be dispute arise it can be resolved. The paper exploits the importance of proper drafting of the dispute clause and it gives the appropriate dispute resolution mechanism for the construction claims. It concludes by analyzing the opportunities and challenges faced by the Engineers and if the Arbitral institution, in the country are well placed to assist the built environment practitioners to handle the problems associated with the disputes in the industry.

Causes of disputes in projects.

When two or more parties failed to have a meeting of mind or each maintain a hard stand of opinion about certainty of a question then dispute is said to have occurred. [10] Construction contracts are contracts made between the project owner (the Employer) and the construction enterprise (the contractor). It defines the order and the procedure to accomplish specific task or installation and further defines the rights and obligation of both parties.[11] The parties themselves are not competitors and in most cases may not have any competing interest but are associates, with different functions to accomplish a certain function. Most of the disputes arises during the occurrence of the contract but unfortunately, they are usually unforeseen at the time the parties are entering into contract. Most of the contractual problems arise from lacunae in and misinterpretation of the clauses pertaining to the following:

i. *Changes in Contract work,*
ii. *Differing in unusual site conditions actually encountered*
iii. *Suspension of Work*
iv. *Variation in quantities*
v. *Damage due to natural disasters and force-majeure*
vi. *Re-inspection and acceptance*
vii. *Termination for the convenience of the client*
viii. *Possession prior to completion*
ix. *Escalation of price due to inflation*
x. *Acceleration of work progress*
xi. *Ripple effect*
xii. *Currency fluctuation effect*
xiii. *Ambiguity and errors in contract documents, specifications and drawings*

If these conflicts are not clearly managed, Claims are made by contractor and further if claims did not get clearly resolved disputes arises.

ADR mechanism in Engineering Contracts

For the parties to effectively deal with or control claims and disputes, the concern parties must establish a good claim management procedure within the institution.[12] Given the uncertainty and ambiguity surrounding the construction projects and the financial obligations involved it is only fair and have any disagreement between the parties being resolved promptly. Should dispute arise, a part from the normal legal processes, alternative dispute resolutions mechanisms are available in construction contracts. Such mechanisms include negotiations, mediation/conciliations, adjudication, mini-trial and Arbitration.

Many parties to contract shall prefer ADR mechanism over litigation because of the advantages it presents to their commercial engagement. The reasons why people may ought for alternative mechanism include but not limited to; greater satisfaction of the outcome of the process, flexibility and confidentiality of the settlement processes and procedure. Low cost since the party are not necessary to be represented by a legal expert[13] that are likely to increase the cost. The speed at which disputants are able to resolve their differences are higher than the time taken in litigation. The proponents of ADR argue that processes such as mediation can maintain existing business relationships as the parties are aided towards a settlement.

Negotiation

This is a process of working out the difference by direct communication. The process is voluntary and non-binding. It can either be bilateral or multilateral especially being that in most case construction matters involved a number of parties performing different roles to accomplish the project. The use of external form can only be recommended if necessary but then the process shall be termed as supported negotiation. The discussions are usually held in a cordial and a peaceful environment. The process aimed at a win-win situation and it is at this stage that the parties brings out the main issues in contention and agree to agree or to disagree[14].

9 Rauzana A., (2016)
10 Karape. A. M. and Joshi A. M. "Dispute Resolution in Construction Industry" IJSTE - International Journal of Science Technology & Engineering | Volume 5 | Issue 6 | December 2018.
11 Mohd et al 2012.
12 Supra note 6
13 Sec 25(5) Arbitration Act No 4, 1995
14 K. Muigua, "Settling Disputes Through Arbitration in Kenya," 4th Edition 2022, p 20-21

Mediation and conciliation

This is like a continuation of the negotiation, being assisted by a third party.[15] These are essentially informal processes whereby the parties are assisted by one or more neutrals in their efforts to reach a settlement. The mediator tries to advise or consult impartially with the parties with the main objective of bringing a mutually agreeable solution[16]. The mediator has no power to impose an outcome upon the parties like the judge[17]. The process is informal and non-binding however when the settlement is reached and is signed by the parties it become binding. The only difference between the mediator and the conciliator is that the Conciliator makes a recommendation or proposes for a solution pertaining to the dispute.[18] A mediation procedure is steered by the parties and the settlement is voluntarily reached. It is likely that an agreement constructed by the parties themselves in which they have been given the flexibility to defend all their interests, will be perceived as fair. Thus, a voluntarily reached agreement is more likely to be honoured than one imposed by an investment tribunal.[19] Therefore, mediation provides for the opportunity to conduct creative and unique resolutions of the disputes in which the interests of parties are adequately considered.[20]

Dispute Review, Avoidance or Dispute Adjudication Boards.

This may be a combination of dispute avoidance, conciliation, neutral evaluation and adjudication, as described here, but with the involvement of a project panel. The panel in most cases are appointed at the beginning of the project and visit site and hold discussions to seek to resolve disputes and give a decision. The main question is whether the decision of the board is binding, conditionally binding or temporarily binding. The cost of providing for and maintaining the board can often be a factor in deciding whether to have a board and this method is usually chosen for larger projects.

Adjudication

This is a process whereby an impartial, third party neutral makes a fair decision, rapidly at a low cost on a construction dispute,[21] that is binding unless and until reversed in arbitration or litigation. The use of an adjudicator has been entrenched in many standard construction documents. Adjudication take different forms; Construction adjudication a mandatory or statutory construction dispute resolution mechanism[22] in other jurisdiction and for all construction contracts and even when the contract itself is not in writing.[23]

Mini trial

In this process the dispute is presented to the senior executives either by a legal expert or any other informed person for the purpose resolution of the matter at hand. In construction project parties hold management meetings or management tender committee to unlock a stale mate between the contracting parties. After hearing presentations from both sides, the panel asks clarifying questions and then the facilitator assists the senior party representatives in their attempt to negotiate a settlement.[24]

Arbitration.

Traditionally, Arbitration is a process where a neutral party (in the context the person(s) is not a party to the contract) is appointed as arbitrator and controls the outcome of the process[25]. Arbitration process is mostly regulated by legal authority. Final decision is imposed on the contending parties which is called an 'award', based on the merits of the case, and such award usually is binding and not appealable except under certain circumstance depending with the jurisdiction and the seat[26]. Arbitration is perhaps the most commonly used mechanism for settlement of technical disputes in a construction project and has proved very effective in the western world[27]. It is a quasi-judicial process to the extent that legal protocol is largely observed, and it is important that the arbitrator, who basically acts as a judge, understands legal procedures[28].

Effective dispute settlement clause

It is important for a contract to contain a language and means of addressing disputes and claims at the relevant stage in a project. The expression must be explicit with clear instruction for parties to resolve disputes as they arise. The first and fore most important thing for the parties to have control on the process of how their disputes are going to be settled is the drafting of the dispute resolution clause. In drafting the clause, there are a few mandatory requirements that must be met, and a few provisions that must be included. These provisions should be clear and unequivocal. [29] In addition to these provisions, however, a clause may be ornamented in virtually endless combinations with a cornucopia of provisions covering topics as important as the situs/seat of the arbitration and as esoteric as class action arbitrations. A word of caution is in order. There is no such thing

15 Ibid, p 22-24
16 Supra, note 10 p 2
17 S.2, Civil Procedure Act, Cap 21, Laws of Kenya (Government Printer, Nairobi, 2010); Mediation Rules, 2015, Legal Notice No. 197 of 2015, Kenya Gazette Supplement No. 170, 9th October, 2015, pp. 1283-1291.
18 Karape. A. M. and Joshi A. M. "Dispute Resolution in Construction Industry" IJSTE - International Journal of Science Technology & Engineering | Volume 5 | Issue 6 | December 2018.
19 Anoosha 2009, p. 30
20 Rhoades et al 2007, p. 407.
21 Chartered Institute of Arbitrators, The CIArb (K) Adjudication Rules, Rule 2.1
22 Housing Grants Construction and Regeneration Act 1996 and Statutory Scheme for Construction Contracts Regulations 1998
23 S139 Local Democracy, Economic Development and Construction Act 2009 repealing s107 HGCRA 1996
24 Lowe, D. & Leiringer, R., Commercial Management of Projects: Defining the Discipline, op cit., p.239
25 Fiadjoe, A (2004). P. 203
26 Ibid p. 286
27 Li D., et al 2018 p. 5
28 Sameer SK et al. (2016)
29 Stephen B., How to Draft an Arbitration Clause (Revisited), 1 ICC Int'l Ct. Arb. Bull. 14 (Dec. 1990)

as a single "model", "miracle" or "all purpose" clause appropriate for all occasions.[30]

In Kenya, the formal requirements of an arbitration agreement are outlined in Section 4 of the Arbitration Act. The Act provides that an arbitration agreement may be in the form of an arbitration clause in a contract or in the form of a separate agreement. An arbitration agreement must be in writing. It is in writing if it is contained in a document signed by the parties; an exchange of letters, telex, telegram, facsimile, electronic mail or other means of telecommunications which provide a record of the agreement or an exchange of statements of claim and defence in which the existence of an agreement is alleged by one party and not denied by the other party.[31]

Pathological clauses in the Arbitration are those clauses that are sick or ill or defective in there very nature. The degree of sickness may vary in the nature of; naming a specific person in the contract as an arbitrator and by the time the dispute occurs the person is deceased or rejects the nomination, naming an institution that is nonexistence for an appointment [32] among many others.

Some other mistakes mistakes or illnesses that arise in drafting arbitration clause include but are not limited to: failure to specify whether arbitration outcome will be binding or non-binding; failure to design a clause that fits the circumstances of the transaction and the needs of the parties; a clause that expresses an agreement to arbitrate, but fails to provide guidance on how to or where to do so; drafting a clause that is excessively detailed; an arbitration clause with unrealistic expectations; and a clause that incorporates litigation or court procedural rules. If possible, it is appropriate to state the number of the arbitrator involve, the seat of arbitration and the appointing authority should parties fail to agree.[33] Ambiguous or defective arbitration agreements can lead to lengthy litigation challenging jurisdiction both at the outset and when enforcement of the award is sought.

There is need to ensure that the foregoing mistakes are avoided because, as it has been contended, the most important clause in any contract is the dispute resolution clause for so many reasons, not the least of which is that the way contracting parties manage any dispute, disagreement or controversy that arises in the course of implementing the contractual agreement, would invariably determine their future commercial relationship.[34]

The Role Engineers in dispute resolution

A lot of research has been done on the proliferation of the lawyers and court indulgence in the construction matter and little influence of the Engineers has been felt. Whether a contract dispute with a member of the construction team or the contracting parties among themselves or a liability suit from a third party, the engineer today has all the reasons to fear litigation from all fronts. Everyone associated with construction industry is probably familiar with construction liability horror stories. [35]

The Fédération Internationale des Ingénieurs-Conseils (FIDIC) for the "Conditions of Contract for Works of Civil Engineering Construction" (often known as the "Red Book"), a standard contract document widely used in international construction and civil engineering projects and is based on the English Institution of Civil Engineers (ICE) Standard Contract. The FIDIC contract involves three parties: the owner or employer, the contractor, and the engineer. The latter is firm of consultants or engineers engaged by the owner under a separate contract to assist the owner and to act on its behalf during the project implementation phase.[36]

The role of the Engineer in the implementation of the contract is placed in a sharp focus in the whole spectrum of the project from the initiation to the closure.[37] In case of a dispute the Engineer decides then inform the parties before the next level of resolution process is evoked.[38] Disputes arising from FIDIC contracts, there is thus a compulsory pre-arbitral stage, which takes place after the Engineer. However, in addition to the fact that it is appointed and remunerated exclusively by the owner, the engineer itself is often at the heart of the dispute.

The Engineer's intervention can hardly be described as arbitration or even quasi arbitration. The engineer is not required to follow a pre-determined procedure before reaching a decision, and any decision is provisional. Although the engineer's decision must be carried out immediately in order to ensure continuation of the works, it will only become final if it remains unchallenged or if it is upheld by an arbitral award.

The Engineer can be appointed as an expert by the Tribunal or by the parties to give evidence on the areas they are well knowledgeable in. The role of the expert is then to give an opinion to enlighten the court or the Tribunal of specific technical issues, however the expert opinion binds neither the party nor the court.[39]

The Engineer that by the very nature is involved in the contractual process is considered as advisors and expert witness within the industry. It then means that the Engineer plays a very key role in dispute avoidance and the resolution process. Engineer holds key project implementation records and information that can drastically reduce the time spend in locating the same and build up claims against the opponent.

30 Ibid
31 Sec. 4 (3) of the Arbitration Act, No 4 1995
32 Ngotho P, 2016, Contemporary Issues in arbitration, p 210-2025
33 "Drafting an Arbitration Agreement in 2022;2021 Considerations' p. 1. Available at https://www.ciarb.org/media/22281/barakat-nylj-series.pdf [Accessed on 11/09/2023]
34 Funmi, R., 'Drafting the Dispute Resolution Clause: The Midnight Clause,' p.1. Available at http://www.nigerianlawguru.com/articles/arbitration/DRAFTING%20THE%20DISPUTE%20RESOLUTION%20CLAUSE.pdf [Accessed on 11/09/2023]
35 Rubino J. 1989, Dispute Resolution in Construction.
36 FIDIC Conditions of Contract, the Red book/Yellow Book
37 Ibid
38 Clause 20, FIDIC Condition of the Contract Red/Yellow book
39 Supra note 27

As an advisor having or being in possession of the factual evidence of the project, understands the technical issues in aspect of the strength and weaknesses of the case and as a result is in a possible to prose a better mitigation measures very important in the promotion of quick settlement.[40]

The role or Arbitral institutions in promoting ADR for Engineers

Arbitral institutions are organisations managing arbitral procedures. Their role is to facilitate the dispute resolution for the parties, by offering a set of procedural rules to guide the arbitration process. The procedural rules set out by the arbitral institutions guide, among other things,

a) the commencement of an arbitration;

b) the elements to be contained in a request for arbitration or in a statement of claim;

c) the elements to be contained in an answer to a request for arbitration, in a statement of defence, or in a counterclaim;

d) the manner in which the arbitral Tribunal will be constituted.

e) time limits for the award to be rendered.

The functions undertaken by arbitral institutions are limited to the procedural aspects of the arbitration. An arbitral institution will not decide on the merits of a dispute – this will be the role of the arbitrators. Furthermore, the arbitral institution has the duty to oversee the proper conduct of the arbitration proceedings.

Arbitral bodies then play a very important roles in weeding out of pathological clauses in engineering contracts and help in the appointment and where possible in the administration of the dispute resolution process.[41]

There is need for the institution to work together with other international commercial courts to provide innovative and improved dispute resolution mechanism adaptive to the need of the users.

Challenges and Opportunities

There are numerous opportunities as well as challenges for the built environment expert in the world of ADR. In most Engineering contract many of the differences which arises between the parties are of technical in nature and technical experts are better placed to offer solution:

A 2015 study by the International Chamber of Commerce (ICC) Commission on Arbitration and Alternative Dispute Resolution found that arbitrators' fees and expenses accounted for only 15% of the costs of arbitration; administrative fees made up another 2%; while the remaining 83% was made up of lawyers' fees and other party costs.[42] Therefore the most significant way costs can be reduced is by encouraging greater efficiency in the disposal of disputes [43] where the Engineer is at the very heart.

Party representation and claim preparation for the party left to the technical people will drastically reduce the cost and time in the settlement process. There is no requirement in law that the plaintiff or the defendant must be represented by a legal expert but the law allow the party to be represented either by themselves or any other person of their choice.[44]

It can generally be appreciated that ADR mechanisms are highly efficacious means of achieving satisfactory resolution of many disputes in the construction industry, however their benefits have not been appreciated by the built environment experts including the general public.

As much as the mechanisms are not universal panaceas of solution the processes can be expensive and could occasionally fail, though their success rates are very high, ADR have greater significant role to play in the civil justice system and decongestion of the national courts in the country.

The parties must know when to engage and when to disengage. Mediation when started too early when the parties still do not know enough about each other's case may not reach a settlement or is undertaken too late substantial cost and time shall have been incurred. To identify the appropriate time to engage is a matter upon which experienced practitioners should advice by reference to the circumstances of the individual case.

There is a need for cultural and attituded change from the built environment practitioners towards disputes in the industry. Change of law and rules including sanctions and compulsions to go the ADR way may not be the solution but the parties should be allowed to operate with the spirit they had at the time they are drafting their contracts and should be based on the individual case.

ADR campaigns is now an urgent issue and especially within the construction industry experts. The indulgence of the litigation lawyers has made most technical people to shy away from the profession but it in now high time Engineers, Quantity Surveyors, Construction experts, the general public among others including judges be sensitized on the benefits of ADR to both small, medium and large businesses and project.

The information including legislation on ADR is very much fragmented, the Arbitration Act 1995 is archaic and not in with the Kenya Constitution 2010. There is no law that governs Adjudication or Mediation procedures including other ADR mechanisms in the country. The ADR practitioner are left, therefore, for self-regulation.

Our ADR institution have been over judicialized with high infiltration of the lawyer and legal expert. The Engineers

40 Hussein F. H. (2020) The Engineer's role in execution disputes of civil engineering contracting contracts – Palarch's Journal of Archaeology of Egyptology 17(07), 1673-1691
41 Supra note 6 p. 5
42 ICC, 'ICC Commissions Report' 2015, p3.
43 Menon S., 17 May 2018, para 21
44 Sec 25(5) Arbitration Act No 4 of 1995

with knowledge in the matters of dispute are better placed to be parties representative and better dispute resolvers of construction disputes.

Most arbitral institution are dependent on the funds from a strong market position to fulfill their mandate, construction industry has been reported to be one of the biggest market shares in the disputes world and this places the construction expert at the competitive advantage.

Conclusion

The following conclusion can then be drawn from the submissions without compromising their neutrality, arbitral institutions need to work with governments, businesses, lawyers, academia and other stakeholders to put in place legal frameworks that promote and shape economic and commercial practice. This can be achieved though an active participation of the built environment experts.

As much the global economic outlook may look bleak and dark the Arbitral institutions and the ADR practitioners should put their talents and skills to proper use to turn disputes into an opportunity for future new business and to spur economic growth.

The main concern of the ADR users and especially arbitration are speed, cost and enforceability and the arbitral institution must come up with innovative way to address them and improve of the quality of arbitration and training of the ADR practitioners in the industry.

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Climate Change Against National Greenhouse Gas Emission Reduction Commitment for Developing Countries - Adaptation by Power Utilities

A case study for Kenya

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Picture: Courtesy

1 Introduction

Kenya's ministry of energy and petroleum makes and articulates energy policies to create an enabling environment for efficient operation and growth of the sector.

The energy and petroleum regulatory authority (EPRA) regulates and licenses players in the entire energy sector. Its other functions include tariff setting and oversight, coordination of the development of the integrated energy plan monitoring and enforcement of sector regulations e.g. the energy management regulations.

Kenya's energy act 2019 set up other agencies, namely:

- Nuclear power and energy agency (NUPEA) to handle nuclear energy programme.
- Rural electrification and renewable energy (REREC) to manage the rural electrification projects.
- Kenya electricity transmission company (KETRACO) to manage the electricity transmission assets.

Other key energy sector players are Kenya electricity generating company (KenGen) that generates the bulk of energy consumed in Kenya and the Kenya power and lighting company (KPLC) that does the power distribution and retail functions in the country.

In 2020, the Ministry of Energy released the Kenya National Energy Efficiency and Conservation Strategy[4]. It establishes energy efficiency targets in the buildings, industry, agriculture, transport, and power sectors to meet the goal of reducing the national energy intensity by 2.8% per year. The strategy also aims to ensure that energy efficiency measures contribute to the achievement of the nationally determined targets (NDC) by keeping Green House Gas (GHG) emissions as per the targets in table 1 below.

2 Methods

In Kenya, climate change action is guided by the climate change act 2016 which provides the framework for mainstreaming climate change across all sectors of the economy. The law has been applied to the development, management, implementation and regulation of mechanism to enhance climate change resilience and low carbon development for sustainable development in the country.

The act obligates the cabinet secretary responsible for climate change affairs to formulate a five-year national climate change action plan (NCCAP) that addresses all sectors of the economy. The plan covers thematic areas of agriculture, forestry, industry, energy, transport and waste. The first NCCAP ran from 2013-2017 and the second from 2018-2022.

Table 1 below shows Kenya's emission reduction potential and the nationally determined contribution (NDC) targets by sectors (in $MtCO_2e$ per year) projected to 2030:

Table 1: Kenya's emission reduction potential and the NDC targets by sector (in $MtCO_2e$ per year [3])

	GHG Emission reduction potential(MtCO2e)				NDC Target
Sector	2015	2020	2025	2030	2030
Forestry	2.71	16.24	29.76	40.2	20.1
Electricity generation	**0.28**	**2.24**	**8.61**	**18.63**	**9.32**
Energy demand	**2.74**	**5.16**	**7.92**	**12.17**	**6.09**
transport	1.54	3.52	5.13	6.92	3.46
Agriculture	0.63	2.57	4.41	5.53	2.77
Industrial processes	0.26	0.69	1.03	1.56	0.78
waste	0.05	0.33	0.5	0.78	0.39

Table 2 below is a summary of the various energy mitigation actions for the electricity generation and demand sectors above:

Table 2: Estimated technical potential emission reduction by 2030 [6-7]

		MtCO2e
Electricity Generation	Clean coal	1
	landfill gas generation	0.4
	Solar-grid connected	0.65
	Hydro	1.1
	wind	1.7
	Geothermal	14
Energy demand	Solar thermal water heating	0.2
	Energy efficient light bulbs	1.1
	LPG stove substitution	1.4
	Renewable lamps	1.8
	Cogeneration in agriculture	1.75
	Improved cook stoves	5.7
Total		30.8

The 2018-2022 NCCAP encompasses development of new 2,405MW of grid-connected renewable power generation and retirement of three thermal plant. The highest mitigation opportunity is in geothermal expansion, envisaged to add 2,775MW to the grid by 2030.

Others targeted measures are: 157MW of Biomass and 30MW of distributed solar/mini grids –largely done by REREC in the counties of Wajir, Mandera, Marsabit, Turkana and Garissa.

3 Results

Table 3 below shows the various interventions and the achieved results.

Table 3: 2018-2022 NCCAP Energy mitigation actions [5-6]

Actions	Expected results by June 2023	Results achieved by June 2022
Increased generation of renewable energy.	Develop 2,405MW of new renewables that include geothermal, biomass, hydro, distributed solar and mini-grids, solar and wind. Retire 300MW of thermal plants – 120MW Kipevu, 108MW Iberafrica and 74MW Tsavo.	2,883MW of generation on renewables. 913MW geothermal plants in Olkaria and Menengai 300MW lake Turkana wind among others in Ngong, Meru and Kipeto 442MW solar in Strathmore, Makindu among others 10% of TVET institutions using solar and five solar mini-grids done- 4 in Marsabit and 1 in Kisumu. Tsavo power has been retired
Increased generation capacity for captive renewable energy	Increase captive renewable energy generation capacity by 250MW by 2022 – 50MW of solar, wind and hydro and 200MW of cogeneration. Direct use of geothermal resources to power industrial applications-Naivasha industrial park.	Meru county has 200 solar-powered boreholes under their captive energy goals. 153MW Kwale sugar biomass plant done 93MW KTDA generation done GDC has established geothermal heated milk pasteurizers.
Improved energy efficiency and energy conservation	Reduce transmission and distribution utility losses from 18% to 14%. Distribute 3.3m CFL bulbs to shave 50MW from the peak demand. Energy efficiency in buildings and industry – EPRA regulations.	4.25m CFL bulbs distributed to 1.4m households by KPLC-funded by MoE. Energy management compliance certificates awarded to many factories under the energy management regulations 2012. The Ministry of Energy has worked with the Kenya Association of Manufacturers (KAM) to establish a Centre for Energy Efficiency and Conservation that promotes energy efficiency.
Climate proof energy infrastructure	Concrete poles to replace wooden poles. Optimize existing hydro plants.	20.47% (22,500 poles) now concrete. Kengen has done a feasibility study on how to optimize hydro power plants by increasing dam storage eg Masinga wall has been raised by 1.5m- because of erratic rain patterns. In other instances, the number of turbines is increased to allow excess spill to generate power- Kindaruma added the third turbine.
Enabling actions (technology)	Research on new technologies to reduce GHG emissions. Climate change resilient technologies such as coolers and scrubbers promoted.	Renewable energies research laboratory established. Energy efficiency research and testing facility established at KIRDI.
Enabling actions(capacity development)	Training and public awareness on climate change adaptation and mitigation mechanism. Train 100 students per year at the KPI on renewable energy technologies. Train 60 participants at the UNU Geothermal's training program.	TVET Instructors trained on solar PV and solar water heating installations. Marsabit county trained staff on solar installations. KPLC trained 163 students on solar installation.

Currently 78% (2,266MW) of generation capacity in Kenya is renewable as seen in table 4 below:

Table 4: Kenya's installed generation capacity [8]

	Installed(MW)	Effective/Contracted(MW)
Hydro	838.51	810
Geothermal	904.98	817
Thermal (MSD)	621.89	589
Thermal (GT)	60.00	56
Wind	436.05	426
Biomass	2.00	2
Solar	212.51	212
Imports	200.00	0
Total Capacity MW	3,276	2,911

The country has a peak demand of 2,149MW with 80.1% of the population having access to electric power.

The graphical illustrations below show the above trends:

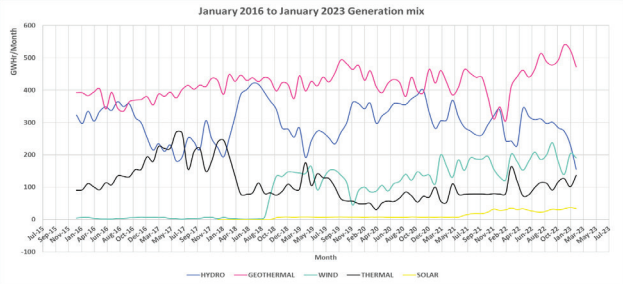

Figure 1: Changes in various sources of energy from January 2016 to January 2023 [8]

4 Discussion

Kenya uses 231/838MW (28% of the total installed capacity, largely to meet peak load demand as compared to the convectional base load) of hydro capacity – due to persistent drought for three years in a row.

Wind power has cut by more than half the gap between it and hydro- now doing 17.8% of the total load against hydro's 14.47%.

Solar energy has a big room for growth- now at 3.11% of the total national load.

Geothermal still takes the lion's share at 44.07% of the total load.

Kenya is on the road to retire all 300MW thermal power plants. Tsavo power 75MW plant already retired, 120MW Kipevu and 108MW Iberafrica pending- Currently contributing 12.72% of the total grid energy.

The draft net metering regulations 2022 are under discussion. These will go a long way in the contribution of the energy sector towards reduction of the targeted GHG emissions.

The electric mobility and time of use tariffs were introduced in April 2023. These will spur more utilization of the generated clean energy. As at the end of 2022, Kenya had well over 400 registered electric vehicles in the country.

5 Conclusion

Kenya is a leader in the generation and utilization of clean energy in Africa [10]. Kenya is number one in the generation of geothermal energy in the continent. The place of the energy sector is well cut out in the 2023-2027 NCCAP and beyond as Kenya seeks to leverage on the above gains and more. The future is bright.

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PICTORIAL

President of IEK, Eng. Shammah Kiteme, engages with Graduate Engineers at Daystar University on July 1, 2024, addressing critical career and professional development issues.

Graduate Engineers actively engage with IEK President, Eng. Shammah Kiteme, at Daystar University during the Graduate Engineers Forum on July 1, 2024.

The IEK President and the Women Engineers Committee during a mentorship session at Limuru Girls High School and Alliance Boys High School.

Comparative Tariff Assessment: Grid vs. Self-Generated Electricity in Kenya

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Picture: Courtesy

1 Introduction

Modern distributed technologies including flexible demand, distributed generation, energy storage, and improved power electronics are driving a huge revolution in the energy sector. This shift is taking place in tandem with broader changes in power systems, such as a rise in the use of renewable energy sources, a closer coupling of the grid, and initiatives to cut carbon emissions [1]. New possibilities for the supply and use of power are being produced by these advancements. Commercial organizations are increasingly implementing hybrid energy systems, utilizing the grid at night and solar energy during the day for a variety of uses. Due to the advancement of renewable energy technology and the demand for reliable and affordable electricity, this tendency has intensified [2]. Consumers producing their own electricity is another new trend. Industrial clients are separating themselves from the grid and putting in place their own energy strategies, frequently using solar power. Many organizations and businesses have installed solar PV systems to suit their electrical needs, including Unilever Tea Kenya, Strathmore University, Garden City Mall, Total Kenya, Mombasa International Airport, and the International Centre of Insect Physiology and Ecology (ICIPE).

The price of renewable energy dramatically dropped between 2009 and 2019. Costs for solar PV decreased by 89%, from $378/MWh to $68/MWh, while those for onshore wind decreased by 41%, from $135/MWh to $41/MWh [3]. In contrast, during this time coal and nuclear energy prices either rose or barely changed. Overall, technical improvements and the desire for less expensive and more dependable electricity are driving a change in the energy sector toward cleaner and more affordable energy sources.

With consumers increasingly shifting to renewable energy technologies (RE), which are less expensive and more dependable, the traditional electricity market structures are being challenged [4]. Although RE may have advantages, its high start-up expenditures, ongoing maintenance, and operational costs cast doubt on the viability of self-generation as an alternative to the grid [5]. Consumers may now regulate their energy output and consumption thanks to advancements in RE and energy storage technologies, but it is still unclear what this means for utilities, customers, and legislators. Understanding this new paradigm's effects on the power industry and using that knowledge to inform decisions requires research. Arguably, it is important to look into and have a better understanding of the overall notion of self-generation and grid defection given the perception of the trend as a disruptor in the energy sector.

2 Methods and Tools

The data collection process involved both primary and secondary sources capturing electricity generated, installed capacity, consumption rate, and reasons for opting for self-generation. The primary data collection process was broken into three phases. Phase I involves collecting information on energy output from businesses that had self-generation systems giving details on installed capacity, installation causes, and difficulties. The sampled self-generating systems had an installed capacity of more than 20 kW. Phase II gathered information from Engineering, Procurement, and Construction (EPC) vendors to reduce biases by capturing their viewpoints on the energy sector's capacity, costs, trends, difficulties, and incentives. In order to provide insights into the variables influencing self-generation and its effects on Kenya's energy sector, Phase III involves acquiring secondary data from EPRA, describing pricing, structural models, and changes in electricity sourcing from the national grid. The information covers tariff techniques and structures from 2013 through 2022.

The least expensive method of producing one's own electricity was determined using the LCoE methodology. The cost that results from comparing the lifetime cost of each organization to the discounted present value of the lifetime power produced indicates the point at which defecting economically makes sense. Although the tool makes comparing the competitiveness of technologies simpler, it does not take into account all project costs and financial factors. It ignores project hazards and oversimplifies project risks and discounted rates. Furthermore, it ignores distributed system efficiency advancements, which results in much higher LCOE, especially for small, efficient loads. The tool has limits in evaluating actual financial decisions, so it should be used cautiously (Hansen, 2019).

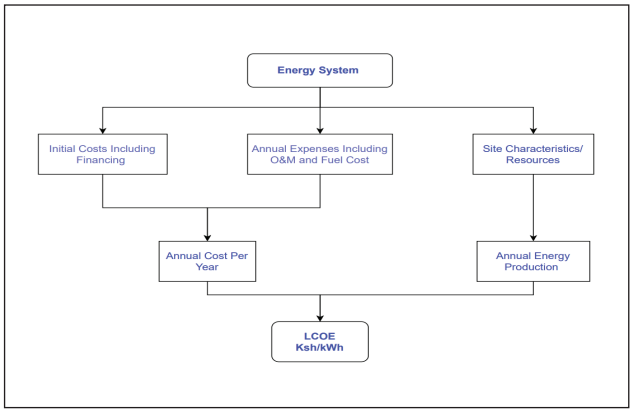

Figure 1: LCoE Concept

$$LCoE = \frac{Lifecyle\ Cost}{Lifetime\ Electricity\ Production\ (kWh)}$$

$$= \frac{\left(\frac{\sum_{t=0}^{n} (I_t + O_t + M_t + F_t)}{(1+r)^t}\right)}{\left(\frac{\sum_{t=0}^{n} E_t}{(1+r)^t}\right)}$$

Where:

LCoE: Levelised Cost of Electricity

I_t: Initial Capital Cost
O_t: Operation Cost,
M_t: Maintenance Cost,
F_t: Fuel Cost
E_t: Total sum of Energy produced over the lifecycle
t: the plant/ system
r: discount rate (r) accounting for depreciation in value of costs and energy

3 Results

Results

From primary data, 11 companies were sampled and data collected from them. Table 1 shows the energy source with respective installed capacities, initial cost, operating hours, operating and maintenance costs (O&M) and electricity sources that include solar PVs, diesel generators, natural gas turbines.

Table 1. System variables for the surveyed companies (1 USD = Ksh 110 at the time of study)

Consumer	Energy Source	Installed Capacity	Initial Capital (Ksh in million)	Operating hours	Annual O&M (Ksh in million)
A	Solar PVs	1.2 MW	270	2500	1.66
	Diesel Generators	7.5 MVA	90	300	2.1
B	Solar PVs	1.67 MW	300	2500	0.3
	Diesel Generator	400 kVA	5	400	0.7
C	Solar PVs	850 kW	60	3000	0.7
	Diesel Generators	2 MVA	20	250	1.5
	Natural Gas	10kW	20	1500	1.1
D	Solar PVs	20 kW	2.1	3000	0.1
	Diesel Generators	160 kVA	0.8	500	0.3
E	Solar PVs	230 kW	23	2500	0.8
F	Solar PV	2.5 MW	270	3000	0.56
	Diesel Generators	4.32 MVA	50	600	3.2
G	Solar PVs	150 kW	15	2500	0.5
	Diesel Generators	1 MVA	10	300	1.8
H	Solar PVs	560 kW	50	3000	0.8
	Diesel Generators	1.5 MVA	20	250	1.5
I	Solar PVs	410 kW	40	2500	0.5
	Diesel Generators	2.5 MVA	30	300	1.4
J	Solar PVs	290 kW	30	2500	0.4
	Diesel Generators	500 kVA	5	200	1.1
K	Solar PVs	670 kW	70	3000	0.9

Levelised Cost of Electricity

The survey discovered that the majority of solar PV systems ran for between 2,500 and 3,000 hours annually, while diesel generators were only used for between 200 and 500 hours. Operation and maintenance (O&M) costs for solar PV systems included replacement parts, maintenance, clearing, administration, annual inspection, and security, whereas diesel generators also had fuel costs in addition to other O&M costs. Based on theoretical data, solar PV systems were projected to have a lifespan of 30 years [6], whilst diesel generators and natural gas turbines were assumed to have a lifespan of about 20 years. The discount rate taken was 7.5% and expected inflation rate was 7%. The calculated LCoE of the systems is shown in the Table 2.

Table 2: Calculated LCoE for the Surveyed Consumers

Consumer	Energy source	Life cycle cost of the system (Ksh)	Life cycle electricity produced (Ksh)	LCoE (Ksh)
A	Solar PVs	930,979,551	10,279,892.71	90.56
	Diesel Generators	433,631,018.70	9,534,232.50	45.48
B	Solar PVs	1,032,443,891	14,306,184.02	72.17
	Diesel Generator	26,837,098.88	677,989.87	39.58
C	Solar PVs	207,998,495.8	8,737,908.80	47.78
	Diesel Generators	101,227,653.70	2,118,718.33	23.80
	Natural Gas	99,344,348.48	70,623.84	70.33
D	Solar PVs	7,538,588	205,597.85	36.67
	Diesel Generators	5,179,089.26	338,994.93	15.28
E	Solar PVs	81,553,815.48	1,970,312.77	41.39
F	Solar PV	930,535,887.90	25699731.77	36.21
	Diesel Generators	250,479,589.50	10,983,435.84	22.81
G	Solar PVs	53,112,779	1,284,986.59	41.33
	Diesel Generators	55,557,502.94	1,271,231	43.70
H	Solar PVs	174,072,850	5,756,739.92	30.24
	Diesel Generators	101,227,653.70	1,589,038.75	63.70
I	Solar PVs	138,778,551.50	3,512,296.68	39.51
	Diesel Generators	147,839,457	3,178,077.50	46.52
J	Solar PVs	104,169,579.40	2,484,307.40	40.30
	Diesel Generators	28,720,404.06	423,743.67	67.78
K	Solar PVs	242,948,131	6,887,528.11	35.27

Grid Tariffs Charges

The Energy and Petroleum Regulatory Authority (EPRA) in Kenya has established tariffs and billing structures for various consumer groups over specific time periods. These consumer groups, categorized as CI 1-5, primarily consist of commercial and industrial consumers. The billing components include fixed charges, energy charges, off-peak charges, and demand charges [7]. Between 2013 and 2018, billing was based on fixed charges, demand charges, and consumed charges. Fixed charges were imposed regardless of electricity usage. However, in 2018, the billing structure shifted to be based on consumed energy, off-peak charges, and demand charges. For instance, CI1 consumers had fixed charges of Ksh 2,000.00, which later increased to Ksh 2,500.00 by 2018. CI4 consumers saw fixed charges replaced with higher consumed energy charges, starting at Ksh 7.30 and increasing to Ksh 7.80 by 2020.

Grid Defection

Many organizations opt for a hybrid strategy due to the high upfront costs of being completely off-grid, the costs of power storage devices, and the need to save money on infrastructure. Some companies also use feed-in tariffs and cheaper off-peak prices to balance their electricity costs. Despite these changes, many users still use the grid for things like controlling supply and demand imbalances, controlling voltage and frequency, and having the option to export excess electricity. Utility providers have proposed solutions like raising fixed fees and demand-based pricing in response to trends in customer desertion.

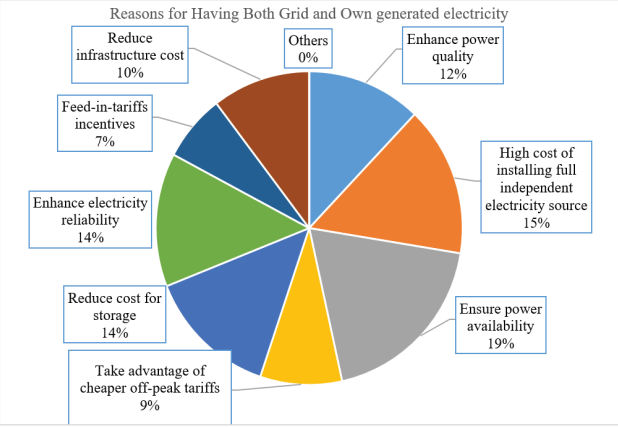

Fig. 1. Reasons for having both grid and own generated electricity

4 Discussion

Hybrid systems in industrial setups with motors drives can increase Total Harmonic Distortion (THD), has a detrimental effect on the performance of self-generated electricity, operational expenses, and equipment reliability [8]. Load sensitivity, component integration, system upkeep, and power quality are a few difficulties. Only a small percentage of respondents, who largely used net metering and FIT pricing, had agreements to deliver extra power to the grid and thought these agreements were favourable. Regulation-related problems, high rates, and lengthy negotiation processes are some of the current impediments to self-generated power, although proper policy implementation might dramatically lower the LCoE [9].

In addition to these charges, consumers face several additional fees, including fuel charges, foreign exchange rate adjustment fluctuation adjustment (FERFA), inflation adjustment (INFA), security support facility (SSF), water levy (WARMA), and various taxes and levies. These additional charges can constitute approximately 45% of the total cost of electricity, making grid electricity relatively expensive. Comparatively, Kenya Power benefits from economies of scale and density in providing electricity. However, consumers generating their own electricity do not incur these additional charges [10]. Nevertheless, self-generated electricity can have a higher LCoE when compared to grid electricity.

For certain consumer categories throughout particular time periods, EPRA in Kenya has defined tariffs and billing systems. Commercial and industrial consumers make up the majority of these CI 1–5 consumer groupings [7]. Fixed charges, energy charges, off-peak costs, and demand charges are some of the elements of the bill. Billing was based on fixed charges, demand charges, and consumption charges between 2013 and 2018. There were set fees regardless of how much electricity was used. The pricing structure changed in 2018 to be based on energy usage, off-peak fees, and demand fees.

Customers also pay for fuel, FERFA, INFA, SSF, WARMA, and other taxes and levies in addition to these expenses. Grid electricity is relatively expensive because of these extra costs, which can account for up to 45% of the overall price of electricity. Kenya Power, in contrast, makes use of economies of size and density while supplying electricity. However, these extra costs are not incurred by consumers who generate their own electricity. Compared to grid electricity, self-generated electricity may have a higher LCoE [11]. However, economic factors also play a role in the choice to keep grid connections.

5 Conclusions

The energy industry has changed significantly over the past ten years as a result of a number of variables, including dispersed generation, flexible demand, grid system liberalization, environmental concerns, and the need for reliable, affordable electricity. In order to solve challenges like power stability, economic effectiveness, environmental sustainability, and energy independence, commercial and industrial consumers in Kenya are rapidly embracing self-generated electrical systems. The study discovers, however, that the price of self-generated power varies considerably, with solar PVs costing, on average, Ksh 46.49/kWh and Gensets Ksh 40.96/kWh, frequently as a result of low capacity utilization. The price of grid power is largely steady. Despite using self-generated electricity, users still rely significantly on the grid because of blackouts and other issues. For more consumers to choose self-generation, policy implementation and utility provider support must be improved. The utilization factor should be increased, policy implementation should be improved, and more study should be done on hybrid integration systems and electrical reliability.

6 Acknowledgement

The author expresses gratitude to Prof. Cyrus Wekesa for continuous support throughout the project. The unnamed participants and companies, as well as EPRA management, are thanked for their valuable contributions and assistance in data collection, crucial for achieving the research objectives.

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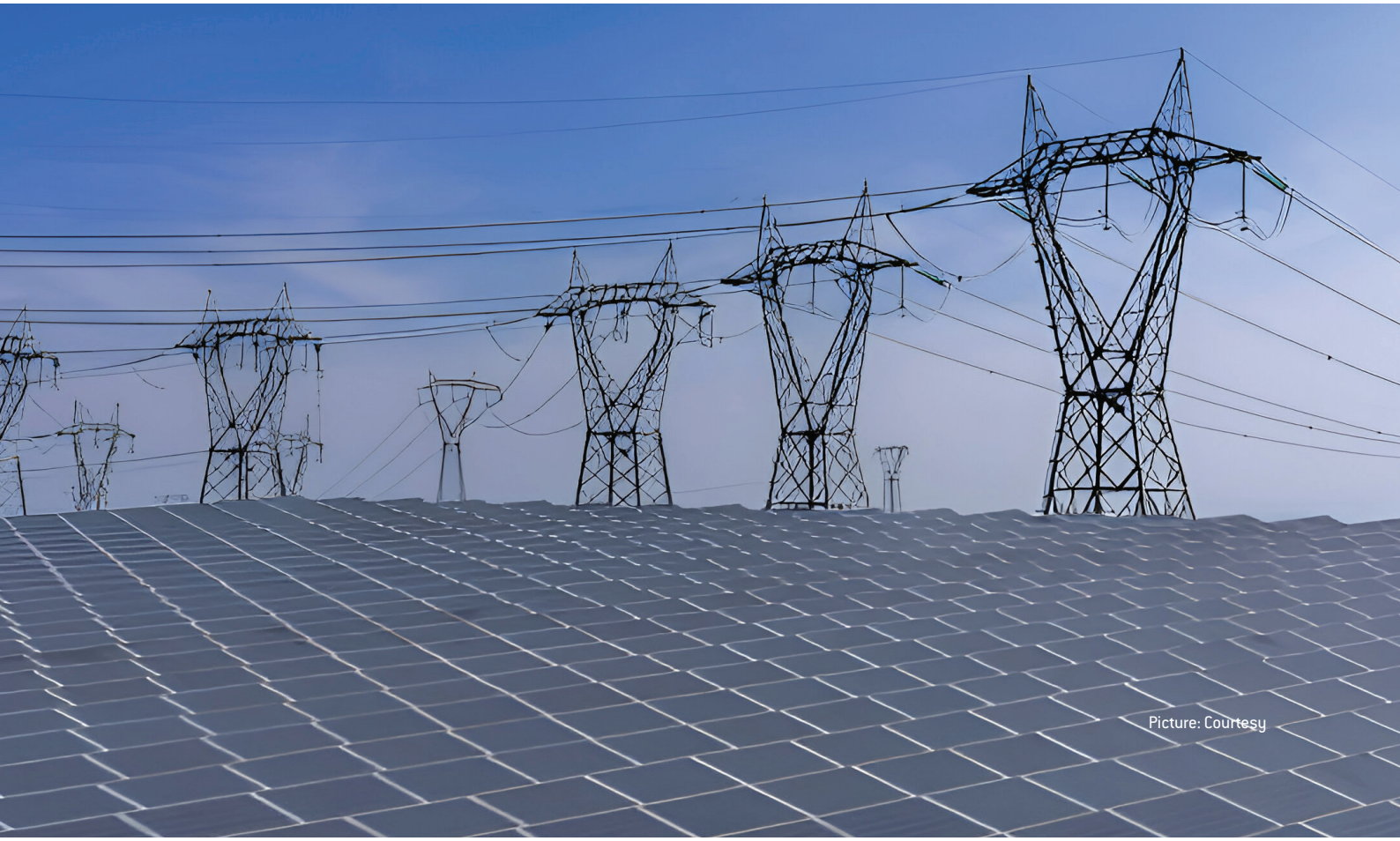


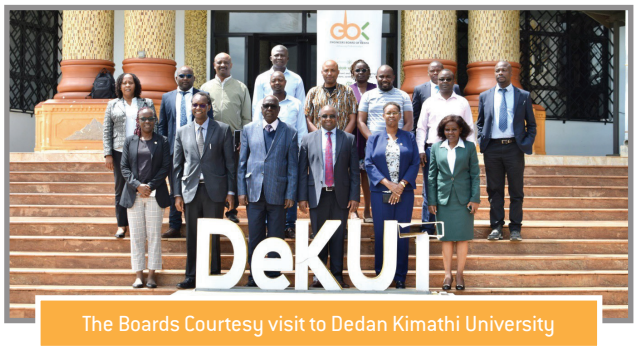
Picture: Courtesy

ENGINEERS BOARD OF KENYA
Enhancing Professionalism

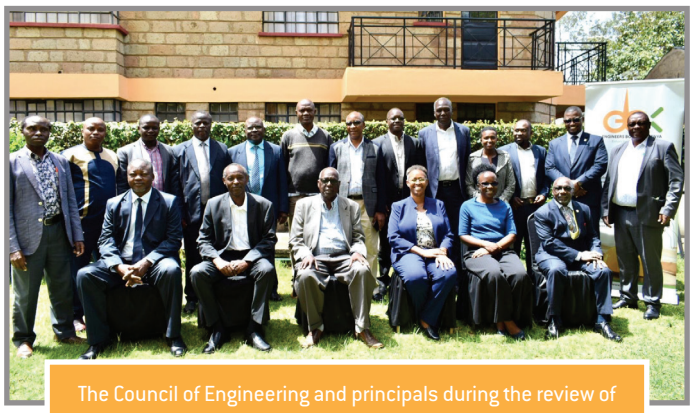
Independent Review of Engineering Programs by Engineers Board of Kenya

Engineers Board led by the chairman, Eng. Erastus Mwongera during independent review of engineering programs at Technical University of Kenya

The Engineers Board of Kenya during independent review of the engineering programmes at Egerton University



The Boards Courtesy visit to Dedan Kimathi University



The Council of Engineering and principals during the review of recognition standards and degree programmes

Enhancing Kenya's Food Security by Leveraging on Excess Electricity during off-Peak Hours

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1 Introduction

Farming in Kenya has historically been dominated by small-scale subsistence agriculture, with approximately 80% of farmers working on plots of less than 3 hectares. However, in recent decades there have been efforts to modernize and improve farming practices to increase crop yields and farmer incomes. Traditionally, Kenyan farmers have relied on rain-fed agriculture with the use of hand tools like hoes for land preparation and weeding. However, there have been initiatives to introduce mechanization through the use of tractors, planters and harvesters. While mechanization can help increase productivity, many small-scale farmers still cannot afford these technologies. [1]

Overall, while there have been efforts to modernize farming practices in Kenya, many challenges remain that prevent the majority of small-scale farmers from adopting more productive and sustainable agricultural methods. Kenya imports a significant amount of food to meet local demand. Some of the most commonly imported foods being: Maize, Wheat, Rice, Sugar and Vegetable oils to supplement local production and meet the country's consumption needs. However, import costs have been trending upwards in recent years due to several factors impacting the cost of living for many Kenyan households.

These imported foods help ensure food security and availability in Kenya. However, the country ought to continue pursuing policies and strategies to promote local production of food and ultimately reduce reliance on food imports in the future. Addressing issues related to access to technologies, agricultural inputs and extension services will be critical for Kenya to achieve agricultural transformation and improve the livelihoods of its growing population. Finding solutions to farm problems and issues is a painstaking process which requires acceptance of new body of knowledge that may disprove and invalidate some long held theories and beliefs.

The use of irrigation is also limited in Kenya due to high costs, lack of infrastructure, unreliable and inadequate electricity supply. Only about 3% of cultivated land is irrigated despite the fact that rain-fed agriculture is vulnerable to climate variability. Although the government has promoted various irrigation schemes, many have faced challenges with poor maintenance and high operating costs. Therefore the aim of this paper is to analyze the available installed energy capacity in Kenya and see whether it is enough and sufficient to drive electric farm tractors with electric motors as drive units towards sustainable agriculture for food security.

2 Agriculture Mechanization Strategy

Mechanization is an essential input in land productivity while reducing drudgery or monotony.[3]. Mechanization has also been used to add value to primary products, create employment and income along the commodity value chain.[3] This enables the growth and efficiency in post-harvest handling, processing and marketing which translates to food security.[2]

Technology has led to tractors and other equipment to allow fewer farmers to handle much larger fields.[28].

Machines water entire fields well and keep crops growing even when there is not enough rainfall. While some crops still need to be picked by hand, others like wheat can be collected by machine.[4]. In the past unlike presently, an invasion of pests could spell doom for an entire crop, which often resulted in starvation. In addition, farmers are better off in handling weeds thanks to modern chemical spreads by tractors. These technologies lowers the price of food significantly.[4].

3 Convectional Diesel Tractors Farming

Tractors have come a long way from their early mechanical versions to now being highly sophisticated machines equipped with a range of advanced technologies.[5] These advancements in technology have not only improved the efficiency of tractors but have also made them more user-friendly and environmentally friendly.[6] Precision farming involves using data and technology to optimize crop production and increase efficiency. The integration of precision farming technologies in tractors has allowed farmers to collect and analyze data on factors such as soil moisture, crop yield, and weather conditions to make more informed decisions.[7]

Today's Kenyan farmers have a wide array of options when it comes to diesel tractors. These diesel engines offer several advantages for agricultural use, including high torque at low revolutions per minute (RPMs), long service life, and the ability to run on biodiesel.[8] They can potentially operate up to 24 hours a day. However diesel fuel is expensive and they add to the overall greenhouse gas (GHG) emissions and noise pollution while in use. [9]

The conventional tractor industry is dominated by a few key players, including John Deere, New Holland, Case IH Industrial, and Kubota. These companies have established themselves as leaders in the market through decades of innovation, production, and marketing. One reason for their

dominance is their ability to offer a wide range of products and services to customers, ranging from 50-700 horsepower, with options for 2WD, 4WD, and track models.[10]

4 Electric Farm Tractors Global Industry Overview

The electric farm tractor market is an emerging sector within the agricultural industry that focuses on the development and adoption of electric-powered tractors for various farming operations. They are designed to replace conventional diesel or gasoline-powered tractors, offering numerous advantages such as reduced carbon emissions, lower operating costs, and quieter operation.[6] Electric tractors utilize electric motors and batteries to power their operations, eliminating the need for fossil fuels. These tractors can be charged through various methods, including grid electricity, renewable energy sources such as solar or wind power, or even portable generators. The use of electric power in farming machinery aligns with the global trend toward food sustainability and reducing greenhouse gas emissions.[11]

The world of farming is changing rapidly. One of the most significant developments in electric tractor technology has been the integration of precision farming technologies. Farmers around the world are increasingly turning to electric tractors to farm their fields. The electric farm tractor market is anticipated to expand as farmers recognize their long-term benefits as they get governments continued support to sustainable agricultural practices.[12] The growth of the market is expected to be influenced by factors such as advancements in battery technology, charging infrastructure development, and the overall cost competitiveness.[13]. Battery technology is a critical area of focus for electric farm tractors and any further advances in battery chemistry, energy density, and durability will result in improved performance and longer operating ranges.[14]

Lithium-ion batteries are the type commonly used due to their high energy density and efficiency.[6] However, ongoing researches aim to develop next-generation battery systems, such as solid-state batteries, which would offer even higher energy storage capacity and improved safety.[14] These advancements are crucial for addressing the range limitations of electric tractors and reducing the time required for recharging.[15] Therefore as a country, if these electric farm tractors can be integrated with precision farming technologies, then agricultural practices such as planting, fertilizing, spraying, and harvesting will be highly revolutionized. These technologies include GPS guidance systems, sensors, and data analytics, enabling precise and targeted farming operations.[16]

5 Determination of Choice among the Two Types of Tractors

The price of diesel powered tractors in Kenya is in the range of between Kshs.1.5M and Kshs.7M.[17] On the other hand, the landing cost of electric tractors range between Kshs.3M and 15M for the most advanced.[6] Although they have a higher upfront purchase cost compared to conventional tractors, battery electric farm tractors can provide long-term cost savings due to their lower operating and maintenance expenses.[17] They have fewer moving parts, resulting in reduced maintenance requirements and costs associated with engine oil changes, fuel filters, and exhaust systems.[6]

Better still, electricity is generally cheaper than diesel or gasoline, leading to lower operating costs over time for same agricultural output.[18] These cost-saving benefits will make battery electric tractors financially attractive to our farmers seeking to optimize their operational expenses and achieve long-term financial sustainability. Moreover, governments worldwide, Kenya included, are implementing policies to incentivize the adoption of electric vehicles. This includes tax credits, grants, subsidies, and favorable financing options, which make battery electric tractors more affordable to farmers.

While it is still a small percentage of the total tractor market, the availability of electric farming tractors is growing rapidly as more farmers seek to reduce fuel costs, noise pollution, carbon emissions and most importantly, increase food production. The capabilities of these electric models will also likely improve over time as battery technology advances. The determination that diesel tractors in any region consume far more MWh/year of energy and contribute more tons of carbon dioxide energy per year (tC02e/year) is already a big drawback. Indicatively, the figure 1 below shows a type made in China.[19] The price of USD12896 is indicative of how the general prices of different brands could be world over. So giving the prices a range of between USD 10000 and 90000 would work well for farmers in Kenya. That cost and reduced long term power usage incentives will be far much less compared to same powerful diesel tractors.

Fig 1:100hp farming electric tractor with air-conditioned cab
Price =USD 12896

6 Anticipated Source of Power For the Electric Tractors

In order to leverage on this technology and achieve the desired results of lowering the cost of food production, then the cost of electricity for charging the batteries is of great consideration. As of July, 2023, Kenya had an installed electricity generation capacity of 3177Megawatts.[20]

This country's power supply relies heavily on hydroelectricity, wind, Solar and fossil fuels. Hydropower accounting for about 29% of that installed capacity with 839 megawatts generated from various plants. Thermal power accounts for about 18% of the installed capacity with 512.8

megawatts generated from various fossil fuel plants. The remaining 53% comes from geothermal energy, wind, and solar sources. More so, the Country has a significant potential to expand geothermal power generation due to its location along the Great Rift Valley. Currently, geothermal energy provides about 852 megawatts of installed capacity. [20]

As a producer of power, Kenya has excess installed generation capacity, especially during off-peak hours which provides an opportunity to power these electric tractors and other farm machinery across the Country. This paper explores how much excess power there is and how leveraging on the excess electricity at night, farmers would charge the batteries and carry out pumped irrigation overnight at reduced off-peak rates. This would allow them to utilize the tractors during the day for plowing, planting, spraying and other tasks. Over time, the increased productivity from that mode of mechanized farming techniques would then help improve the food security situation in Kenya. The table 1 is a tabulation of the installed generation capacity in Kenya by type.

Type	Installed	Effective*/ Contracted	% (Effective)	% (Installed)
Hydro	838.50	809.60	28.60%	26.39%
Geothermal	940.00	851.70	30.09%	29.58%
Thermal	512.80	506.40	17.89%	16.14%
Wind	435.50	425.50	15.03%	13.71%
Biomass	2.00	2.00	0.07%	0.06%
Solar	210.30	210.30	7.43%	6.62%
Interconnected System	2,939.00	2,805.00	99.12%	92.50%
Off grid thermal	35.57	23.03	0.81%	1.12%
Off-grid Solar	2.26	1.92	0.07%	0.07%
Off-grid Wind	0.55	0.00	0.00%	0.02%
Imports	200.00	0.00	0.00%	6.29%
Total Capacity MW	3,177.00	2,830.00	100.0%	100.0%

7 Part of Geothermal Energy Rejected as the Game Changer

Out of the geothermal energy produced, not all is used during electrical load management. It is rejected and steam vented out.[20] One benefit of using the rejected Geothermal energy is using energy that would otherwise be wasted and thus lead to a decrease in the overall demand for other energy sources, which can have a negative impact on the environment and on energy security.[21] By using rejected geothermal energy, it is possible to reduce the amount of diesel energy that is used, which in turn reduce the amount of greenhouse gas emissions to the atmosphere.[22] The following figure (see chart 2) is a reflection of the area each component in our generation mix covers to meet the country-wide demand of power.

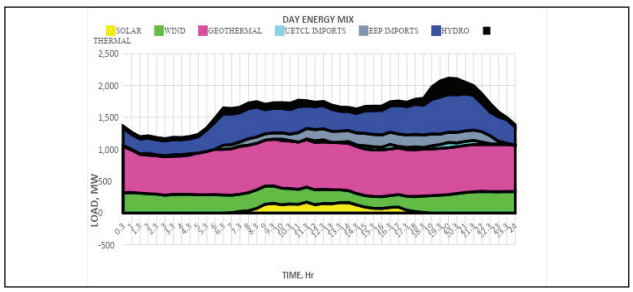

Fig2: Chart of July 7th 2023 load curve with different components of generation mix.

There are regulatory and operational barriers that limit the use of rejected geothermal energy during off-peak periods when the demand is low.[20] These barriers take the form of policies that favor the use of more expensive energy sources over rejected geothermal energy,[30] as well as regulatory frameworks that do not adequately support the use of this cheaper energy.[23]

Table 2 shows the amount of power (MW) curtailed/rejected and thus wasted in the month of July, 2023 with 7th of July venting out 435.7MW of power to the atmosphere. For charging electric tractors and other farm equipment, then that is the power to use. On average, assuming a single tractor of 200KW rating to charge daily for 5hrs and do a 5 acre farming, then the total average energy consumed would be 1000KWh units. Therefore for a fleet of 1000 tractors, the total energy consumption in a day would be 1000000KWh for 5000 acres. 10000 acres will take double (2000000KWh) the energy.

Therefore the value of 435MW on July 7th 2023 for the 5 hour off-peak period, will translate to 5 hours times 435MW giving 2175MWh or 2175000KWh of energy. The 1000 tractor fleet will leave a balance of 175000KWh of energy. That balance can go toward the integral pumped irrigation. In a week of 6 working days, 60000 acres will be cultivated. Therefore if we have 1000 tractors bought with government support, in a month of 24 working days, a total of 10000 acres by 24 equal to 240000 acres. At the end of it, what would have been rejected geothermal energy will find its use and thus enhances food security. These numbers mean food security in the long run for the Country.

Table 2: Month of July Curtailed/Rejected energy

Mon	Tue	Wed	Thu	Fri	Sat	Sun
					1061.67 [1]	2776.233 [2]
808.233 [3]	1008.633 [4]	493.2 [5]	617.4667 [6]	435.6667 [7]	629.5 [8]	2080.5 [9]
1038.5 [10]	176.3333 [11]	402.5 [12]	611.8333 [13]	366 [14]	87 [15]	59 [16]
525.033 [17]	540 [18]	102.1667 [19]	489.5 [20]	534.5 [21]	1032 [22]	2418.833 [23]
1604.9 [24]	269.1667 [25]	558 [26]	548.9333 [27]	826.7333 [28]	483.83 [29]	1246.333 [30]
628.1667 [31]						

So as it is now, unless unforeseeable circumstances arise, there is enough and available energy for farmers to power their farming equipment and drive sustainable agriculture to food security. The government of Kenya already has an electricity tariff that gives manufacturers power at discounted rates.[24] This Times of Use (ToU) tariff, which offers large power users a 50 per cent cut on their bills on meeting certain thresholds, is set by the Energy and Petroleum Regulatory Authority (EPRA).[25] Under the tariff announced in November 2017, industrial and commercial power users pay half the rate when they use power during the off-peak hours of between 10pm and 6am upon meeting certain thresholds.[26] Many commercial and industrial customers are already benefiting from the ToU tariff. Large power users metered at between 450 volts and 11 kilovolts (kV) pay as low as Sh15 per unit of electricity consumed under the tariff.

With this kind of framework in place, then it is incumbent of the Government to expand such plans to the agricultural

sector to boost food production towards sustainability and self-reliance after subsidizing the importation of electric driven farm equipment. Dropping the tariffs even further, will spur the purchase of more and more electric powered tractors among other equipment and negate the narrative that their prices are exorbitant and uneconomical. Pumped irrigation coupled with the technology of battery powered tractors will then drive the Kenyan agriculture dominated economy to growth.

8 Conclusion

The electric farm tractor market is no longer in its early stages but has experienced significant growth and technological advancements in recent years. The market is driven by increasing environmental concerns, stricter emission regulations, and the desire for sustainable farming practices. However, challenges such as limited battery range, longer charging times, and higher upfront costs compared to conventional tractors still need to be addressed to accelerate adoption. Major agricultural machinery manufacturers, as well as startups, are investing in research and development to bring more efficient and affordable electric tractors to the market.

Rejected geothermal energy is therefore a valuable and often-overlooked source of clean and renewable energy. It is and has the potential to make a significant contribution in food production. By capturing it, it is possible to increase food production through electric driven tractors. From the foregoing, it can convincingly be used for modern irrigation farming instead of reliance on unpredictable weather conditions. That will then reduce greenhouse gas emissions. While there are challenges in investing in these electric tractors, such as high upfront costs and technical difficulties, the potential benefits of using them make it an important consideration in clean energy farming and food security future. As such, it is important to continue exploring and imploring technologies and policies that support the production and use of this rejected energy whose use will increase food production and security in the country.

9 Acknowledgement

Many thanks to my colleagues at Kenya Power and Lighting Company Limited and my family for their generous, valuable support and words of encouragement during the period of writing this paper.

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The Carbon Gap in Sustainable Housing and Infrastructure Development, A Lifecycle Approach for Climate Change and Adaptation in Developing Countries

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1 Introduction

The world today is faced with troubling issues of rising accumulation of greenhouse gases and consequent global warming (Tathagat and Dod, 2015). According to the Paris Agreement 2015, a target was established to reduce the global temperature rise at between 1.5ºC to 2ºC above pre-industrial levels by 2030. According to the International Development Infrastructure Commission Recommendation Report, 2020, an outlay estimated at US$ 90 trillion is required for infrastructure development by developing and emerging countries for the period 2016-2030. Further, the United Nations (UN) conference on trade and development estimated US$ 2.5 trillion to address the investment gap in developing countries including infrastructure needs annually to realize the global goals. Noting that each infrastructure and building construction has a carbon footprint, higher carbon or greenhouse gas GHG emissions are expected from developing countries. This applies if business as usual situation is sustained in engineering developments.

Beside Kenya being a signatory and obligated to the Paris Agreement 2015 and use of Kenya Carbon Emissions Reduction Tool (KCERT 2050) to establish optimal energy pathway to realize reduction in GHG emissions by 32%, there exists a gap in carbon and GHG emission management i.e., tracking, measurement, accounting and reporting at project or activity level in Kenya. The application of the KCERT2050 tool is only limited to modelling energy consumption and corresponding annual GHG or carbon emissions for policy considerations. The identified gap which is lack of mechanism to project, measure, track and account for carbon emissions in projects impacts sector level performance and reporting on carbon or GHG emissions. The study focused on construction sector where housing and infrastructure constructions are highest. Buildings are responsible for 35% of global energy consumption and 38% of global energy-related CO2 emissions (United Nation Environment Programme (UNEP), 2020). Kenya's carbon or GHG emission data is primarily collected from the operational or use phase of most projects implemented across various sectors. This is inadequate as it lacks life cycle carbon contribution. For green construction, project life cycle PLC approach with life cycle assessment LCA is commended for wholistic determination of carbon footprint (CF) [15]. The deficiency of data on carbon estimates at project determinative stages i.e., initiation, planning, design, approval, commissioning, decommissioning and disposal impedes emission control over the PLC [1,8]. The LCA is beneficial to decision-making process in that it can be used to review sustainability initiatives throughout the entire life cycle of the infrastructure or building, including the design, detailing, delivery and disposal phases. A number of studies in North America, Europe and Japan used LCA as a useful tool for determining the carbon footprint and embodied energy consumption in assessing the environmental performance of buildings (Lemay, 2011, Bribián et al., 2009, Junnila and Horvath, 2003, Junnila et al., 2006, Suzuki and Oka, 1998). Various construction activities lead to environmental pollution through land clearing, equipment's engine emissions, demolition, burning, and use of dangerous chemicals, among others according to (Adebowale Philips Akinyemi et al., 2017). Lack of accurate accounting and tracking emissions as identified in the gap further risks loss of credit opportunities in carbon markets. Effective accounting of carbon emission requires continual evaluation of variances during the entire PLC comparing baseline estimates established at project initiation (planning) versus actual levels measured during construction, operation or use phase. Building construction accounts for an estimate 40% of global energy-related emissions.

The study used qualitative techniques and reviewed literature associated with reduction of carbon or GHG emissions in construction project with notable case study of buildings [2,3,4,5,6,8] and port construction [15]. The study recommends use of project life cycle PLC approach with incorporation of life cycle assessment (LCA) [2,3,6,8,13]. PLC assures effective projections of carbon or GHG emissions for project life cycle however LCA established embodied energy analysis and emissions for materials (with existing carbon values or coefficients) and components used at different stages of project life cycle [1]. Study findings to improve policy framework, adoption of carbon plans, and establish inventory for sustainable materials (carbon coefficients) etc. These will improve carbon or GHG management through introduction of carbon plans in project approval and funding as part of sustainability, accurate reporting on carbon or GHG emissions and projections, increased opportunities in carbon markets for infrastructure and housing projects by the Government of Kenya, public and private sector players and non-governmental institutions. Stakeholders in regulatory, standards and capacity building notably the Institution of Engineers of Kenya (IEK), the Engineers Board of Kenya (EBK) and Environment Institute of Kenya (EIK), ministries and other agencies etc. will use the findings to advance low emission strategies and capacity at sector and institutional levels for engineering development and success of NDC targets.

1.1 Carbon Quantifications

Carbon footprint is a measure of the exclusive total amount of carbon dioxide emission that is directly and indirectly caused by an activity or is accumulated over the life stages of a product, including activities of individuals, populations, governments, companies, organizations, processes, industrial sectors etc. *(Wiedmann and Minx, 2008).* Outstanding merit for CF calculation is that it is possible to adapt it to any project

[15]. All sectors should be obliged to perform CF calculations for posterity more so construction sector whereby significant impact on the environment due to large earth movements, the treatment of compound materials, and land modification is prevalent. Globally, 20% of carbon and GHG emissions are generated by construction sector being the first in material(s) consumption. LCA methodology allows calculation, evaluation, and interpretation of the generated emissions during the lifetime of an infrastructure or building thereby showing the GHG produced during all the project phases [2,3,6,8,13]

1.2 Project Life Cycle (PLC) for Carbon Reduction in Construction Projects.

LCA allows the calculation, evaluation, and interpretation of the generated carbon emissions during the lifetime of an infrastructure, building thereby showing the GHG produced during all the project phases [2,3,6,8,13]. PLC acts to establish the start and end of a project [1]. The four stages in PLC are initiation or conceptualisation, planning or design, execution or implementation, and termination or closure [1]. Green and conventional projects are similar with one notable dissimilarity. Green construction model focuses on sustainability and environment friendly requirements unlike conventional. PLC requires low carbon emission or GHG strategies to be considered at the project initiation and concept stage [1]. These benefits are transferred inter-stage to the end of the project [1]. Each project stage in a green construction concept interrelates with the next for transfer of green benefits or low carbon gains [1]. It is expected that an accumulated gain of green benefits is realizable at the end of the PLC [1].

1.3 The Initiation phase / Project Initiation

At this stage conceptualization or concept development incorporates low carbon planning. This impacts the design concept and whole series of construction activities to the project end of life [1]. The owner sets a green centric project strategy leading to green designs, shapes, technology, and construction. Green model influences the process(s) hence control project financing, team, cost, quality, and time [1]. The people qualifications include training on sustainability and or low emission. Stage deliverable(s) comprises documentation on tasks, responsibilities, project details (name, budget, appointments etc).

1.4 The Design Phase / Project Planning

The most significant stage of PLC that projects expected carbon or GHG emissions associated with the gradual implementation of a projects [1]. Green drawings, designs and building specifications done for low carbon. Consultancy or expertise sourced for complex projects to avert risks of poor designs causing changes in project scope, and strategy, repetitive work, delays in schedule, and cost swelling [1]. Green centric design comprises two main aspects: (1) Life Cycle Assessment (LCA) and (2) Eco-Conscious Design (ECD) [1]. LCA is key in determination of embodied carbon hence critical for material selection [2,3,6,8,13]. Green centric planning stage assures deliverables that transfer benefits to construction stage in form of project structure and team, detailed design drawing(s), task scope(s), technical data, project schedules, work schedules, material / spending schedules, procedures, etc.

1.5 The Construction Phase / Project Execution

Dependent on the deliverables from initiation, planning and design stage [1]. Major risks occur that change project scope at this stage notably force majeure, resource and finance constraints, contractual and stakeholder conflicts etc [1]. Key activities are supply of materials, construction methods, use of tools and labour, waste management and upkeep prior to handover. These influence emissions mainly choice of materials and transportation. Cradle to gate, cradle to site and cradle to handover processes apply in supply of materials for low emission objectives. Heavy equipment consume fossil-derived oils hence higher footprint. Labour efficiency during construction activities determines carbon reduction as carbon is calculated on the activities of workers during the project. Waste management and residual cleaning of buildings and maintenance of buildings is the ultimate activity of the project life cycle [1]. Direct carbon-based wastes originate from the combustion process of material waste at the project site while indirect waste come from the process of transporting solid waste discharges to landfill sites. Research shows that construction industry produces large amounts of waste and more than 50% of the waste material is deposited in the final dump [1]. Nearly 26% of landfill sites are occupied by construction waste [1]. Quality and control are key at this stage of construction. Deliverables are project documentation i.e., reports comprising of change management, tests, inspections, risks and meetings.[1].

1.6 Project Handover / Closure / Operational / Maintenance

Final examination of works in respect to the contractual scope is done upon completion of construction stage. Detailed checklists are used containing all items of work including pending item(s) capture in defects liability period. Once all corrective actions are effected, it is necessary to review all construction activities before the work is declared complete and handover to owner. The final inspection should involve all key stakeholder representatives. The final deliverable is documentation comprising all control documents in the construction phase, final drawing (as built drawing), and the operating manual and the handover report. Green construction concept requires an evaluation of carbon and GHG emissions is performed to account for variances in actual project emissions from projections at initiation.

1.7 Carbon Emission in Construction

Infrastructure and buildings constructions consume the largest volumes of materials. This makes them lead in carbon emissions due to high embodied energy in materials used. Embodied Energy corresponds to the energy expended by all processes associated with the production of building materials and their components. This includes mining, manufacturing materials and equipment, assembly and transportation etc. Therefore, total contained energy during construction of infrastructure and buildings is directly proportional to the level of complex material used and process(s) involved. In typical construction(s) highest emissions of CO2 arise from the use of concrete, aluminium and steel. These have high contained energy levels. This imply the contained energy is as an indicator of the overall environmental impact of building materials and systems. Carbon energy is the energy spent during the construction process. It is consequential energy from the manufacturing, distribution / supply, transportation and equipment used during construction work. Generally, it comes from combustion (fossils), such as in factories and vehicles. Embodied carbon is calculated by KgCO2 / Kg unit of material or based on its functional unit using kgCO2 / m3 of material or kgCO2 / m2 of material, where each material has different energy values.

2 Methodology

This study used qualitative methods Literature associated with reduction of carbon emission Literature on select cases associated with low carbon emission strategies were reviewed as follows building construction in Western Australia [4], Port Construction [15], Industrial Park in China [7], storey building Växjö, Sweden [8]. The study analysed and divulged findings and interpretations of previous research on reduction of carbon emissions. The study attempted to categorize the content of the research into the project life cycle (PLC) scope. Grounded on this opinion, the formulation of research problems associated with carbon emission in relation to PLC drawn clearly.

The study adopted two steps to improve the quality and reliability of the literature review sources (Alwan et al., 2017). Firstly, using organized keywords in well-established and high-quality scientific journals and repositories. Key words were used to collect materials for the study. The study adopted two steps to improve the quality and reliability of the literature review sources (Alwan et al., 2017). Firstly, using organized keywords to collect information in well-established and high-quality scientific journals and repositories. Lastly the literature review of carbon emission reduction strategies from industry, Governments and international agency reports, Internet and media publications, etc. Further secondary data sources in the form of a literature review consisting of industry, Government and international agencies reports, internet and media publications, etc were used. Purposive sampling and descriptive analysis methods used in data collection however analysis and interpretation done by mapping each of the research topics of the journal in tabular form. Table 1 below comprise results of research journal mapping on carbon emission reduction strategy reviewed in PLC as below.

3 Results

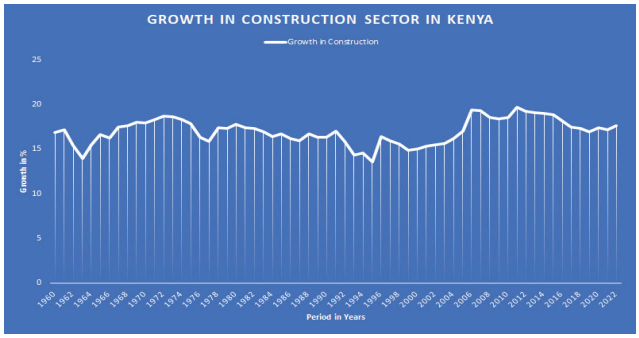
Table 1. Research On Carbon Emission Decrease Strategies Reviewed in The Project Life Cycle (PLC).

Reference	Year	Location	Type of Research / Analysis	Type of Construction	Parameter Studied	Project Life Cycle – PLC			Case Study
						Init	Design	Const	
Pomponi & Moncaster	2016	-	LCA	Building	CO2	-	-	X	Construction
Atmaca & Atmaca	2015	Turkey	LCA (LCEA & LCCO2A)	Building	Energy & CO2	-	-	X	Building const, operation & Demolition
Baek et al.	2013	-	LCA (LCCO2)	Building	CO2	-	X	X	Design, Const, Operation, Disposal
Dong et al.	2013	SETDZ, China	Hybrid LCA	Industrial Park	CO2 / GHG	-	-	X	Operations
Pomponi & Moncaster.	2016	European Union-EU	LCA,	Building	CO2	-	X	X	Design, Const, Operation, Disposal
Biswas, 2014	2014	Western Australia	LCA	Building	CO2	-	X	X	Design, const, Operation, Disposal
Chou & Yeh	2015	-	LCA & Monte Carlo	Building	CO2	-	X	X	Design, const, Operation, Disposal
Gustavsson et al.	2010	Sweden	LCA & Bottom-up	Building	CO2	-	X	X	Construction

Source: (Author,2023), NB: Range in years 2010 < > 2016

LCA concept evaluates the resources inputs, including energy, water and materials, and environmental loadings including CO2 emissions and wastes of a building during different phases of the life cycle. Equation

I= (1), where I represent the life cycle environmental impact.



Source: data.worldbank.org

Figure 1: Growth in construction sector in Kenya period 1960 to 2022.

It is deducible from figure 1 above that construction sector in Kenya had a growth rate of 17.7% in the year 2022. Construction industry in Kenya is expected to grow by 7.7% reaching KES 973 billion-in 2023[11]. The construction output in the country is projected at KES 1,279.1 billion by 2027[11].The industry is expected to register annual average growth rate of 5.7% from 2023 to 2026, supported by investments in transport, electricity, housing, and manufacturing [10] Additionally construction are 250,000 new affordable houses every year through PPPs, new 'level six' hospitals in six new sites, a 100,000km fiber optic connectivity network, and building a 700km road along the Kula, Isiolo, Mawe-Modogashe-Samatar-Wajir-Kutulo-El Wak-Ramu corridor, etc. [10]. All these constructions will increase the carbon footprint if business as usual scenario persists

4 Discussion

Table 1 above illustrates the literature-based review on carbon emission reduction relation to activity on the project life cycle PLC. From the 8 pieces of literature, researchers adopted the LCA method. A case of hybrid LCA as well as combinations of LCA with other analytical models noted i.e., Monte Carlo simulation, and Bottom-up analytical techniques. LCA is prevalent for analysis of embodied energy and consequent carbon emissions over a material, product or item lifecycle. This is useful for emission reduction strategies in construction noting most materials used emit variant levels of carbon dependent on embodied energy. It is noteworthy that PLC requires low carbon strategies be incorporated at the project initiation stage. The 8-research literature reviewed did not explicitly demonstrate in PLC activity.

Table 3 Summary of activities recommended under each stage of the PLC for low carbon model.

No	Initiation	Design	Construction and handover
1	Stakeholder awareness for low carbon planning	Emphasis on low carbon designs with attention to optimizing the structure / building element.	Optimize and go green procurement or green supply chain for faster acquisition of material and equipment distribution
2	Government facilitate dissemination of knowledge on low carbon strategies.	Prioritization of low carbon building materials.	Reduction of emissions through machine optimisation and increased operator expertise.
3	Government and International institution establish environmentally sound building standards planning the building	Design for ease of disassembly	Best choice of construction method to increase efficiency in time, cost and material to have low waste generation.
4		Design concept to include use of renewable energy.	Use of eco-labelled materials in every building component for carbon reduction
5		Use of PLC and LCA in selection of low carbon material i.e., cement, steel & ceramic important.	Optimisation of energy, electricity, gas and water and material utilization in every construction operational activity
6		More innovative low carbon designs.	Adoption of the concept of reduce, reuse and recycle in waste management.
7			Utilize new technologies and renewable energy for reduction of carbon emissions
8			Engineer building structures using green cement and utilize wood materials to further reduce carbon emissions

Source: Author, 2023

5 Conclusions

The Government has prioritized affordable housing and infrastructure development in Kenya. It is noteworthy that Kenya is a signatory to the Paris Agreement 2015 and hence obligated through NDC to ambitiously achieve below 2C temperature rise by 2030. Each project regardless of scope has a carbon footprint. The carbon emissions reduction measures in the construction life cycle start from the initiation stage where the project owner has great authority in determining the whole series of construction activities [1]. The PLC approach ensures that putting forward the concept of low carbon in the initiation phase, the same is passed to successive stages of PLC herein low carbon design and further low carbon construction [1]. Therefore, the concept of low carbon will be developed on low carbon operational, low carbon dismantling and recycling following the life cycle of the building. In addition, current issues on the taxation of carbon in each sector including construction will emphasise the stakeholders to prefer the concept of low carbon development as well as sustainable environmental insight.

However, priority should also be placed on the selection of sustainable construction management techniques, useof heavy equipment, production of construction material, human activities at the site, and transportation *(Hong et al., 2014)*. Furthermore, greater emphasis needs to be given to macro-level management, international collaboration, and the development of concepts, technologies, and standards related to low-carbon construction due to their significant contributions towards net-zero energy building development *(Shi et al., 2015)*.

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ENGINEERS BOARD OF KENYA
Enhancing Professionalism

Current State of Engineering, Initiatives for Improving Skills and Professional Development Initiatives

By Eng. Margaret Ogai, CE, FIEK
Registrar/CEO, Engineers Board of Kenya

Can you provide an overview of the current state of engineering education in Kenya?

Engineering education and professional development are vital for Kenya's development as it strives to compete in an increasingly globalized world. We so far have 15 universities in Kenya offering 66 recognized engineering degree programs. The scope of disciplines has also grown from the traditional civil, mechanical, electrical engineering to include mechatronics, biomedical, aeronautical, mining, marine, materials & metallurgical, chemical & process among others.

One of the functions of the Board as per the Engineers Act 2011 is to recognize both local and foreign engineering programs. The programs are recognized through a process of independent review to ensure that the graduates have the necessary attributes to seamlessly transition to industry upon graduation. The Board has recognized 66 programmes which graduate over 2,500 students annually. This year, the Board targets to complete review of 26 pending programs.

The Board is currently working on a joint accreditation framework with the Commission of University Education to ensure that the standards of recognition of engineering programmes is seamless.

What trends and challenges do you see in the engineering education sector today?

Currently, engineering programs in Kenya are not recognized globally. To remedy this, the Engineers Board of Kenya is currently undergoing mentorship to accede to the Washington Accord which is global mutual recognition for Internation Engineering Alliance (IEA). The Board is being mentored by the Pakistan Engineering Council and the Board of Engineers Malaysia and is looking to attain provisional signatory status by June 2025. Acceding to the Washington Accord will enable global recognition of Kenya's engineering education and facilitate global mobility of our engineers to other jurisdictions that are signatories.

Engineering is a prerequisite when it comes to the development of any country, as most infrastructural needs are driven by engineers; be it roads, telecommunications, energy, electrical systems and manufacturing. As the government implements the Bottom Up Transformation Agenda (BETA), there is a great need to deploy engineers in all sector of the economy, to enhance productivity and competitiveness of our nation.

Currently there are trade negotiations for liberalization to enhance professional engineering services under East Africa Community (EAC), African Continental Trade Agreement (AfCTA) and World Trade Organisation (WTO) agreements. This requires that Kenya's is able to produce competent and capable engineers who are able to compete on a global platform. This calls for greater linkages between industry and academia to drive innovations, open up new skill areas, re-tooling and ensuring that the engineering programmes are addressing the needs of industry and therefore, there will be less reliance. The goal would be to produce and export engineering services to other countries especially within the continent where there is acute shortage of engineering skills.

What role does practical training and internships play in engineering education, and how does the EBK support these initiatives?

An engineering professional's lifecycle goes through three key stages which are all regulated by the Board, namely, recognized engineering education, a period of engineering training and finally, engineering practice.

Sound and wholesome engineering education is the prerequisite for one to become a professional engineer. When one goes through recognized engineering education, then they attain graduate attributes which prepares them to get into the next phase in the engineering value chain, i.e. engineering training.

To ensure that an engineer goes through structured training, the Board has mounted the Graduate Engineers Internship Programme which seeks to ensure that graduate engineers undergo structured training that will give them the professional competencies required for professional registration. The Board runs 3 models of the Programme as follows: -

i) EBK GEIP (Exchequer Funded) model – for fresh graduates
ii) Agency-based model – for graduate engineers already in employment in industry
iii) Academia-based model – for graduate engineers employed in academia

The Board collaborates with various Ministries, Departments & Agencies and Engineering Consulting Firms in the delivery of the GEIP programme.

Towards EBK strategic intent to register 10,000 Professional Engineers , the Bard is seeking expansion of the EBK GEIP model to 2,000 per annum and has submitted proposal to government on the same . This will address the high unemployment of the Graduate Engineers.

What steps is the EBK taking to promote gender diversity and inclusion within the engineering profession?

Currently, only 12% of the engineers' registered by the Board are women.

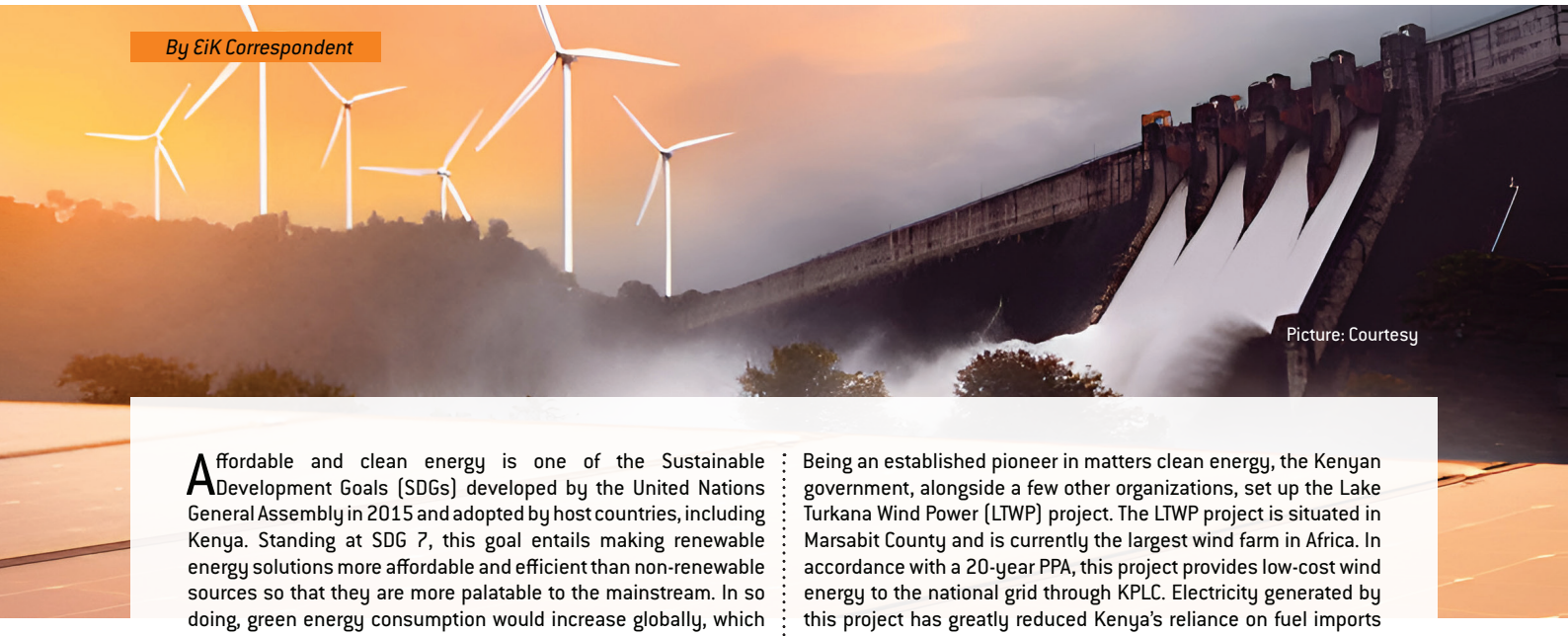
The Board collaborates with Institution of Engineers of Kenya (IEK) and Association of Civil Engineers of Kenya (ACEK) and supports the Women Engineers Chapter (WEC) and Future Leaders program. The Board is actively involved in carrying out and funding mentorship and outreach programmes in high schools and universities to encourage more girls to take up STEM subjects and to pursue careers in STEM. The Board has submitted proposals for funding to implement a women engineers development program which will include training, leadership development and policy identification for gender mainstreaming across public and private sectors.

Are there any international partnerships or collaborations that the EBK is currently engaged in?

Yes, the Board participates in and is a member of various regional, continental and global Organizations. Firstly, with the East Africa Community -Mutual recognition Agreement (EAC-MRA) which aids in cross- registration of engineers and harmonization of engineering standards across the region. The Board is also an affiliate member of the World Federation of Engineering Organization that helps to tap the international resources like training and best practices globally. Further, the Board has an MOU with the Korean Professional Engineers Association in which they collaborate on development projects, capacity building and cultural exchange. Finally, the Board wants to become a provisional member of the Washington Accord/ International Engineering Alliance. These collaborations are creating several opportunities for Kenyan engineers globally.

Sustainable Energy Silutions in Kenya's Energy Needs: Advances in solar, wind, and geothermal energy projects, their implementation, and benefits

By EiK Correspondent



Picture: Courtesy

Affordable and clean energy is one of the Sustainable Development Goals (SDGs) developed by the United Nations General Assembly in 2015 and adopted by host countries, including Kenya. Standing at SDG 7, this goal entails making renewable energy solutions more affordable and efficient than non-renewable sources so that they are more palatable to the mainstream. In so doing, green energy consumption would increase globally, which would help mitigate against climate change.

Kenya has been achieving remarkable progress in establishing and implementing sustainable energy solutions that are in consonance with Kenya's energy needs. This is done through the relevant state agencies such as the Rural Electrification and Renewable Energy Corporation (REREC), Energy and Petroleum Regulatory Authority (EPRA) and the Geothermal Development Company (GDC).

Through REREC, Kenya was able to set up the Garissa Solar Power Plant, a flagship project of the agency. The Garissa Solar Power Plant was set up to harness solar energy with a view to diversifying the power generation mix and reducing reliability on electricity. It boasts an installed capacity of 54.65 MW, making it the largest grid connected solar power plant in the East and Central Africa region.

All the power generated through this plant is sold to the Kenya Power and Lighting Company (KPLC) through a Power Purchase Agreement (PPA). To implement this project, a 6-kilometer, 132 KV power transmission line was constructed between Kenya Electricity Transmission Company (KETRACO) sub-station located in Garissa and the REREC solar power plant that feeds the generated power into the power grid.

The Garissa Solar Power Plant is an outright manifestation of Kenya's commitment towards adopting sustainable energy solutions that not only mitigate climate change but also satisfy Kenya's energy needs by improving access to electricity in rural areas. Additionally, this program has significantly reduced Kenya's overreliance on fossil fuels, which is a firm step towards fulfilling SDG 7.

Wind power is an equally clean source of energy whose popularity is increasingly growing among green-thinking countries. Since it doesn't require burning coal or fossil fuels to harness, it produces no carbon emissions, making it one of the cleanest alternatives to non-renewable sources of energy.

Being an established pioneer in matters clean energy, the Kenyan government, alongside a few other organizations, set up the Lake Turkana Wind Power (LTWP) project. The LTWP project is situated in Marsabit County and is currently the largest wind farm in Africa. In accordance with a 20-year PPA, this project provides low-cost wind energy to the national grid through KPLC. Electricity generated by this project has greatly reduced Kenya's reliance on fuel imports from neighbouring states.

Since its inception, the project has led to the upgrading of more than 200 kilometers of the roads leading up to the wind farm site, which is beneficial to the community around the farm. As part of its Corporate Social Responsibility (CSR), the LWTP also contributes to the development of social amenities around the area. For the example, the Burri-Aramia dispensary in Laisamis constituency is a direct beneficiary of LWTP's financial support. Currently, the dispensary enjoys increased access to vaccination programs and higher maternity birth rates thanks to the support of LWTP.

Aside from its impressive advances in solar and wind energy, Kenya is also home to Olkaria Geothermal Project, one of the largest geothermal power plants in Africa. The Olkaria Project is located within Hell's Gate National Park in Nakuru County, and it sources energy from the magma bodies below the surface of the Olkaria landscape. To harness this energy, wells are excavated to tap water and steam at very high pressures and temperatures. The tapped steam is then piped to turbines which rotate generators and produce electrical energy.

Geothermal energy provides a fairly reliable power supply that remains largely unaffected by weather conditions. It is a clean source of energy that contributes significantly to Kenya's energy needs. In addition to catering to the country's energy supply needs, the Olkaria Project has also created several job opportunities during different phases of its operation, thereby benefitting members of the Olkaria community.

SDG 7, like all other SDGs, is a progressive goal that cannot be achieved overnight. However, it would be a grave injustice to fail to recognize the commendable steps Kenya, through state agencies like REREC, has made towards achieving this SDG. By harnessing these alternative sources of clean energy, we reduce our reliance on fossil fuels and in the process, leave the world a better place for the benefit of future generations.

Digital Transformation in Engineering: The Role of Technology in Modern Engineering Practices

By Lorein Odhiambo

Introduction

In the last three decades, engineering has been a fairly technological space. There is no hiding that with the constant advancement of tools, software, and equipment, it is crucial for professionals in this sphere to evolve and reinvent themselves on a regular basis.

Engineering has been a fundamental part of human development and progress for centuries; From the ancient Egyptians building pyramids to the latest advancements in technology, engineering has played a vital role in shaping the world we live in.

As technology continues to evolve, engineers are at the forefront of innovation, developing new and improved solutions to the challenges we face today. From tackling climate change to improving healthcare, engineers are working to create a better future for everyone.

Impact of Technological Advancement on Engineering Practices today.

Picture: Courtesy

In Kenya, digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT) and Blockchains are being adopted to address local challenges and enhance engineering practices.

For example, AI and IoT are being utilized in large-scale infrastructure projects like road construction and urban development to improve efficiency and quality. In the renewable energy sector, IoT and AI aid in the management and optimization of projects, enhancing energy production and distribution. Block chain and IoT are also making significant strides in agricultural engineering by improving supply chain transparency and enabling precision farming.

i. Artificial Intelligence Technology:

At its most basic, AI technology encompasses various techniques that enable machines to simulate human-like intelligence. For those already working in engineering fields, knowledge of the technical advancements in AI can provide a valuable way to get ahead and stay relevant.

Machine Learning (ML) focuses on developing algorithms that allow systems to learn from data and improve their performance over time without explicit programming. ML can perform tasks like predictive maintenance, optimization, and automation, freeing up the engineer's time for creative problem-solving.

Neural networks are another subset of AI. They are designed to mimic the functioning of the human brain by processing data through interconnected nodes to recognize patterns and make decisions. Engineers apply neural networks for tasks such as image recognition, fault diagnosis, and control systems to make their work more efficient.

Data analytics involves analyzing vast amounts of data. AI-driven data analytics tools help engineers streamline tasks such as predictive modeling, risk assessment, and performance optimization.

ii. Blockchain technology applications

In Kenya, blockchain technology is being adopted across various engineering projects to address local challenges and improve practices. For instance:

a) Infrastructure Projects: Blockchain is being used in large-scale infrastructure projects to ensure transparency and accountability in project management and execution.

b) Renewable Energy: In the renewable energy sector, blockchain helps manage and optimize energy production and distribution by providing a secure and transparent record of energy transactions and usage.

c) Agriculture: Blockchain is revolutionizing agricultural engineering by enhancing supply chain transparency and enabling precision farming. By recording and sharing data securely, blockchain ensures that all stakeholders have access to accurate and reliable information.

iii. Internet of Things Technology

The Internet of Things (IoT), on the other hand, is making significant strides in Kenya, particularly in the utility sectors, where it is enhancing efficiency, sustainability, and service delivery. Various sectors, including transportation, energy, waste management, water, and sanitation, have adopted IoT solutions.

The energy sector has adopted IoT in the form of smart metering, micro grids, and PAYG cooking. Even with the limited IoT use in its operations, Kenya Power and Lighting Company (KPLC) has, in the recent past, installed smart meters to over 55,000 SME customers as part of a World Bank-funded project. KenGen has also integrated IoT within its geothermal sites to enable remote monitoring. This clearly shows how Kenya has made strides in the use of Pay-As-You-Grow (PAYG) solar household systems to provide affordable energy alternatives. The rapid growth of PAYG solar has largely been driven by the country's extensive mobile money coverage, which has enabled clients to make payments over time. The use of mobile payments in IoT use cases has been replicated in several other sectors, such as water, irrigation, and clean cooking.

In the waste management industry, the most prevalent IoT use cases are smart bins that involve remote monitoring of the location and container waste level, as well as smart recycling.

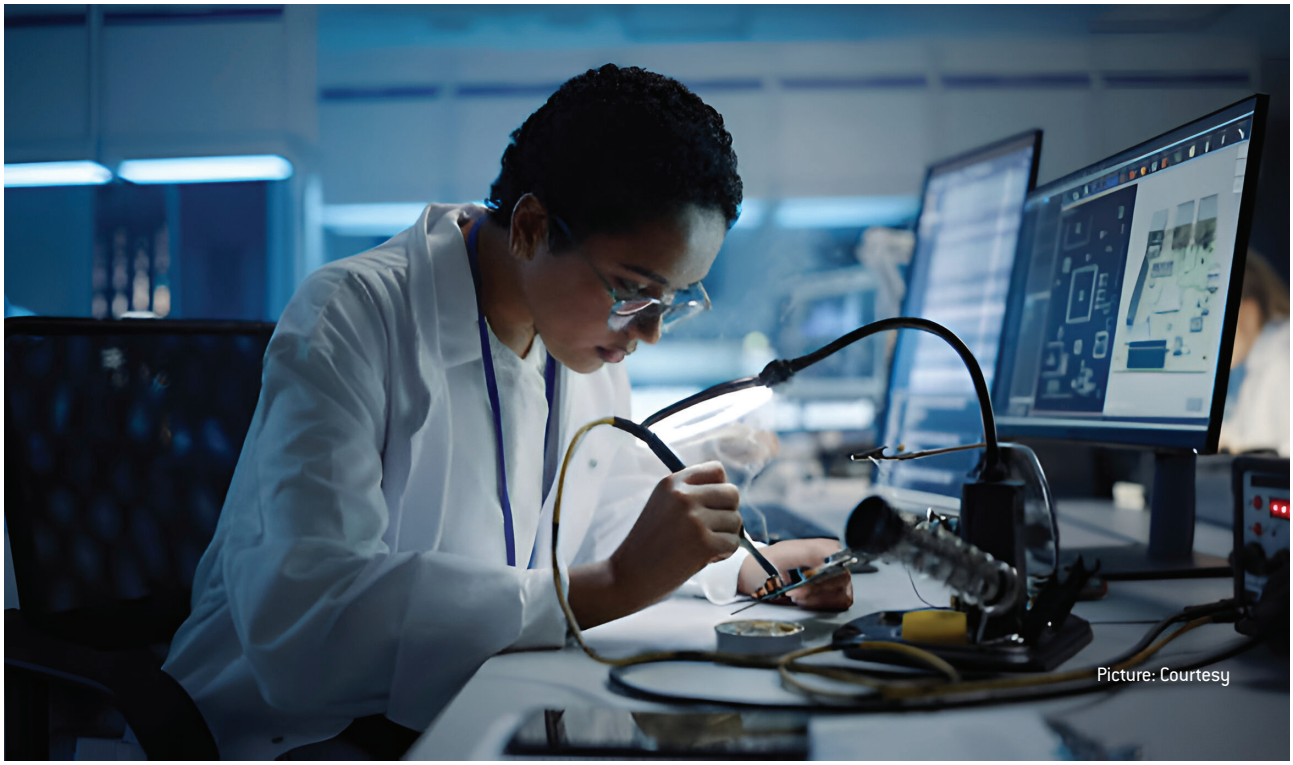
Notably in the water sector, water treatment, smart water meters, water ATMs, and supply network monitoring are few of the IoT applications available. We have seen Safaricom's narrowband IoT network being used for piloting smart water meters in various cities in the country, creating a water product line. Furthermore, Liquid Intelligent Technologies has used its Sigfox network for a number of solutions in the water sector. However, most of the smart metering implementations have struggled to move past the trial stage, given the difficulty in generating a return on investment. Similar to the energy sector, the water sector has relatively demonstrated caution with testing IoT applications.

The transportation sector stands out as having the highest number of IoT applications. The sector has profoundly embraced IoT through various applications such as asset tracking, smart public transport, delivery drones, and electric vehicles. Electric vehicles have been equipped with sensors to monitor routing and energy consumption in addition to pointing to nearby charging stations available on their routes. Drones, on the other hand, are increasingly being used for the delivery of items, mostly medical supplies, in Kenya. Asset tracking is the most common use case of IoT in the transport sector. Companies such as Safaricom, Airtel, and Liquid Intelligent Technologies have since offered a range of fleet management and asset-tracking solutions through their networks.

As IoT continues to evolve, its impact on utilities in Kenya is expected to grow, driving further innovation and improvement in quality of life.

Conclusion

By embracing digital technologies, our country is positioning itself at the forefront of engineering innovation. All the ongoing transformation that we see highlight the importance of continuous learning and adaptation in the engineering field, seeing to it that professionals stay ahead in an ever-evolving technological space.



Picture: Courtesy

Innovative Engineering Projects in Water Supply, Irrigation and Sanitation

By Audrey Rendo

Kenya is on a transformative journey in the fields of water supply, irrigation, and sanitation. Despite the challenges posed by rapid population growth, climate change, and urbanization, the country is making remarkable progress. Leading the way, organizations like Davis & Shirtliff and the Ministry of Water, Sanitation, and Irrigation are spearheading innovative engineering projects that are creating sustainable solutions and significantly improving water management. These efforts are not only addressing the current challenges but also paving the way for a brighter, more resilient future for Kenya.

Current State of Water Supply, Irrigation, and Sanitation in Kenya

Kenya's water resources are unevenly distributed, with some regions experiencing severe water scarcity. The country's water supply infrastructure is outdated and inadequate, particularly in rural areas. According to the Ministry of Water, Sanitation, and Irrigation, only about 60% of the population has access to safe drinking water, and sanitation coverage is similarly low, especially in informal urban settlements.

Irrigation is another critical area, as agriculture accounts for a significant portion of Kenya's economy and employment. However, inefficient irrigation practices and limited access to modern technologies hinders agricultural productivity. The government and private sector are increasingly recognizing the need for sustainable solutions to these pressing issues.

Innovative Projects by Davis & Shirtliff

Davis & Shirtliff, a leading supplier of water-related equipment in East Africa, has been at the forefront of innovative engineering solutions in water supply, irrigation, and sanitation. Some of their key projects include:

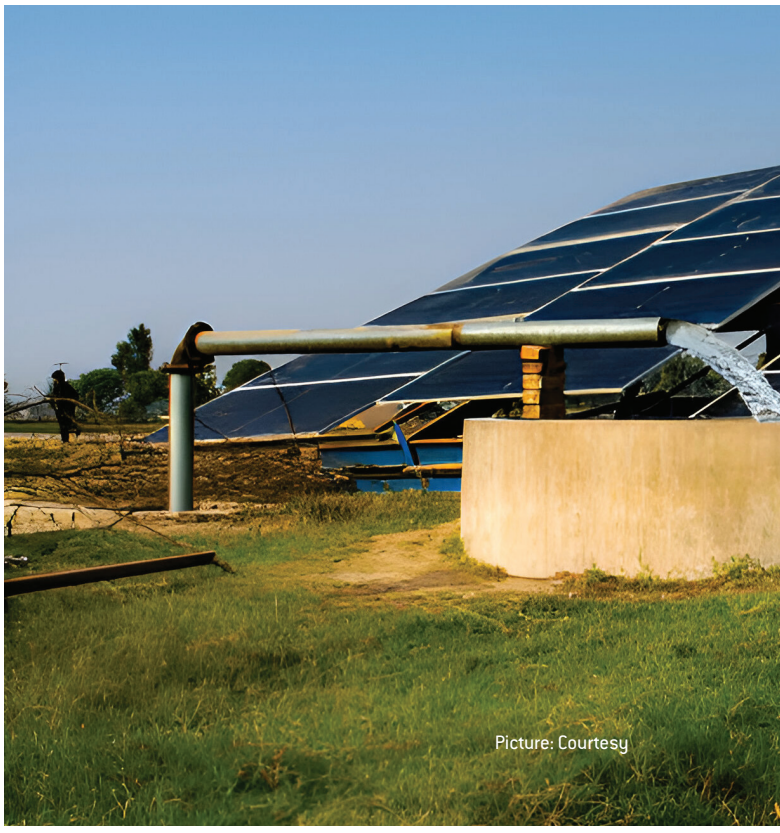
- *Solar-Powered Water Pumps:* Davis & Shirtliff has developed and deployed solar-powered water pumps to provide reliable water supply in off-grid areas. These pumps harness solar energy, making them an environmentally friendly and cost-effective solution. By reducing dependence on traditional power sources, they ensure a consistent water supply for drinking, irrigation, and other uses.

- *Rainwater Harvesting Systems:* To address water scarcity, Davis & Shirtliff has introduced advanced rainwater harvesting systems. These systems collect and store rainwater, which can then be used for domestic purposes, irrigation, and even potable use after proper treatment. This approach not only conserves water but also reduces the strain on existing water sources.

- *Smart Irrigation Systems:* The company has also embraced IoT-enabled smart irrigation systems. These systems monitor soil moisture and weather conditions to optimize water use, ensuring that crops receive the right amount of water at the right time. This technology significantly improves water efficiency in agriculture, boosting productivity while conserving resources.

- *Water Purification and Treatment Plants*: Davis & Shirtliff has been instrumental in designing and constructing modular water treatment plants that can be easily deployed in remote areas. These plants provide clean drinking water, improving public health and reducing the incidence of waterborne diseases.

- *Sanitation Solutions:* In the realm of sanitation, Davis & Shirtliff has developed innovative solutions such as biogas digesters. These systems treat waste while producing biogas, which can be used for cooking or electricity generation. This approach not only improves sanitation but also provides a renewable energy source.



Picture: Courtesy

Initiatives by the Ministry of Water, Sanitation, and Irrigation

The Ministry of Water, Sanitation, and Irrigation has been proactive in implementing large-scale projects to improve water access and sanitation across Kenya. Some of their notable initiatives include:

- *Community Water Management Programs:* The Ministry has launched community-driven water management programs that empower locals to maintain and oversee their water resources. These programs foster a sense of ownership and ensure the sustainability of water supply systems.

- *National Rainwater Harvesting Campaigns*: To combat water scarcity, the Ministry has promoted rainwater harvesting through nationwide campaigns and subsidies. This initiative encourages households and communities to adopt rainwater harvesting systems, particularly in arid and semi-arid regions.

- *Desalination Projects*: The Ministry has invested in large-scale desalination plants to augment freshwater supplies in coastal areas. These plants convert seawater into freshwater, providing a reliable source of drinking water for communities facing water shortages

- *Upgrading Water Treatment Facilities:* Upgrading existing water treatment facilities and building new ones is a key priority for the Ministry. These efforts aim to ensure that urban and rural areas have access to safe drinking water, reducing the risk of waterborne diseases. *Sanitation Infrastructure Improvements*: The Ministry has undertaken several projects to improve sanitation infrastructure, such as constructing eco-friendly toilets and enhancing sewage treatment processes. These efforts aim to protect water sources from contamination and improve overall public health.

Picture: Courtesy

In the evolving landscape of water management, several key trends are shaping the future of water supply, irrigation, and sanitation. These trends reflect advancements in technology, sustainability practices, and policy initiatives aimed at addressing global water challenges.

1. Decentralized Water Treatment

Decentralized water treatment systems, which treat water at or near the point of use, are becoming increasingly popular. These systems provide a flexible and scalable solution for rural and peri-urban areas, where centralized infrastructure may be lacking. They also reduce the risks associated with long-distance water transport.

2. Integrated Water Resource Management (IWRM)

IWRM is a holistic approach that considers the interconnections between water resources and other sectors such as agriculture, energy, and urban planning. This trend emphasizes coordinated and sustainable management of water resources, balancing social, economic, and environmental needs.

3. Climate Resilience

Water management strategies are increasingly incorporating climate resilience measures. This includes designing infrastructure to withstand extreme weather events, implementing drought-resistant technologies, and developing adaptive water management plans. Climate resilience ensures the sustainability and reliability of water supply systems in the face of climate change.

4. Public-Private Partnerships (PPPs)

Collaborations between the public sector, private companies, and non-governmental organizations are becoming more common. PPPs leverage the strengths of each sector to finance, implement, and manage water projects. This trend facilitates access to expertise, technology, and funding, driving innovation and efficiency.

Conclusion

The innovative engineering projects are transforming Kenya's water supply, irrigation, and sanitation landscape. By leveraging technology and sustainable practices, these initiatives are addressing critical challenges and paving the way for a more water-secure and healthy future for all Kenyans.

Role of Engineers in Addressing Climate Change

By EiK Correspondent

As climate change keeps posing a great threat to future generations, engineers in Kenya, with the help of the National Environmental Management Authority (NEMA), endeavor to take a proactive stance in fighting climate change by applying green practices in their projects. At the center of these projects is the net-zero goal; the reduction of net carbon emissions to zero in the foreseeable future.

The first step towards the net zero goal is replacing carbon fuels with renewable sources of energy. Judging by the increased use of solar energy as opposed to non-renewable sources energy in construction projects, the net-zero goal does not seem so far-fetched. The Kenya Off-Grid Solar Access Project (KOSAP) is one example of collaborative initiative between NEMA and Kenyan engineers, which aims to provide solar energy to remote areas in the country.

The KOSAP project is premised on the need to replace electricity with solar energy which is a green source of energy. In the project, NEMA is responsible for conducting environmental impact assessment before the construction of mini-grids begins. The authority also oversees environmental compliance and monitoring to ensure that the project is in full compliance with environmental standards during its pendency.

In 2011, NEMA, in collaboration with six other state agencies, embarked on the Kenya Coastal Development Project which was aimed at enhancing the management and exploitation of Kenya's marine resources. This project was financed by the Global Environmental Facility (GEF) and the World Bank and was scheduled to run for six years. Through this project, engineers have been able to apply environmental-friendly practices in building infrastructure that is instrumental in implementing this project, such as sanitation solutions and coastal protection structures. NEMA's involvement in this project was particularly focused on its third component, which is building coastal capacity for sustainable natural use and management.

Aside from environmental conservation, disaster resilience also ranks quite highly in the priority list of engineers in addressing climate change. Disaster resilience entails improving infrastructure to mitigate the impact of natural disasters. Such disasters range from floods and drought to landslides and earthquakes. In Nairobi, engineers are working hand-in-hand with NEMA to gradually improve the drainage infrastructure and prevent flooding in various areas of the county.

This includes building sustainable urban drainage systems (SUDS) and retention ponds, and improving storm water drainage systems. However, this is very much still a work in progress as borne out by the amount of flooding that happened in Nairobi when the country was experiencing El Nino rains in April and May, 2024. Thanks in no small part to the poor drainage systems within Nairobi, more than 100 people lost their lives and scores were left homeless as well. This highlights the need to develop infrastructure that takes into account the geographical make-up of an area vis-à-vis its population size.

NEMA has also been working together with engineers to mitigate the effect of landslides in the Kakamega and Nandi Hills areas. These two areas are prone to landslides because of their topography. In Kakamega, a landslide that occurred in 2007 claimed at least 18 lives and destroyed several acres worth of agricultural property. In the wake of that disaster, state agencies have been working together with engineers to avert any such subsequent disasters, by designing slope stabilization techniques such as terracing.

Engineers play a vital role in addressing climate change through their construction projects. Most times, they engage other stakeholders such as NEMA in coming up with holistic strategies that would ensure their projects maintain the highest possible standards of environmental conservation and disaster resilience.

Picture: Courtesy

Kenya Association of Manufacturers: Strategies for Transforming Manufacturing in Kenya

By EiK Correspondent

The Kenya Association of Manufacturers (KAM) has been at the forefront of driving industrial growth and development in Kenya since its inception in 1959. Representing over 1,000 manufacturing and value-add companies, KAM plays a critical role in shaping policies, advocating for a conducive business environment, and fostering sustainable industrial growth. In recent years, the association has focused on transformative strategies to propel the manufacturing sector into a new era of innovation, competitiveness, and sustainability.

Over the years, KAM has employed a number of key strategies to achieve this ambitious transformation.

1 Policy Advocacy and Regulatory Reforms

One of KAM's primary strategies is robust policy advocacy aimed at creating a favourable regulatory environment for manufacturers. KAM works closely with the government to ensure that policies are conducive to industrial growth. This includes lobbying for tax incentives, streamlined regulatory processes, and reduced bureaucratic hurdles. By advocating for policies that support industrial growth, KAM aims to make Kenya a more attractive destination for both local and international investors.

A notable success in this area is the push for the *"Buy Kenya, Build Kenya"* initiative, which encourages the consumption of locally produced goods. This policy not only boosts local manufacturing but also fosters a sense of national pride and self-reliance.

2 Enhancing Competitiveness through Innovation

Innovation is at the heart of KAM's strategy to transform the manufacturing sector. Recognizing that technological advancement is key to competitiveness, KAM has been instrumental in promoting the adoption of cutting-edge technologies. This includes the integration of Industry 4.0 technologies such as automation, Internet of Things (IoT), and artificial intelligence (AI) into manufacturing processes.

KAM also supports research and development (R&D) initiatives by collaborating with academic institutions and research bodies. These partnerships aim to bridge the gap between research and practical application in the industry, fostering a culture of continuous improvement and innovation.

3 Capacity Building and Skills Development

The manufacturing sector's transformation hinges on a skilled workforce capable of operating advanced machinery and adapting to new technologies. KAM has prioritized capacity building and skills development through various training programs and initiatives. The association offers workshops, seminars, and certification courses tailored to the needs of the manufacturing industry.

Additionally, KAM collaborates with vocational training institutions to align their curricula with industry needs, ensuring that graduates are equipped with relevant skills. By investing in human capital, KAM aims to build a robust and adaptable workforce that can drive the sector's growth and transformation.

4 Sustainable Manufacturing Practices

Sustainability is a critical aspect of modern manufacturing, and KAM is committed to promoting environmentally friendly practices within the industry. The association encourages manufacturers to adopt green technologies and sustainable practices to reduce their environmental footprint. This includes initiatives aimed at energy efficiency, waste management, and water conservation.

KAM's Centre for Green Growth and Climate Change (CGGCC) plays a pivotal role in this endeavor, offering guidance and support to manufacturers in implementing sustainable practices. By championing sustainability, KAM not only helps protect the environment but also enhances the global competitiveness of Kenyan products, which are increasingly favored by environmentally conscious consumers.

5 Market Access and Trade Facilitation

Expanding market access is another crucial strategy for transforming Kenya's manufacturing sector. KAM works to open up new markets for Kenyan products both regionally and internationally. This involves advocating for trade agreements, reducing trade barriers, and participating in trade missions to promote Kenyan goods abroad.

KAM also supports manufacturers in meeting international standards and certifications, which are often prerequisites for entering global markets. By facilitating access to new markets, KAM helps manufacturers scale their operations and increase their competitiveness on a global stage.

6 Infrastructure Development

Adequate infrastructure is fundamental to the growth of the manufacturing sector. KAM advocates for the development of infrastructure that supports industrial activities, including reliable power supply, efficient transportation networks, and modern industrial parks. The association works with government and private sector partners to address infrastructure gaps and ensure that manufacturers have access to the resources they need to thrive.

The development of Special Economic Zones (SEZs) and Industrial Parks is a testament to these efforts. These zones provide manufacturers with world-class infrastructure, tax incentives, and simplified regulatory procedures, creating an enabling environment for industrial growth.

7 Fostering Collaboration and Partnerships

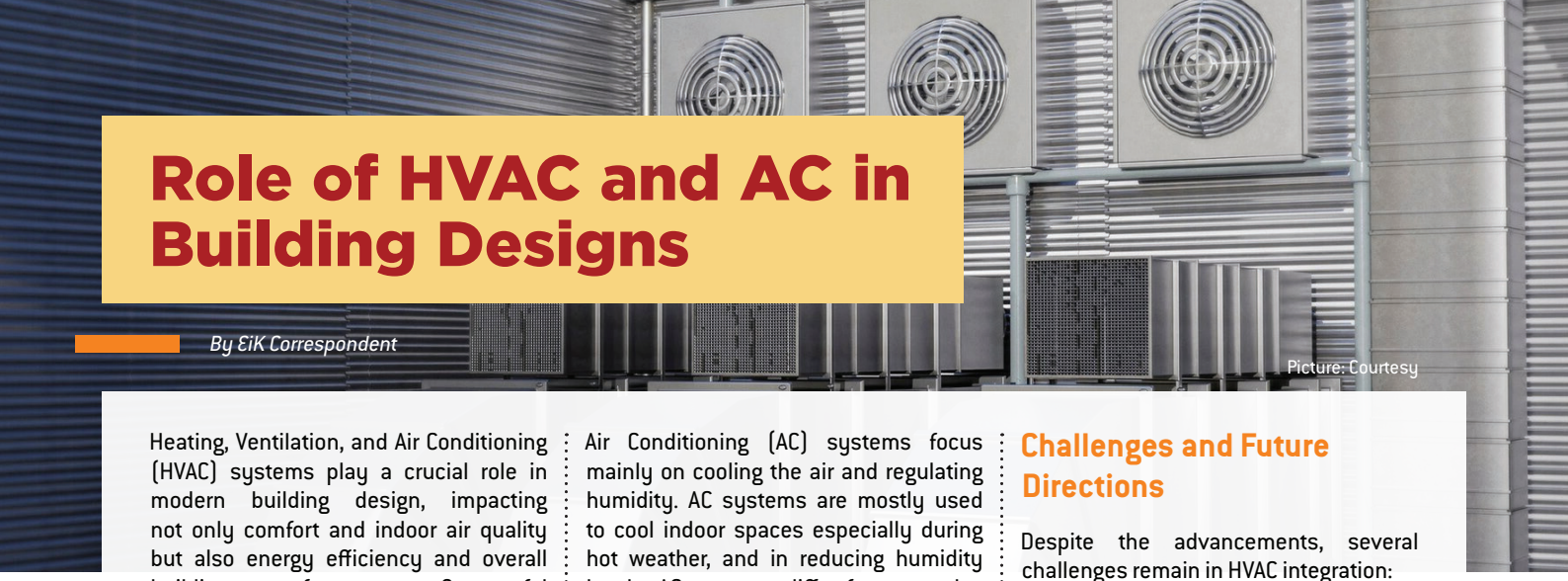
Collaboration is a cornerstone of KAM's strategy. The association fosters partnerships between manufacturers, government, and other stakeholders to address common challenges and leverage collective strengths. By creating platforms for dialogue and cooperation, KAM ensures that the interests of manufacturers are represented and that solutions are jointly developed

KAM's various sectoral committees and working groups are instrumental in this regard. These bodies bring together industry players to discuss issues, share best practices, and develop strategies for sectoral growth.

8 Conclusion

The Kenya Association of Manufacturers is spearheading the transformation of the manufacturing sector in Kenya through a multifaceted approach. By advocating for favorable policies, promoting innovation, building capacity, championing sustainability, facilitating market access, developing infrastructure, and fostering collaboration, KAM is laying the groundwork for a vibrant and competitive manufacturing industry. As these strategies continue to unfold, the manufacturing sector in Kenya is poised to become a significant driver of economic growth and development.

Picture: Courtesy



Role of HVAC and AC in Building Designs

By EiK Correspondent

Picture: Courtesy

Heating, Ventilation, and Air Conditioning (HVAC) systems play a crucial role in modern building design, impacting not only comfort and indoor air quality but also energy efficiency and overall building performance. Successful synergy of HVAC systems into the building design is the sure key to energy efficiency, sustainability, and occupant comfort increase.

The Fundamentals of HVAC Systems

HVAC systems are integral to controlling the indoor environment of buildings. They encompass a range of technologies used to regulate heating, cooling, ventilation, and air quality.

These systems include a range of components such as furnaces, heat pumps, boilers, air handlers, ductwork, ventilation fans, and air conditioning units. HVAC systems are often integrated with smart controls and thermostats for optimized performance.

Effective HVAC design ensures:

1. **Thermal Comfort**: Maintaining desirable indoor temperatures regardless of external weather conditions. HVAC systems work by heating or cooling accordingly, thus maintaining comfort for the building occupants.

2. **Indoor Air Quality**: Ventilation is a vital part of modern buildings. HVAC systems work to bring fresh air and exhaust the stale air. They are even more necessary in areas of the building where the airflow is tight. Proper ventilation and filtration removes pollutants and controls humidity.

3. **Energy Efficiency**: Minimizing energy consumption while maintaining comfort and air quality.

4. **System Integration**: Seamlessly incorporating HVAC systems into the overall building design.

Air Conditioning (AC) systems focus mainly on cooling the air and regulating humidity. AC systems are mostly used to cool indoor spaces especially during hot weather, and in reducing humidity levels. AC systems differ from complex HVAC systems in that they lack heating capabilities unless they are part of a heat pump system.

They often consist of an indoor unit (evaporator coil) and an outdoor unit (condenser coil and compressor).

Importance of HVAC and AC in Building Design

The inclusion of HVAC systems in building design is essential for several reasons. Foremost, it promotes occupant comfort, which is a key aspect in residential, commercial, and industrial buildings.

Secondly, it is essential for the health and general well-being of the building occupants. Good HVAC systems ensure proper ventilation and air filtration, which in turn improves indoor air quality and reduces the occurrence and risk of respiratory issues and other health problems.

More so, efficient HVAC systems are a definite step towards energy management as they significantly reduce energy consumption. This goes a long way in lowering the operational costs.

Mold growth and the resulting structural damage to buildings can be directly attributed to humidity. Proper humidity control prevents the mold growth and contributes significantly to building longevity.

HVAC systems play a crucial role in enhancing a building's sustainability. Adopting sustainable practices, such as integrating energy-efficient equipment, utilizing renewable energy sources, and implementing water conservation strategies, helps in lowering the building's carbon footprint. These measures are in line with the increasing emphasis on eco-friendly building design.

Challenges and Future Directions

Despite the advancements, several challenges remain in HVAC integration:

1. **Energy Consumption**: HVAC systems are one of the most significant energy consumers in buildings. This means incorporating HVAC systems IS not only a matter of aesthetics, but they have to continuously reconcile the energy use to enhance efficiency and lower costs for both occupants and the owners of buildings.

2. **Maintenance**: Most of the HVAC systems require regular maintenance for them to work optimally. This can ultimately feel expensive.

3. **Climate Variability**: Designing HVAC systems that can adapt to varying climate conditions is a complex task, but also one that cannot be ignored as the world makes a unique shift towards climate resilient buildings.

The future of HVAC lies in further integration of renewable energy sources, advanced materials, and smart technologies. Emphasis on sustainable and green building practices will drive the development of HVAC systems that not only meet comfort and efficiency standards but also contribute to environmental conservation.

HVAC systems are indispensable in modern building design. They, to a large extent, impact comfort, health, energy efficiency, and sustainability. Successful incorporation of these systems around the world illustrate how advanced HVAC systems are being integrated into diverse building projects, setting benchmarks for future developments. As technology continues to evolve, HVAC systems will play an increasingly critical role in shaping the built environment, ensuring buildings are comfortable, efficient, and sustainable.

The New Energy Landscape in Africa and Youthful Potential – the Time for Incremental Change is Over

By Ifeanyi Odoh, Country President, Schneider Electric East Africa


Ifeanyi Odoh Country President, Schneider Electric East Africa

The world is becoming increasingly electrified and with this comes challenges and opportunities. It is a time that sees countries across the globe witnessing a change in how we produce and consume energy.

It is a world that races against time to meet emissions reduction targets and the urgency to fulfil subsequent sustainable transformation. It is a place which sees organisations prioritise digitalisation, decarbonisation and sustainability.

At the heart of it all lies the new energy landscape.

Defining the new energy landscape

The new energy landscape represents the outcome of the global shift toward renewable energy sources, which is crucial to fight climate change. And for each country this is somewhat unique, depending on the sum of the alternative energy resources that ultimately make up the part that is the new energy landscape.

In Kenya, for example, we're seeing the emergence of an electric vehicle (EV) marketplace which will leverage the country' geothermal and hydropower energies baseload. This transition not only represents the adoption of new technology but also a cultural shift towards higher productivity driven, if you will, by alternative energy.

However, with this adoption should also come sound energy management practices. People tend to charge their EVs at their destination—be it their office, home, or shopping malls—accounting for almost 80% of charging behaviour. This shift could potentially double or triple the energy demand of buildings overnight.

To illustrate, a typical electric car might use approximately 7KW to charge, while in Kenya, has a power demand of about 2KW. Introducing an EV to a household could multiply its energy consumption by three to four times.

To meet this demand, and allow for the increased adoption of EVs, optimised energy management strategies should be implemented, allowing for the development of onsite renewable generation, such as rooftop solar and introducing efficiency measures, with digitised real-time monitoring to manage and reduce energy use.

Developing the skills for the new energy landscape

Africa, particularly East Africa, boasts a youthful population. For example, over 80 percent of Kenya's population is aged 35 years and below. It's a young, impressionable population that has the potential to change the course of history.

It is also this demographic which underscores the importance of training young people to drive forward the new energy landscape. Here, vocational schools can play a critical role in preparing the youth for the future, ensuring that East Africa capitalises on its demographic advantage without the need to import skills.

Establishing this young, dynamic and skilled labour force can also extend to entrepreneurship and training, again emphasising the importance of partnerships with vocational schools and industry stakeholders. This will equip the next generation with the necessary skills to thrive in the new energy landscape.

Indeed, small and medium-sized enterprises (SMEs) are set to become the backbone of East Africa's new energy landscape movement. It is these organisations that will create jobs and with the support of large global organisations like Schneider Electric set benchmarks for the establishment of the new energy landscape.

Schneider Electric envisions a future shaped by countries like Kenya, acting at this intersection between technology and decarbonisation. It is also leaders such as the youth and SMEs, which we refer to as *impact makers,* which are driving change and shaping a more resilient, electric, and net-zero world.


Picture: Courtesy

Understanding the road Sector in Kenya

By Senior Corporate Communications Officer, KeNHA

KeNHA

The Kenya National Highways Authority (KeNHA) is committed to develop, maintain, and manage resilient, safe, and adequate National Trunk Roads. To deliver on this mandate, the Authority is driven by innovation and optimal utilization of resources for sustainable road

development. KeNHA has continuously improved the road network under her jurisdiction, comprising classes S, A, and B roads countrywide hence revolutionizing economic growth in the country and the region.

By Joseph Kariuki Thuku, MPRSK

One challenge that public officers have had to contend with is navigating the ever-evolving regulatory landscape of their various areas of jurisdiction. This is in a bid for them to stay up-to-date with the changing regulations and ensure compliance, which often prove to be a daunting task.

This calls for the Public Officers to deliberately invest in continuous learning and training so as to keep abreast of regulatory changes. This is even more urgent for Public Officers working in the Road Sector.

This is one sector that the government has been investing in for a long time thus continuously improving the road infrastructure to enhance connectivity, promote economic growth, and improve the quality of life for all. A government officer in this Sector, therefore, should - among other issues - consider the aspects discussed below which are critical in understanding and appreciating the operations in this jurisdiction.

Regulatory Environment

The officer should familiarize oneself with the relevant laws, regulations, and policies governing road development. This includes understanding the roles and responsibilities of government agencies in this sector such as the Kenya National Highways Authority (KeNHA), Kenya Urban Roads Authority (KURA), Kenya Rural Roads Authority (KeRRA), and the Kenya Roads Board (KRB).

Not many people appreciate the distinction of the mandate of these different agencies in the road sector. The Kenya Roads Board is established is to oversee the road network in Kenya and coordinate its development, rehabilitation and maintenance. It administers the fuel Levy Fund.

The agencies are responsible for select classes of roads with KeNHA charged with the responsibility to develop, rehabilitate, manage, and maintain all National Trunk Roads comprising Classes S, A, and B roads.

On the other side, KeRRA deals with the development, rehabilitation, maintenance and management of rural roads while KURA is concerned with the Management, Development, Rehabilitation, and Maintenance of urban roads.

Project Planning and Design

An officer in this Sector needs to appreciate and engage in the planning and design phases of road projects. This includes conducting feasibility studies, environmental assessments, traffic studies, and community consultations.

It is important to take cognizance of the fact that it takes collaborative effort of engineers, architects, communicators, accountants, supply chain officers and other professionals to ensure that road designs are efficient, safe, and sustainable.

Stakeholder Engagement

Officer in this sector frequently conduct engagement sessions with various stakeholders throughout any project lifecycle. This includes collaborating with local communities, government officials, Non-Governmental Organizations (NGOs), and the private sector players to effectively deliver a project.

Effective communication and consultation is essential to address concerns, gather feedback, and build consensus across all the stakeholders surrounding the project. A slight level of misinformation could stall an otherwise significant project for a country.

Construction and Project Management

The Sector players often oversee the construction phase of roads through ensuring that the projects are implemented according to the approved plans and specifications. This involves managing contractors, monitoring progress, quality control, and adhering to health and safety standards agreed upon.

Effective project management skills are, therefore, crucial for officers in this Sector if they are to ensure timely completion of project at appropriate costs.

Quality Assurance and Maintenance

Officers in this Sector are tasked to ensure that road construction meets requisite quality standards and specifications. This calls for implementation of regular maintenance programs so as to preserve the condition of the roads and extend their lifespan.

An approach that has often yielded desirable results, at least from experience Sector players, is implementation of routine maintenance, repairs, and rehabilitation works.

Sustainability and Innovation

An officer in this Sector should seek to embrace sustainable road development practices such as incorporating green infrastructure, energy-efficient lighting, and environmentally friendly materials. There is need to explore innovative technologies and approaches that can improve efficiency, reduce costs, and enhance the durability of the road infrastructure.

Collaboration and Partnerships

One will quickly realise that the Sector performs better though collaboration and partnerships with other organizations, both nationally and internationally. This includes collaborating with development agencies, research institutions, and private sector entities so as to leverage expertise, funding, and resources mobilization.

Monitoring and Evaluation

Officers in this sector often establishes robust monitoring and evaluation systems meant to assess the performance and impact of road projects. This helps to identify areas for improvement, measure the effectiveness of interventions, and ensure accountability.

Embrace Technology

Just like in may jurisdictions, officers in this Sector have learnt to embrace digital technologies and innovations in road development, such as Geographic Information Systems (GIS), remote sensing, and data analytics. These tools often aid in project planning, monitoring, and maintenance.

Capacity Building and Training

It is evident, therefore, that any employee in this Sector requires to invest in capacity building and training programs for efficient service delivery. This includes acquisition of technical skills, project management, and knowledge-sharing sessions. This is often supplemented by Continuous Professional Development trainings for the officers to keep up with advancements in the Sector.

In a nutshell, working in the Road Sector in Kenya offers an opportunity learn continuously while contributing to the country's infrastructure development and economic growth. Focusing on quality, sustainability, and stakeholder engagement ensures the Sector players make a positive impact on the road network and the lives of the people who depend on it.

Picture: Courtesy

Sprintex Engineering Services Ltd:
Experts in Motor Rewinding

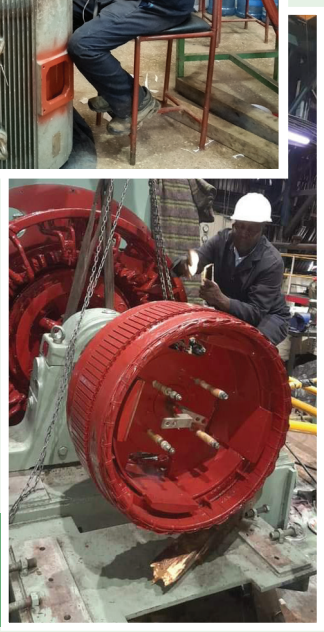
Sprintex Engineering Services Ltd is an established professional electrical motors rewinding and repairs workshop, with vast and knowledgeable experience in overhauling and rewinding of all types of electric motors both AC/DC motors, generators, transformers, Semi Hermetic Compressors, Stepper motors, Servo Motors, Lift motors and Welding machines.

We offer high tech quality, efficient and quick turn around services ensuring that our clients' down time is minimized in refurbishment of electric machines.

The company is headquartered in Nairobi, Kenya and has a branch in Jinja, Uganda.

Eng. Okoth, the managing director, has authored a book on Electrical Engineering titled Electrical Power Distribution, Industrial Electricity, Electric Motors and Control Systems.

'Our services render conform with IEC, EASA, AEMT Standards. All electric machines repaired are subject to thorough instrument and electrical tests before dispatch to the client,' quips the MD.



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Anton Jacobsz resigns as Exclusive Networks Africa managing director

JOHANNESBURG – July 30, 2024 –

Cybersecurity specialist Exclusive Networks Africa has announced the imminent departure of long-serving managing director, Anton Jacobsz, who will remain a shareholder with the organisation as well as serving in an advisory capacity moving forward.

Jacobsz today advised that he would be stepping down from his position, three years after the Exclusive Networks acquisition of value-added distributor Networks Unlimited in early 2022, where he held the capacities of chief executive officer for three years and managing director for almost six years.

Reflecting on his tenure, Jacobsz expressed pride in the local team's collective achievements, particularly noting significant milestones reached since the sale of the business to Exclusive Networks, including a revenue growth of more than 160 percent and profitability growth in excess of 230 percent since January 2022.

"Exclusive Networks Africa has delivered tremendous growth over this period, establishing a strong footprint across the continent and developing into the region's cybersecurity value-added distributor of choice."

Sharing his gratitude, Jacobsz added that he would like to thank his staff for the teamwork and friendships developed over the years. "This has been a special time in my life and Networks Unlimited in particular was like a child to me. I believe I will be leaving the business in good hands with our current management team."

Although Jacobsz's operational role will end at the end of July 2024, he will remain involved in the organisation's handover process during the third quarter of the year.

STUDENTS' VOICES

Name: Juliana Muendo

Age :22 years

Technical university of Mombasa

Bs Mechanical Engineering

Year 4

The ever-changing nature of engineering means that there is always something new to learn, keeping the field fascinating the engineering education system in Kenya has made substantial progress. However, it could benefit from additional developments like revising the curriculum to incorporate developing technology. Kenya is undergoing numerous large infrastructure projects, including the development addressed by CCE2024 Engineering Conference. Exploring affordable housing alternatives and sustainable transportation systems provides an intriguing peek into how Kenya might develop for a brighter future. Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) Corridor. These initiatives are intended to greatly promote economic growth, ultimately benefiting the country's overall development. Kenya's attempts to create renewable energy sources, particularly solar and wind power, are praiseworthy.

As a future engineer, participating in these activities is critical. Sustainable energy solutions address environmental problems while simultaneously ensuring energy security and economic stability.

Kenya's water resource management faces issues such as, poor distribution, and contamination. Engineers address these concerns by developing creative solutions such as sophisticated water filtration system and sustainable water management methods. Smart cities and the (IoT) have the potential to transform Kenya's engineering future by offering better urban planning, more effective resource management.

The possibility of being a part of such dramatic changes is quite exciting. Engineers play an important role in reducing climate change and fostering environmental sustainability in Kenya by designing eco-friendly technologies.

Name: Nduhiu Bill Mureithi

Age: 24

University: Kenyatta University

Major/Program: Bsc In Agricultural And Biosystems Engineering

Current year of study: 4th Year

IEK Membership No. S.13326

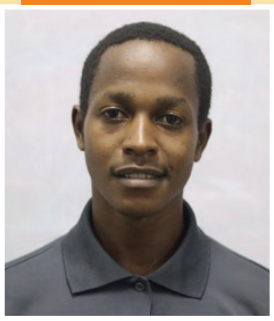
My passion for Agricultural and Biosystems Engineering studies fuels my excitement in problem-solving and societal improvement for applying innovative technologies to enhance agricultural productivity and sustainability. While my educational journey has been rewarding, I see a need for more hands-on training, industry collaboration, and updated curricula to reflect emerging engineering trends.

Kenya's major infrastructure projects, like the development of irrigation schemes in regions such as Galana-Kulalu and the construction of dams, promises significant agricultural benefits by improving water availability and enhancing food security. These projects will boost agricultural productivity, create jobs, and support economic growth in rural areas.

The expansion of renewable energy projects, such as solar and wind power, is crucial for reducing fossil fuel reliance and promoting environmental sustainability. Water resource management in Kenya faces challenges like scarcity, inefficiency, and pollution. Engineers can address these issues through efficient water management systems, conservation infrastructure, and advanced monitoring technologies.

The advent of smart cities and IoT will revolutionize engineering in Kenya, optimizing resource management and enhancing urban living, which excites me greatly. Engineers play a vital role in mitigating climate change and promoting sustainability by developing renewable energy systems and sustainable infrastructure. By integrating sustainable practices, engineers can significantly reduce environmental impact and contribute to Kenya's sustainable future.

STUDENTS' VOICES



Name: Miheso Levis Maina

Age: 23

University: Technical University of Mombasa

Major/Program: Bsc Mechanical Engineering

Current Year of Study: 3rd year

As a mechanical engineering student in Kenya, my passion for engineering comes from a love for mechanics and the desire to innovate. I dream of designing machines and energy solutions that advance society. Our education system is strong but needs more hands-on learning and real-world problem-solving. Kenya's big infrastructure projects, like the Nairobi superhighway, the Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) Corridor and Standard Gauge Railway, are creating jobs and boosting the economy. They show the important role engineers play in our country's growth.
Sustainable energy is also key. Projects like the Garissa Solar Power Plant, Lake Turkana Wind Power, the Olkaria geothermal energy and rural electrification highlight Kenya's commitment to green energy, which is crucial for me as a future engineer.

Water management is another challenge. Engineers can help by developing new conservation and treatment technologies. I'm excited about smart cities and IoT, which can make our infrastructure smarter and life better.

Engineers must help fight climate change and promote sustainability. We can create eco-friendly materials and systems to protect the environment. I'm ready to face the challenges ahead and use my skills to make a positive impact on Kenya's future.

Name: John Njuguna Macharia

Age: 21years

University: Dedan Kimathi University of Technology

Program: Bachelor of Science in Civil Engineering

Year of Study: 4th year

One of the key attractions that draw me to civil engineering is its focus on problem-solving. Influenced by personal role models in the engineering field, I pursued this career, drawn by its challenges and opportunities. My university education has combined theoretical knowledge with some practical experiences, although I believe more real-life day to day applications would enhance and improve the learning experience.

A significant project to note is the LAPSSET corridor, which aims to boost transport, trade, and economic growth while also impacting tourism, infrastructure, and job creation. Kenya's commitment to sustainability, highlighted at the recent Africa Climate Summit in Nairobi, is evident in the increasing use of solar power, presenting future engineers like me with opportunities in green technology and research.

Water resource management remains a challenge in Kenya, particularly during dry seasons. As an engineer, I propose creating storage systems for water harvesting and distribution to address scarcity and reduce climate change impacts. The rise of IoT and AI technologies also offers potential improvements in the transportation sector through real-time traffic data and adaptive signals to manage traffic and reduce emissions.

Engineers play a crucial role in climate change mitigation, with sustainable initiatives such as renewable energy projects. By developing solar and wind power plants, we can reduce fossil fuel consumption and greenhouse gas emissions, contributing to global climate justice efforts.

STUDENTS' VOICES

Name: Wambui Gathirwa Catherine

Age: 20

University: Dedan Kimathi University of Technology

Major/Program: Bsc. Mechanical Engineering

Current Year of Study: 3rd Year

My motivation for pursuing engineering stems from a passion for solving problems and developing innovative solutions also the fact that growing up, I have watched my dad, enjoy and just transform some broken machines into a moving car. The thrill of tackling technical challenges in energy production, automotive engineering, and machining makes the field exciting and rewarding.

In Kenya, the current engineering education system is largely theoretical, limiting practical application. To better prepare students, we must invest in hands-on projects, modern laboratories, and stronger industry partnerships.

Major infrastructure projects like the Nairobi Expressway and the SGR are transforming Kenya's development by improving connectivity and fostering economic growth. Additionally, Kenya's push towards sustainable energy solutions, particularly in solar and wind power, is vital for reducing carbon emissions and ensuring energy security.

Water resource management remains a significant challenge, but engineers can develop efficient systems like rainwater harvesting and smart water grids. The advent of smart cities and IoT and embedded systems will further revolutionize engineering, making urban and rural areas more sustainable.

Engineers play a crucial role in mitigating climate change by designing solutions that promote energy efficiency and environmental sustainability. By addressing educational gaps and embracing technological advancements, engineers can drive Kenya towards a prosperous and resilient future. Being an energy and a climate justice advocate, I believe we can do better.

IEK Membership Report

The IEK membership committee meets every month to consider applications for membership of the various classes received at the secretariat. The IEK council at its 525th and 526th council accepted the following members under various membership categories as shown below;

MEMBERSHIP CLASS	NUMBER ACCEPTED-525TH COUNCIL	NUMBER ACCEPTED-526TH COUNCIL	TOTAL
FELLOW	1	0	1
CORPORATE	10	114	124
GRADUATE	98	57	155
GRADUATE ENGINEERING TECHNOLOGIST	10	4	14
GRADUATE ENGINEERING TECHNICIAN	18	13	31
STUDENT	28	13	41
TOTAL	**165**	**201**	**366**

During the period, we had 1 member who transferred from the class of Corporate to Fellow member and 124 from Graduate to Corporate member. In addition, we had 155 graduates, 14 graduate engineering technologists, 31 graduate engineering technicians and 41 students were accepted as members.

Gender Data

Class	Male	Female	Percentage (Male)	Percentage (Female)
Fellow	1	0	100%	0%
Corporate	104	20	84%	16%
Graduate	124	31	80%	20%
Graduate Engineering Technologist	13	1	93%	7%
Graduate Engineering Technician	30	1	97%	3%
Student	28	13	68%	32%
TOTAL	**300**	**66**	**82%**	**18%**

Summary

Gender	No.	Percentage
Male	300	82%
Female	66	18%

Gender	No.	Percentage
	366	**100%**

525TH APPROVAL

FELLOW

S/NO.	NAME	MEMBER NO.
1.	Arif Ali Salim	F.10750

CORPORATE

S/NO.	NAME	MEMBER NO.
1.	Godfrey Wekesa Wanjala	M.9747
2.	Vincent Odhiambo Ahono	M.7578
3.	Solomon Nyambaga Ayieko	M.5919
4.	Thelma Ntinyari Mukunga	M.13339
5.	Nicholas Kipkemboi Tanui	M.10610
6.	John Mainge Kihori	M.9321
7.	Daniel Muthuri Mwereria	M.8584
8.	Edwin Wafula Sabuni	M.11621
9.	Grishon Odhiambo Nyobange	M.9316
10.	Brenda Chepchumba Koros	M.7335

526TH APPROVAL

CORPORATE

	NAME	MEMBER NO.
S/NO.	NAME	MEMBER NO.
1.	Andrew Oyiengo Kainga	M.12161
2.	Andronicos Ogambi Taffi	M.8610
3.	Anthony Kariuki Wamugunda	M.10695
4.	Antonny Gedion Mumina	M.10696
5.	Ayub Senteu Murianka	M.9453
6.	Barasa Ongeti Jay	M.11402
7.	Barnice Mumbua Nzamba	M.8514
8.	Benedict Wachira Mwangi	M.13370
9.	Benjamin Kiptai Cheseny	M.9299
10.	Bildad Odhiambo Osire	M.8415
11.	Boaz Andrew Wangwe	M.11492
12.	Caleb Kibet Maritim	M.5621
13.	Caleb Muli Muteti	M.11348
14.	Calistus Wangila Wasike	M.4318
15.	Calvince Otieno Onditi	M.12172

	NAME	MEMBER NO.
16.	Catherine Ndinda Kitela Ndeto	M.6803
17.	Cheserek Kimutai Julius	M.6780
18.	Collins Edward Maina	M.8683
19.	Collins Olaki Amayi	M.8682
20.	Cornelius K. Kapkeron	M.8582
21.	Dan Mlango Mwawuda	M.6755
22.	Daniel Kariuki Mwangi	M.11339
23.	David Kibet Rop	M.8536
24.	David Otieno Rege	M.7262
25.	Denis Omondi Opudo	M.8955
26.	Dennis Mbuthia Njoroge	M.8587
27.	Duncan Oduor Miyere	M.8305
28.	Eliab Bett Kimutai	M.11888
29.	Eliud Njoroe Gitonga	M.8019
30.	Emmanuel Barasa Were Buluma	M.3214
31.	Emmanuel Kiptarus Kipruto	M.8250
32.	Emmanuel Masaku Musyoka	M.11078
33.	Emmanuel Seth Oluoch Alando	M.11105
34.	Eugene Obunde Otwani	M.8790
35.	Evelyn Mumbua Mutula	M.12970
36.	Felix Anayo Onduru	M.7541
37.	Felix Brian Omondi	M.8258
38.	Festus Kiplagat Kiplaat	M.12183
39.	Fridah Nyaboke Ombati	M.10339
40.	Geoffrey Oguk Ogumbe	M.11098
41.	Gregory Ivan Kiprop	M.12888
42.	Ian Marekia Kinuthia	M.9465
43.	Irene Atieno Oduor	M.7835
44.	Isaac Maina Wanjiku	M.11572
45.	James Barasa Imwen	M.9555
46.	James Gichuki Mwaniki	M.10017
47.	Jane Wambui Mwangi	M.9257
48.	John Kennedy Thotho Njenga	M.8980
49.	John Ngugi Waithira	M.6926
50.	John Njane Kamau	M.9802
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52.	John Wanjohi Muiyuro	M.6534
53.	Joseph Otieno Weya	M.6537
54.	Joshua Odongo Okello	M.10309
55.	Joyce Ngina Musyoka	M.6505
56.	Joyce Susan Liavuli Ogada	M.7526
57.	Judith Achieng Odhiambo	M.9220
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61.	Kenneth Muriithi Karaithe	M.9264
62.	Kenneth Ochieng Adodi	M.10657

	NAME	MEMBER NO.
63.	Kevin Maraka Ndiema	M.11218
64.	Laban Kiprono Rop	M.12974
65.	Laureen Shivoko Muloli	M.10254
66.	Lawrence Otieno Ogada	M.10337
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71.	Mariari Manwa Kelvin	M.8715
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73.	Maxwell Kipngetich Kogo	M.10109
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75.	Mike Grifins Osare	M.8992
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78.	Nancy Atieno Omanga	M.10327
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82.	Obed Nyangoka Mogaka	M.11777
83.	Onyancha Orutwa Isaac	M.6968
84.	Pamela Atieno Oyugi	M.6590
85.	Pamela Jelagat Chebon	M.10286
86.	Paul Eshinali Washiali	M.6869
87.	Paul Nginyo Njoroge	M.11016
88.	Peter Mosoti Nyarangi	M.9960
89.	Peter Muhoho Karanja	M.9759
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91.	Purity Nyakio Muthii	M.10051
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96.	Simon Mburu Njoroge	M.2100
97.	Solomon Ngari Muthungu	M.12031
98.	Stanley Kinoti Kinoti	M.12690
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102.	Steve Ochieng Otieno	M.7877
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104.	Timothy Omollo Okello	M.8437
105.	Victor Ochieng' Kungu	M.7511
106.	Victor Ochieng Opolo	M.6181
107.	Vincent Akihanga Manyego	M.9343
108.	William Ponari Lengaka	M.7865
109.	Wilson Nyakundi Omae	M.7038

	NAME	MEMBER NO.
110.	Wyclife Otieno Omboga	M.9053
111.	Wycliffe Okeyo Ochola	M.9228
112.	Yvonne Mali Mutuli	M.12039
113.	Zadock Kipkorir Rotich	M.7171
114.	Zebidah Wanjiku Ndoro	M.9526

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