C.E.T.S

CENTMAX ENGINEERING TECHNOLOGY SOLUTIONS

2023

BIOGAS DESIGN AND CONSTRUCTION CONSULTANTS

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1.0 COMPANY PROFILE

Centmax has been in operation since January 2017 providing consultancy services in the fields of renewable energy resources such as biogas, solar, hydropower. We also provide expertise in piped water engineering design, geospatial (GIS) technology, environmental management, general engineering and WASH consultancy. The company has been mainly involved within the oil and gas sector, power generation-transmission and storage, with key clients such as Government, NGOS, Utility companies etc. We also provide capacity development in key areas such as renewable energy resources management, Engineering Design, ICT and Project Management through our partner institute; Centmax Institute of Industrial Training-CITI. A list of our training programs can be accessed via our website: https://citi.ac.ug/.

CENTMAX is tax compliant company

TIN: 1009890722

TAX CONSULTANT: Proxor and partners consultants.

VISION

To become a world class consultancy firm in design and engineering works services.

MISSION

To provide quality engineering and technology services in an effective, efficient and ethical standard with utmost professionalism.

OUR TEAM

We have a team of interdisciplinary and dedicated professionals with skills, well updated in water resources planning, development and management technologies backed by a wealth of experience working in government, private sector and non-governmental organizations. These include; Energy specialists, Hydro-geologists, Water Quality Analysts, Water and Sanitation Engineers, Public Health Specialists, Community Development Specialists, Accountants and Data analysts. The Directors and staff of Centmax Ltd are all fully qualified and experienced water resources specialists, hydro-geologists, civil and electrical engineers registered with a number of professional bodies outlined below; therefore, have sufficient capacity to implement and manage major projects in engineering, geology and environment.

Our staff members subscribe to the following professional bodies.

- Uganda Institute of Petroleum Engineers (UIPE)
- European association of Geoscientists and Engineers (EAGE)
- Geological Society of Uganda (GSU)

2.1. SERVICES OFFERRED

Centmax carries out several consultancy services from renewable Energy, Civil and Structural engineering, Water Resources including general WASH, energy, and mineral resource development, Geospatial (GIS) and ICT services as outlined below: -

1. **Renewable Energy and Mineral Resources Management**
    - Biogas and Biofuels
    - Geothermal Energy Consultants
    - Electrical Engineering
    - Solar Energy
    - Mine Design and Ore Economics
    - Feasibility studies for Mining and Oil and gas
    - Mini hydropower & Solar energy

2. **Civil and Structural Engineering**
    - Site Leveling & Drainage System Design
    - Steel Structures design
    - Geotechnical investigations
    - General Earthworks
    - 3D modeling of structures
    - Civil Design
    - Foundations Reinforcement Details
    - Foundations Structural Layout

3. **Water Resources, WASH & QHSE**
    - Borehole siting, drilling and motorization.
    - Water supply design and Construction
    - Borehole and surface water rehabilitation
    - Environment Impact Assessments (EIAS, ESIAs)
4. **Piping classes**
    - Piping Classes
    - Isometric Drawings
    - Piping supports
    - Flexibility check reports

2. BACKGROUND

Waste management has persisted to be a major challenge in the developing world and specifically in developing nations like Uganda. According to the National Environment Management Authority (NEMA), Kampala capital city alone generates up to 1500 tones of waste per day. The waste generated per capita is estimated at 1kg per day. It is estimated that only 40% of this waste is disposed off properly therefore over 60% ends up in wetlands, communities, on the streets etc.

In this regard, Uganda has poor waste disposal and management challenges which also feeds into general lack of access to water sanitation and Hygiene (WASH) services. Besides facing challenges on how to manage wastes and general sanitation issues, there is limited technical expertise on how to generate energy from it.

Therefore, experience of domestic biogas plant construction as well as information dissemination on available technologies is still a major challenge. However, in line with the agenda of de-carbonizing the future and therefore going into greener fuels, there is need to invest in large biogas plants across Uganda to mitigate the over-dependence on wood-fuel (firewood)which has had a detrimental effect on the environment through deforestation. **Figure-1** shows typical biomass feedstock.

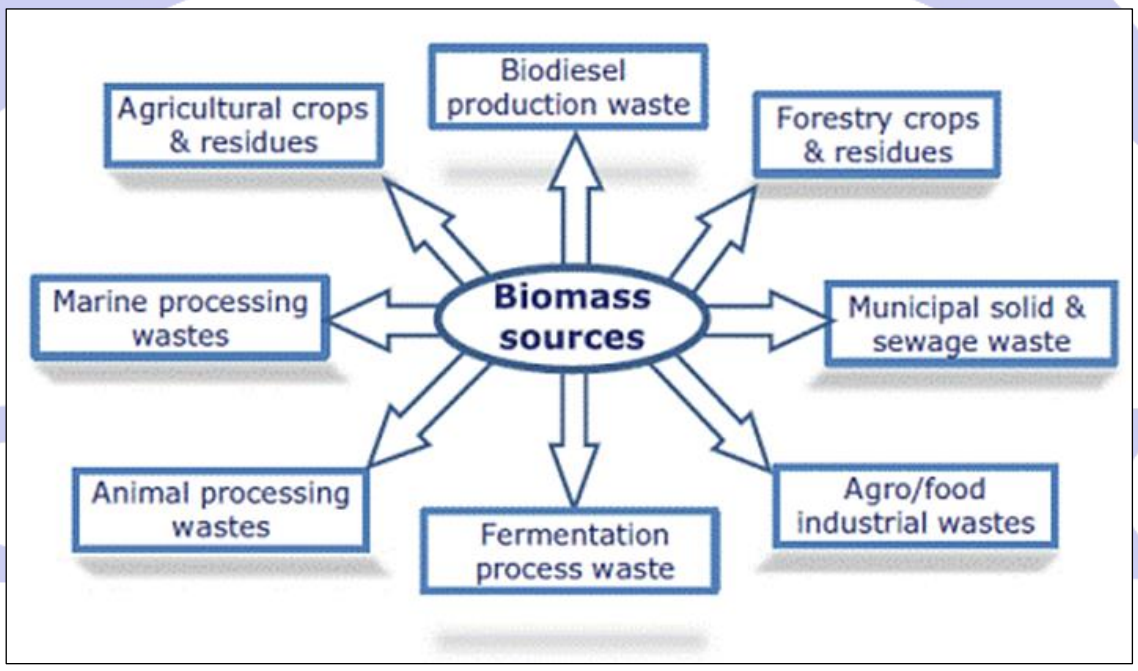


Figure-1. biomass feedstock

There is a need to manage biodegradable waste which is in plentiful supply from sewage effluent, kitchen refuse, garbage and garden, farm droppings from livestock among others (**Figure-1**. It is critical to develop sustainable **waste to energy projects** across entities in growing municipalities and cities all over Uganda.

The main benefits of adopting biogas technologies include:-

i) Provides a cheaper source of energy for cooking and lighting in rural homes compared to firewood, charcoal and kerosene.

ii) Incorporation of waste recycling and re-use especially in pit latrine construction leads to general hygiene and minimizing of water related illnesses such as diarrhoea, cholera etc

iii) Provides clean and smoke free cooking with less health risks like cancer, respiratory complications, and eye problems related to use of firewood.

iv) Protects the environment through reduced tree cutting and emission of harmful gases.

v) The bi-product (bio-slurry) is an excellent organic fertilizer that boosts production for all kinds of crops.

vi) Bio-slurry is a high nutrient feed supplement for animals, birds and fish.

vii) Reduces the risks children and women would encounter looking for firewood.

viii) Earn extra income through sale of excess bio slurry

SELECTED PREVIOUS BIOGAS AND RENEWABLE ENERGY PROJECTS

Client, Location	Year	Scope of Biogas project
Ndejje University, Kampala	From 2018 to date	Partnership with Ndejje University in:- • Piloting efficient design of anerobic biodigesters, • Biogas feedstock research to achieve maximum yield, • Plant and Equipment design, construction and sizing
Ministry of Energy and Mineral Development-Tilenga Oil and Gas Project	2020	• Consultancy services to explore and develop natural gas deposits, • Establishment of biogas in plants in the oil and gas construction camps • Feasibility study on gas storage, packaging, and transmission
TotalEnergies	2020	• Development of gas to power (GTP) schemes using both natural gas and biogas • Packaging, transmission and storage of LPG and biogas plants
Mustard seed primary school, Lukaya-Masaka	2022	Cooking gas, bio- fertilizer, construction of VIP latrine for efficient waste to energy management
IIRR, Kyangwali Refugee Settlement	2022	Cooking gas, bio- fertilizer, lighting gas
CNOOC, BUCOLA Community, Bugoma, Kikube district	2019	Feasibility study, ESIA, Project design for cooking gas, bio-fertilizer, lighting gas, VIP pit latrine construction
NUCAFE-Simusolar partnership renewable energy partnerships (Luwero, Wakiso, Mbale)	2018-2021	Feasibility study, project design, Cooking gas, bio- fertilizer, lighting gas
Sacred Heart School SS, Gulu,	2018	Feasibility study, project design, Cooking gas, bio- fertilizer, lighting gas
Katweyamba Community, Jinja Mpumudde	2017	Cooking gas, bio- fertilizer, lighting gas
Loi Waisi Primary School (EnergyAid)-Mbale	2017	Cooking gas, bio- fertilizer, lighting gas

2. OUR APPROACH TO BIOGAS SYSTEMS

Therefore, to make such projects, cost effective and sustainable, **CENTMAX** has come up with proposals that consider technical, social and environment as well as commercial aspects on how to develop and scale biogas projects from households (micro scale), communities as well as Municipalities (macro scale). In terms of scale, there are 5 types of biogas projects that **CENTMAX** is supporting our stakeholders to develop i.e.

i) Domestic/ Household
ii) Institutional,
iii) Community
iv) Commercial and
v) Municipal Solid Waste (MSW) biogas plants

During the implementation of the projects, we undertake feasibility studies to assess the waste feedstock, environmental and social safeguards in line with the National Environment Management Authority (NEMA) and other guidelines that are provided for by the Uganda National Renewable Energy and Energy Efficiency Alliance (UNREEEA) and the Ministry of Energy and Mineral Development (MEMD).

Table 1: Classification of Biogas Systems

Biogas Digester Plant Size	Biogas Plant Type	Target Market	Estimated population to be served	Applications/Usage
Plant size of 25 m^3 to 45m^3	Domestic	Household, Homestead, farm, small	Under 30	Cooking, lighting, water heating, drying of produce, Biofertilizer
Plant size of 60 m^3 to 85 m^3	Community	School, settlement, minicamp, restaurant	150 to 300	Cooking, lighting, water heating, drying of produce, Biofertilizer feedstock
Plant size of 100 m^3 to 200 m^3	Commercial	Larger school/ campus, larger camp, hotel, restaurant, construction base	500 to 1000	Cooking, lighting, water heating, drying of produce, Biofertilizer feedstock
Plants greater than 500 m^3	Municipal Solid Waste (MSW) biogas	Municipalities, Cities, larger urban centers	5000 to 20,000	Cooking, lighting, water heating, Biofertilizer feedstock , cooling of machines, drying of produce, power generation

We also undertake technical and commercial feasibility studies so that the projects are sustainable from the start to meet the current and projected energy needs of our clients taking into consideration their future energy needs (scalability).

The key technical parameters to be considered for the project include: -

i) resource inputs,
ii) technology used and processes involved,
iii) energy outputs, and
iv) operational results

Commercial projects that require significant pre-investment capital have to undergo full-cycle economic feasibility studies to assess the internal rate of return (IRR), Net present value (NPV), Yield of the plant and overall profitability.

The technology above all to be adopted, should be easily applicable and transferable to suit, the local context, affordable and easy in operational handling.

Centmax shall undertake Detailed Feasibility Studies for biogas digesters ranging **50m³ to 200m³**. **Table-1** above shows the classifications of Biogas plants.

3.0 PROJECT DESIGN AND IMPLEMENTATION

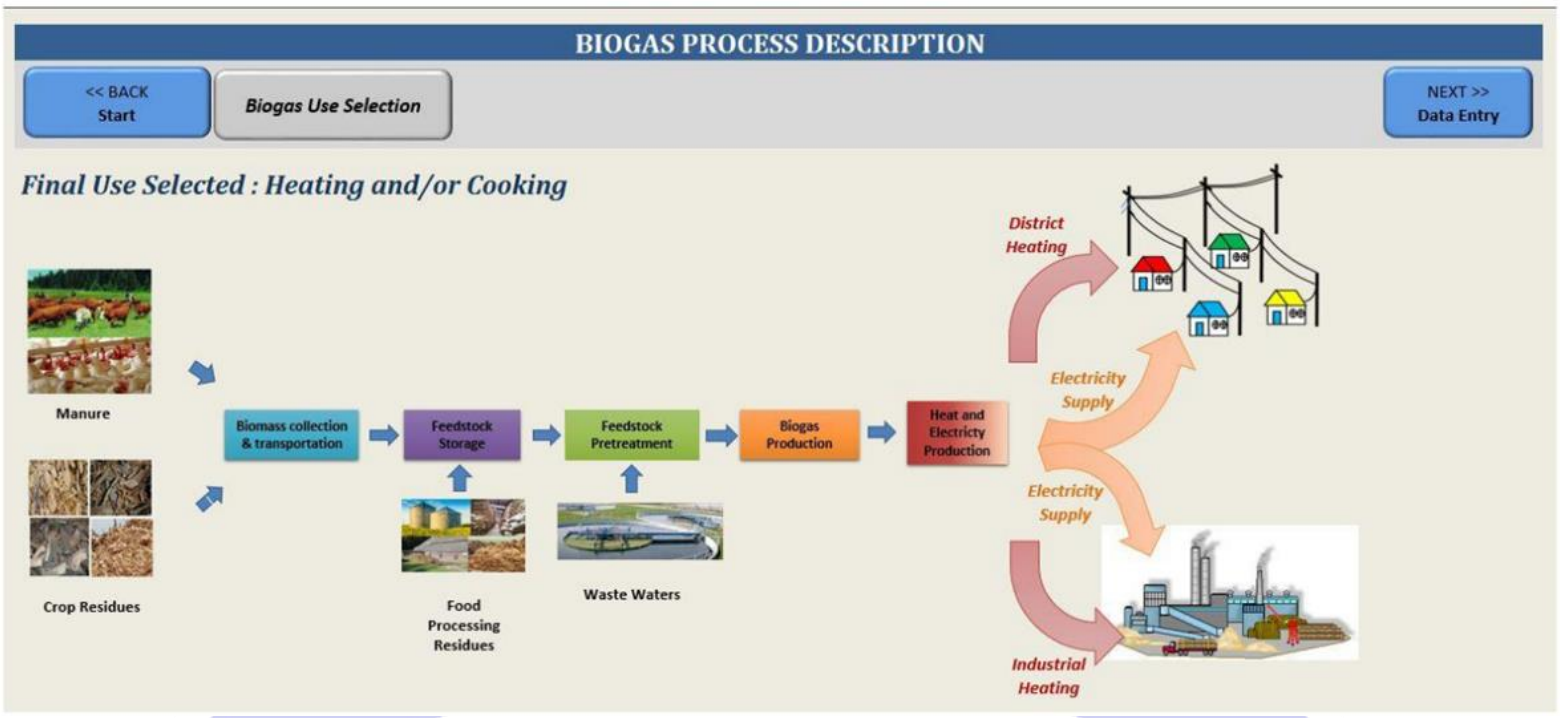
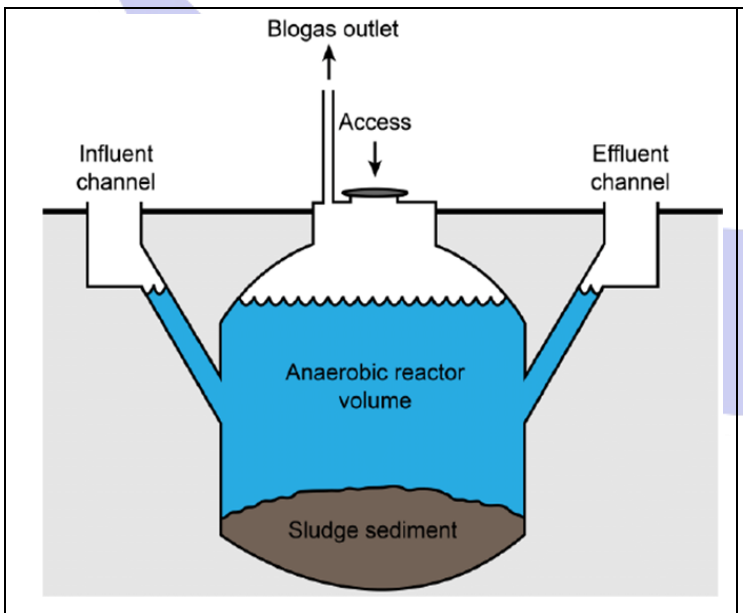


Figure 2. Biogas production process at an Industrial Scale (Source: FAO)

3.1 Resource Inputs

We assess the suitability / appropriateness of the anaerobic reactor design for treatment of a specific waste. An assessment of the Quantity and Quality (Characteristics) of the waste available and reasonableness of the capacity / size of the biogas plant and other units for gas utilization is also undertaken. Key evaluation is undertaken for the following parameters: -

i) organic loading rate,
ii) conversion efficiency,
iii) expected biogas production rate per tonne of waste/ m^3 of effluent,
iv) Hydraulic Retention Time (HRT)/Solid Retention Time (SRT),
v) reactor operating temperatures and other conditions,
vi) Feed preparation requirements
vii) possibility of recycling of effluent / waste water,



Top: General design of bio-digester, **bottom:** feedstock from cattle dung being prepared	**Top:** construction of biodigester, **bottom**: construction of VIP pit latrines to allow effluent collection

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Feeding of effluent into biodigester	Collection and management of farm waste

3.2 Technology and Processes

- We continuously Share our experience of the technology (Reactor Design) for treatment of biodegradable waste from different parts of Uganda.
- We also review technology tie ups arrangements from legal and technical standpoint i.e. propriety equipment if any, capacity building of our counterparts in Uganda, technology acquisition costs among others in case of technologies which are sourced from outside.
- Reviewing authenticity, legitimacy and Intellectual Property Right (IPR) of the technology to be supplied.
- Assessing the reasonableness of the output parameters committed in the Detailed Feasibility Study.
- Advise our clients on any improvements required and prepare and review standard operating guidelines.
- We ensure that we source local labor, raw materials and train resource persons from the community thereby ensuring local participation in our supply chains.

3.3 Biochemical Interactions and Health and Safety

Feedstocks and effluent from the digesters shall be monitored for standard wastewater and fertilizer metrics including indicator organisms (Escherichia coli and fecal coliform), chemical oxygen demand (COD), biological oxygen demand (BOD5), total Kjeldahl nitrogen (TKN), total phosphorous (TP), heavy metals, pH, temperature and total solids (TS) over the project life. The laboratory studies shall be conducted in line with the guidelines from the Ministry of Water and Environment as well as the National Water and Sewerage Corporation (NWSC) standard operating procedures for managing

Laboratory tests shall be undertaken to ensure that digester effluent meets standards for wastewater discharge or international safety standards for field application. Feedstock shall further be subjected to tests that shall determine whether digestate could be a suitable source of fertilizer (TKN = 1467 mg L−1, TP = 214 mg L−1) and its likely impact on water quality if not managed properly (TS = 26,091 mg L−1, COD = 3471 mg L−1 and BOD5 = 246 mg L−1).

Additional tests shall be conducted to assess whether the digester contains pathogen indicator organisms (fecal coliform = 8.13 × 105 CFU/100 ml, E. coli = 3.27 × 105 CFU/100 ml) and whether their concentrations meet the minimum recommended rate for use as fertilizer and discharge into the environment.

Scope of laboratory analysis on the digestate shall also ascertain the dosage of heavy metals.

Other technical specifications to consider include: -

i) land and manpower requirements,
ii) Operations and Management (O&M) cost,
iii) energy and mass balance,
iv) QHSE
v) source of technology,
vi) commitment of the technology supplier for plant performance

Measurement and monitoring of feedstock for the biodigester

Construction of sustainable pit latrines with biodigester

Incorporation of local and communal labour during construction

Top view of biodigester under construction

3.4 Energy Outputs

It is critical to measure the potential energy yield from the biogas facility before, during and after construction. Key parameters such as kg of dung/day and retention times inside the digester and their specific yield should be evaluated.

Installed gauges for monitoring pressure and gas levels

3.5 Tools and Equipment

1)Pressure gauges and pressure valves for inspecting gas pressures and yield per hour hour, per day etc

2)Mobile Gas Analysers for sampling gas compositions

3)Global Positioning Systems (GPS) for mapping households, feedstock sources etc

4)Ph meters to assess the Ph of the feedstock

5)Temperature guns for monitoring ambient temperature conditions

3.6 Operational Results

Ensuring that we maximize gas yield for the clients inline with the objective and desired application. Depending on the applications required such as**; Cooking, lighting, water heating, Biofertilizer feedstock, cooling of machines, drying of produce, power generation etc**. A sustainability model is also essential to make sure that the plant operates for a reasonable timeframe.

Installed biogas units ready for use

Cement Sand Screed finishing

Testing the Biogas System

Construction of sustainable pit latrines with biodigester

Internal Connections to the Biogas System

ANNEX: List of our equipment

Equipment	Make and year	Condition	Ownership	Use
Hilux	Pick up double cabin,1994	Good	Hired	Transport
Thermo Niton XL3t XRF Analyzer	Niton XL3t 900	Good	Hired	Analysis of elements
Resistivity equipment	ABEM SAS 1000 terameter, 2003	Good	Hired	Siting
Resistivity equipment	ABEM SAS 300C terameter, 2000	Good	Hired	Siting
2 GPS	Garmin GPS Etrix 2010 &Oregon 300, 2010	Good	Owned	Location
3 EC meters	Eijekelkamp, 1999	Good	Owned	Water quality
3 pH meters	Eijekelkamp, 1999	Good	Owned	Water quality
2 Water level meters/dippers / solinst	1 of 50m and 1 of 100m	Good	Hired	Water depths
2 Laptop Computer	Toshiba and a dell		Owned	Field data collection and Reporting
1 Generator	Hale Pumps Hot4200GE-D W/ Lombardini, Motor 1 Ph 17937LR	Good	Hired	Test pumping

Software

Software name	Ownership	Application
Microsoft office (word, Excel, Access)	Owned	Reporting, data, analysis, presentation of geophysical data
RESSOUND	Owned	Sounding interpretation
Aquitesolv & Aquitest	Owned	Pumping test data interpretation
Surfer version 8.0 Arc GIS 10.5	Owned Owned	Presentation of data on Maps Interpretations and analyses

List of other field equipment

EQUIPMENT	PICTURE	APPLICATION
Conductivity meter From Ahaus cooperation		Measuring salinity/conductivity of water.
BD Plastic pack syringe		For taking quantified water samples
Sulphide test paper		For testing sulphide content.
P.H fixed 0 -14 test strip From acherey Nagel		For easy and quick determination of P.H of water.

EQUIPMENT	PICTURE	APPLICATION
Mityvac Vacuum pump		For sucking in water into the gas tubes.
Copper tubing		For collecting gas samples
Gas mouse		Trapping Gas samples

Profiles of our Key staff

STAFF	EXPERTISE	EDUCATION	Experience
Dr.John Mugisa (PhD)	• Renewable Energy-Biogas • Solar Power • Chemical Engineering	PhD in Production Engineering- University of Bremen- Germany MSc Chemistry (MUK) BSc Chemistry (Kyambogo Univ) Postgraduate Research in:- • Renewable Energy Engineering- • Production Chemistry of Gas	Over 14 Years
James Ecau	Geological resource specialist, GIS Expert	MSc Reservoir Geoscience (Manchester-UK-2012) BSc Geology (MUK-2012), Post grad training in • renewable energy, • energy policy, • oil and gas engineering • QHSE M&E and Project Management	Over 10 years
VIANNEY LUKANGA	Biogas specialist, Mechanical engineer	BSc Mechanical Engineering (MUK-2015) Post grad training in • Biogas construction • Pipeline design and construction • CAD • Renewable energy • ICT	Over 7 years
SIMON ALIKER	Biochemist and Biotechnologist	BSc Biomedical Laboratory Technology (MuK) MSc Biochemistry (MuK) • Over 10 years in Biomedical loboratry • Epideamology	Over 10 YEARS
ALVIN ASINGYA	Agricultural Engineer, Solar and Renewable Energy Specialist, GIS Expert	BSc Agricultural Engineering (MUK-2015) Post grad training in:- • ArcGIS • Renewable Energy • Computer Programming	Over 7 years of experience
Eriaku Emmanuel	Social Scientist, Stakeholder engagement, public relations	BA.Social Science (2015) Post grad training in: • Public relations • QHSE • Graphics Designing • Civic engagement	Over 7 years of experience

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Ref. No. CENT/SSP/2022/01

SUSTAINABILITY POLICY FOR CENTMAX GROUP

At Centmax Group we appreciate the importance of sustainability as part of corporate social responsibility in an effort to cut-down greenhouse missions while improving on our value chains and product development to ensure responsible growth.

Our Corporate sustainability philosophy is governed by the following principles: -

Sustainable Water Management

using water in a way that meets current, ecological, social, and economic needs without compromising the ability to meet those needs in the future. Looking beyond jurisdictional boundaries and their immediate supply operations, managing water collaboratively while seeking resilient regional solutions that minimize risks.

Waste Management and Recycling

Handling, storing, and disposing of waste in a way that minimizes negative environmental impacts including reducing the amount of waste generated, recycling or reusing waste materials, and safely disposing of any remaining waste. Allowing waste materials to be reused instead of sent to landfills.

Use of Renewable Energy

Focusing on the use of renewable energy instead of fossil fuels to reducee greenhouse gas emissions, improving energy security, and creating jobs.

Community Engagement

To ensure that local communities are consulted and involved in decisions about our projects in their area to ensure that any potential negative impacts of our operations such as; mining, construction, WASH, ICT are minimized and that any benefits from our operations go to the community.

Biodiversity Conservation

Our sustainable practices involve protecting and managing natural habitats so that they can continue to support a diversity of plant and animal life, protect the environment against loss of habitat and biodiversity

Supply Chain Management

We are fully responsible and ensure that the materials are sourced sustainably from certified sustainable suppliers who subscribe to our corporate values such as; using conflict-free minerals and resources, and avoiding environmental damage.

Responsible Marketing and Communication

we proactively engage with stakeholders and address concerns in a transparent and timely manner through adopting responsible marketing and communication practices.

JAMES ECAU

GROUP CEO

CENTMAX GROUP

QUALITY, HEALTH SAFETY AND ENVIRONMENT (QHSE) POLICY STATEMENT

CENTMAX LIMITED recognizes the importance of managing EHS matters effectively as an integral part of its business activities and the company's obligation under the **OSH Act no.9, 2006**. The management accepts its moral and legal responsibility and is committed to protect its personnel and the environment from foreseeable hazards including the public where they come into contact with company activities.

CENTMAX will in the conduct of its activities:

1. Comply with latest requirement of **ISO 45001, ISO 18001, ISO 14001** and **ISO 9001** and all relevant statutory and industrial requirements and cooperate with enforcement authorities/agencies.
2. Recognizes and meets its responsibilities and duties as an employer to do all that is reasonably practicable to prevent accidents, incidents, injuries, occupational illnesses and pollution that can result in damage of the company reputation and property, injury to employees, the adverse effect to the environment and surrounding community.
3. Safeguard employees, the public and the environment from foreseeable hazards connected with work activities, processes and working systems
4. Develop and maintain a culture that strives towards behavior-based safety, personal well-being and environmental awareness and conservation. Continually improving the Environment, Health and Safety management System.
5. Communicate and consult with employees to inform train and raise awareness in all safety, health and environment matters. Recognize and manage contractors as employees for the duration of projects.

CENTMAX will as far as reasonably practicable:

1. Conduct risk assessments and take necessary control measures to eliminate or minimize the risk within the acceptable risk level.
2. Provide and maintain a safe working environment, personal protective gear, equipment and machinery which are without risk to the safety, health and environment of people involved in the company activities.
3. Train all employees to be competently aware of their own responsibilities in respect of relevant safety, health and environment.
4. Participate in the prevention of incidents, co-operate with measures taken to prevent industrial diseases and protect the environment. Conduct inspections, audits and management reviews to ensure safety, health and environmental objectives are targets being met. Conduct comprehensive incident investigations with root causes identified and document the findings to prevent future occurrence.
5. Periodically audit EHS systems and benchmark the company's operations against international standards.
6. Provide necessary resources for implementation and monitoring of this policy.
7. Develop, implement, maintain and practice an emergence preparedness and contingency system to ensure personnel including the public, where they come into contact with the company activities are safe.
8. This policy will be periodically reviewed and applied over all our processes and operations.

GROUP CEO

Date: July 16th, 2022