



Bioenergy in the Sisal Processing Sector in Kenya

SUMMARY

Kenya is one of the world's three largest sisal producers.

Its ten large sisal estates generate significant quantities of bioenergy-rich effluent with good potential for anaerobic digestion (AD) to generate power and heat. These residues could generate as much as 20 MW of electricity.¹ Environmental legislation on the treatment and disposal of these wastes provides an ideal impetus for sisal companies to invest in AD for biogas production. In the mid-to-late-2000s, there was considerable interest in using AD to generate electricity from agri-processing residues, including sisal wastes.

But only one company, Kilifi Plantations, has invested in AD for this purpose in Kenya. Currently the political-economic viability assessment indicates that the commercial case for replication is discouraging. Based upon interviews with 5 of Kenya's large sisal estate owners, interest has waned for investing in sisal waste for electricity from AD due to the low electricity feed-in tariffs (FiT) for biogas-generated electricity and difficulty accessing the grid. Kenya Power lacks the finance to invest in upgrading its rural distribution infrastructure to handle new electricity from often isolated rural generators. However, a new 1.75 MW combustion-based CHP unit at REA Vipingo's Dwa Kibwezi Estate, one of Kenya's largest sisal companies, was commissioned in 2021 and illustrates that these hurdles can be overcome (Figure 1).

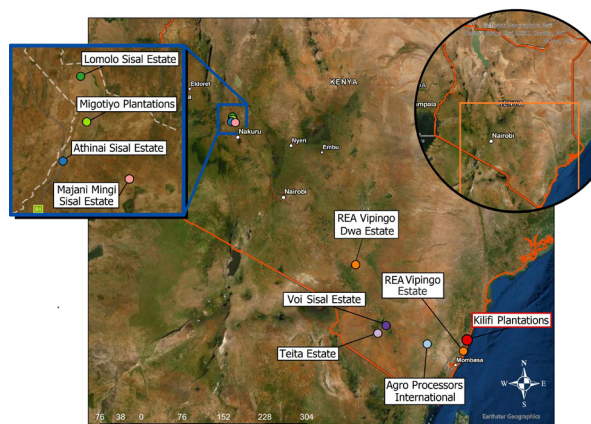


Figure one: Kenya Map with All Sisal Estate Locations

The key recommendation to the Government of Kenya is to double its feed-in-tariff for biogas electricity to create the necessary incentives for investment in generating renewable energy from sisal sector. This could not only generate much-needed electricity for these large facilities themselves, but for their rural neighbours while helping to strengthen Kenya Power's weak rural grid with new embedded generation to supply distributed electricity in these areas. The relevant Government agencies and sisal estate owners need to work together to create the conditions to invest in both sisal AD combined heat and power (CHP) and combustion CHP, as sisal could be a large source of Kenya's bioenergy for electricity in rural areas.

This policy brief analyzes the policy, legal, regulatory, institutional and market set-up and framework for investment in biogas AD for electricity and heat in Kenya's sisal processing sector.

SECTOR OVERVIEW

Sisal was introduced to Kenya in the 1920s under a plantation-based large estate model.

Although synthetic substitutes were developed during the mid-20th Century that significantly reduced global sisal demand, interest in natural and recyclable fibres has reinvigorated the industry (Fibre Crops Directorate [FCD] 2021²). Kenya is now a leading global producer of sisal.

The country is estimated to produce an average of 25,000 tonnes of sisal every year. Ten estates employing over 100,000 people account for 95% of Kenya's output, with over 10,000 small-scale producers (outgrowers for some of the estates and smallholders elsewhere) supplying the remaining 5% (FCD 2020³). Over 90% of Kenya's

processed sisal is exported, with China being the largest single market (WGC 2020⁴). Sisal is one of Kenya's largest agricultural exports. Kenya vies with Tanzania as the world's second and third largest sisal exporters. Kenya's sisal industry, in terms of value-added, has grown on average by 5% per annum since 2005, accelerating to over 7% today, due mainly to rising global demand for natural and recyclable fibres (WGC, 2020).

Fibre makes up only 5% of the fresh sisal leaf, with the balance discarded as a blend of solid and liquid residues during the decortication (crushing) process (Mshandete, et al. 2005⁵). This wet residue is well-suited to AD for the production of biogas to generate heat and electricity. Kilifi Plantations is the only sisal company in Kenya using decorticator residues for AD-based electricity production.

1 Fischer, et al., Agri-industrial biogas in Kenya. GIZ Renewable Energy Project Development Programme East Africa, 27 January 2010, p.16.

2 FCD. 2021. Overview - sisal. Available at Overview (agricultureauthority.go.ke) (last sighted on 19 March 2021).

3 AFD. 2020. Sisal industry performance July 2020. Nairobi, Kenya.

4 Wilhelm G. Clasen (WGC). 2020. Sisal market report May 2019 to January 2020. Hamburg, Germany.

5 Mshandete, A., Björnsson, L., Kivaisi, A. K., Rubindamayugi, M.S.T., and Mattiasson, B. 2005. Performance of a sisal fibre fixed-bed anaerobic digester for biogas production from sisal pulp waste. Tanzanian Journal of Science. 31(2): 41-51.

INSTITUTIONAL SET UP FOR SISAL SECTOR

The institutional set up for Kenya’s sisal sector includes private and government bodies (Figure 2).

Private sector bodies produce and process all sisal. Government bodies are responsible for policy and support to the sector.

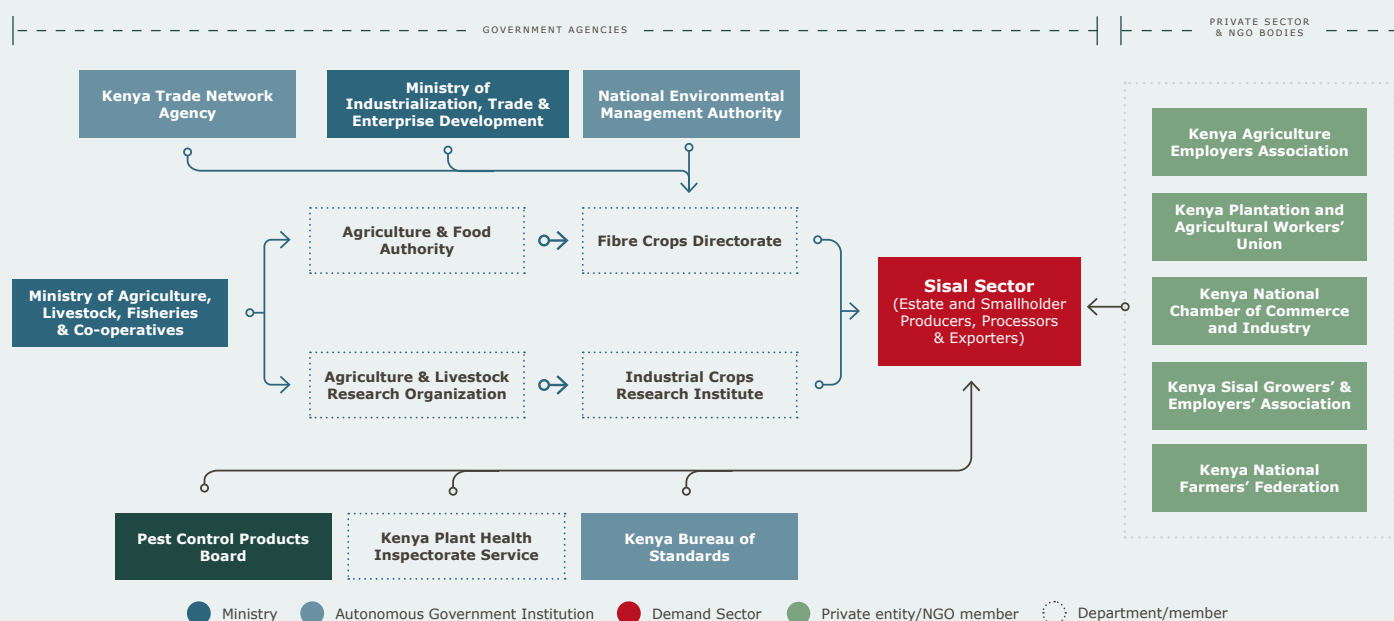
The Ministry of Agriculture, Livestock and Fisheries (MoALF) is the paramount body responsible for policy making, technical, legal and financial support, promotion and advocacy for the sisal sector in Kenya. Its Fibre Crops Directorate (FCD), a part of the Agriculture and Food Authority (AFA), is the main support and regulatory body for the sector. The Kenya Agricultural and Livestock Research Organization (KALRO), under the AFA and through the Industrial Crops Research Institute (ICRI), provides development and capacity building support for developing, expanding and improving the sisal sector. The Kenya Plant Health Inspectorate Service and the Pest Control Products Board are jointly responsible for enforcing regulations and standards for ensuring quality and hygiene in the sisal

sector. The Kenya Bureau of Standards (KEBS) is Kenya’s national standards body and has developed standards for the horticulture sector, particularly the Sisal Industry Code of Practice (Kenya Standard 2858:2019).⁶

The National Environmental Management Authority (NEMA) is Kenya’s paramount environmental enforcement agency. NEMA has offices in all 47 counties and is responsible for licensing and enforcing regulations concerning air quality/pollution, water quality, waste management, waste disposal and utilisation from sisal processing residues.

There are two key private sector associations relevant to the sisal sector. The Kenya Sisal Growers Association (KSGA), a loose association of Kenya’s ten largest sisal growers, whose main function is to set up the framework for estate owners and estate workers to interact. The Kenya Plantation and Agricultural Workers’ Union, represents estate employees’ rights and interests, primarily in the sisal, cotton, coffee, tea and pyrethrum plantation sectors.

Figure two: Institutional framework for sisal sector in Kenya (Source: BSEAA II team compilation)



INSTITUTIONAL SET UP FOR BIOENERGY GENERATION BY SISAL SECTOR

The institutional set up for electricity and heat generation by Kenya’s sisal processing includes both environment and energy entities.

Sisal processing and production residues, and effluents associated with cleaning and disposing of those wastes, are covered by both national and county laws and

regulations primarily enforced by NEMA. The Environmental Management and Co-ordination Act (EMCA, 2012)⁷ establishes legal and institutional mechanisms for the management of the environment. NEMA’s Environmental and Social Impact Assessment (ESIA) Department is based in Nairobi with inspectorates in every county responsible for overseeing ESIA development and compliance.

6 Source: www.kebs.org.

7 Environmental Management and Co-Ordination Act (EMCA), Chapter 387, 2012.

NEMA requires an Effluent Discharge License (EDL) for any facility generating effluents that could harm ground water, surface water or coastal waters, and effluent tests to ensure compliance is carried out at least annually by NEMA.⁸

The Ministry of Industrialization, Trade and Enterprise Development and the Kenya Trade Network Agency (KenTrade) are the primary bodies regulating the industrial

(e.g. processing) and commercial (e.g. marketing) aspects of the sisal sector. The Kenya National Chamber of Commerce and Industry (KNCCI) is a membership-based trade support institution that works to protect commercial and industrial interests of the Kenyan business community, including in the sisal sector. KNCCI has offices in all 47 countries and its membership constitutes enterprises of all sizes.

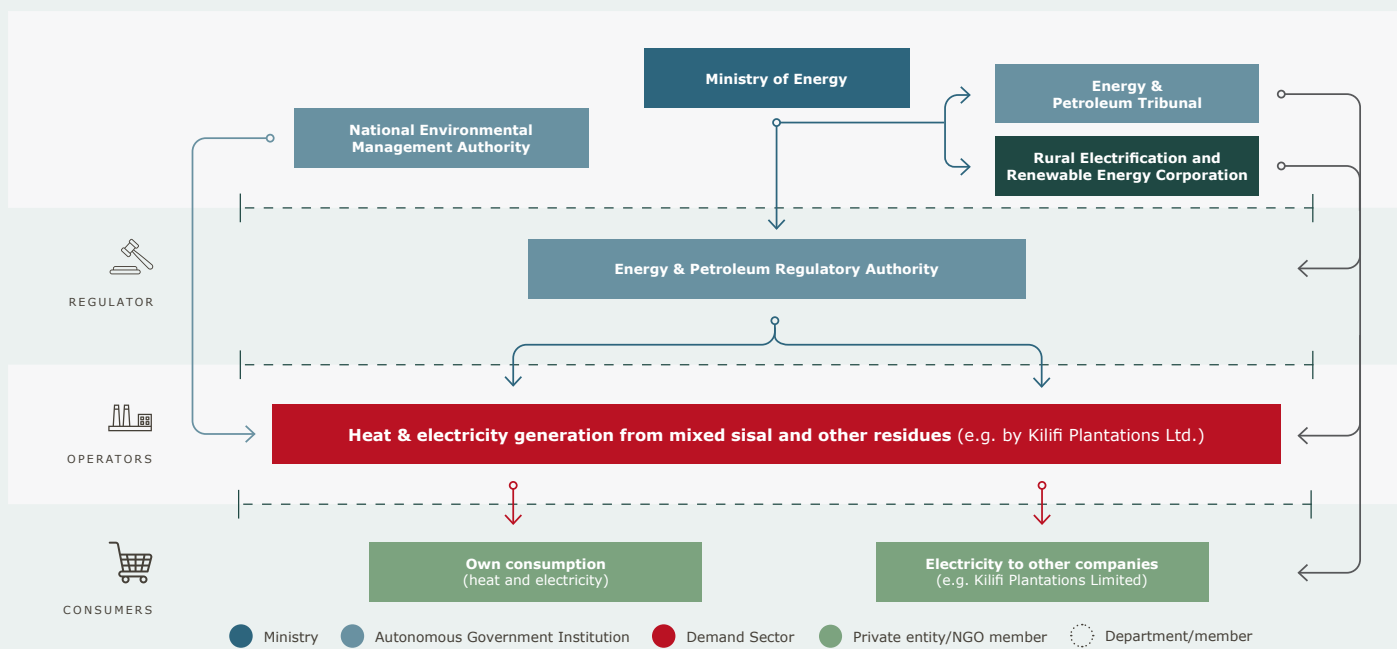
REGULATORY SET UP FOR BIOENERGY GENERATION BY SISAL SECTOR

Several policy and regulatory areas provide governance for the use of wastes from sisal processing, including (i) waste treatment and waste disposal, generating biogas for own consumption and/or sale to other parties and (ii) generating electricity for own use and for sale to other parties, including to the grid (i.e. Kenya Power, or to third parties utilising the grid).

Most of these policies are set and enforced at a national level (Figure 3).

The Environmental Management and Co-ordination Act (EMCA, 1999) establishes legal and institutional mechanisms for the management of the environment under three sets of regulations on impact assessments and audits, water quality, and air quality. The objective of these regulations is to protect air quality and soil, land, watershed and groundwater sources from inadequate handling of solid and liquid wastes from the production, harvesting and processing of various crops, including sisal.

Figure three: Institutional framework for bioenergy sector in Kenya (Source: BSEAA II team compilation)



INSTITUTIONAL AND REGULATORY SET UP FOR BIOENERGY

The Electricity and Petroleum Regulatory Authority (EPRA - ‘The Energy Regulator’), created under the Electricity Act (2019), replacing the former Energy Regulatory Commission (ERC), is responsible for regulating the import, storage, handling, transport and sale of gas, including biogas produced from any agricultural or agro-processing activity, including generating sisal wastes.

A new Bioenergy Strategy (2020-2027) was developed in the Ministry of Energy’s (MoE) Renewable Energy Directorate (RED) and published in late-2020.

The MoE is responsible for policy, planning and oversight in Kenya’s energy sector (Figure 3). The Ministry’s Rural Energy Directorate is responsible for renewable electricity policy formulation, review, planning, promotion, development,

⁸ An EDL is required under the Government of Kenya’s Water Quality Regulation, Legal Notice 120, of 2006.

M&E and Feed-in-Tariff (FiT) formulation and review. The electricity sector was liberalised and restructured during the 1990s. Kenya Power is the power off-taker from all power generators, including sisal AD electricity generating companies (IPPs – independent power producers), on the basis of negotiated Power Purchase Agreements (PPAs) for Kenya Power to supply to consumers.

The Energy Bill (2015) provides for the use of renewable energy resources, including bioenergy, to generate electricity and expands the scope of electricity FiTs which were first introduced in 2008. This includes setting the framework for biogas electricity generation support through FiTs setting eligibility of bioenergy projects generating electricity between 200 kW and 10 MW. The Energy Bill (2015) was replaced by the Energy Act (2019). The EPRA, created under the 2019 Energy Act, licenses bioenergy generators as IPPs to sell their electricity to the grid or to third parties using the national grid to 'wheel' (transport) renewable electricity from point of generation to a customer on the grid upon payment of a 'wheeling' charge. The modalities of 'wheeling' are being worked out now. Under the Energy Act 2019, FiTs are set for projects that

generate from 0.2 to 10 MWe (which includes biogas). The FiT for electricity generated from biogas has been fixed at USD 0.10 per kWh since 2008. Projects that generate more than 1MW require licences from the EPRA, whether for own consumption or for sale to the grid. However, electricity generation below 1MW does not require an EPRA licence unless that electricity is sold to a third party, including Kenya Power. Tariffs and licenses for sale to Kenya Power require an EPRA licence which is granted as part of the PPA process. All electricity generators above 200 kW generation must be registered with EPRA for the purposes of data collection.

EPRA sits on the FiT Committee, alongside other government parastatals and public sector players, which sets the tariffs for sale to Kenya Power. The FiT process is currently being reviewed for simplification by a national committee set up to operationalise third party electricity sales and 'wheeling' on the national grid, as authorised under the Electricity Act (2019). It should be noted that VAT was removed for biogas in the 2021 Finance Act 30 June 2021

IMPACT OF POLICIES ON BIOENERGY GENERATION BY SISAL SECTOR

Kenya's institutional and regulatory framework is not supportive of using sisal or any agricultural residues for bioenergy electricity generation.

The FiT is not high enough to encourage investment in biogas electricity projects. Environmental regulations cover sisal processing residues regulated and enforced by NEMA which carries out EIAs and inspections to ensure compliance with waste treatment protocols. For the sisal sector, NEMA issues two types of licence, composting licenses for management of agricultural wastes, and effluent discharge licences for wastewater. Projects considered to have high impact are licensed and monitored at the national level, while others are monitored by NEMA's county offices.

Financing commercial-scale AD plants in Kenya through local financial institutions is very difficult, while Government support for arranging financing for such projects is limited. Kilifi Plantations is the only estate in Kenya to use AD to convert sisal waste biogas to generate electricity, although REA Vipingo's Dwa estate (Makueni County) recently commissioned a 1.75 MW CHP project using dry sisal residues (McDonnell 2021). The main constraint is the low FiT paid for sisal bioenergy electricity generation, poor infrastructure, and lack of interest on the part of Kenya Power. This could change if some of the measures, under the 2019 Energy Act, such as wheeling, and improved FiTs for small-scale bioenergy generator are adopted.

RECOMMENDATIONS

The Energy Act of 2019 recommends a biogas FiT of USD 0.10 per kWh for biogas, which is approximately half the industrial tariff Kenya's sisal estates pay for their electricity. This does not provide any incentive for investment in sisal-based AD for electricity production. Two key recommendations come out of this work:

- Sisal companies should invest in sisal residue AD electricity generation to enable them to treat sisal waste to meet NEMA's ever-increasing sisal waste and

effluent remediation standards while generating enough electricity to meet the facility's own electricity demand and allow selling surplus electricity as another revenue stream.

- The BSEAA2 team, based upon extensive research and discussions with key stakeholders recommend strongly that a FiT of USD 0.20 per kWh of sisal biogas-generated electricity be approved by the EPRA for PPAs signed with Kenya Power.