Zambia Circular Economy Study 2024

Business opportunities in Zambia's circular economy, focussed on five value chains:
Municipal Solid Waste, fertiliser, biogas, mining, and textiles.
Report commissioned by the Ministry for Foreign Affairs of Finland through the Embassy of Finland in Lusaka to support the development of the private sector in Zambia and to increase trade between Finland and Zambia.

tandem
circular economy consultants

Embassy of Finland
Lusaka

Contact details

Embassy of Finland, Lusaka

https://finlandabroad.fi/web/zmb/mission

+260 211 251 234

Sanomat.LUS@gov.fi

Presented by

Tandem Circular Consulting Limited

1277 Lubuto Road

Rhodes Park

Lusaka

Zambia

Contact person

Mr. Andrew McNaught

T: +260 963 020 583

E: andrew@tandemcircular.com

Date

Lusaka, 8th October 2024

Contents

Acronyms

ASM	Artisanal and Small-scale Mining
A2C	Alternatives to Charcoal program
CBZ	Cotton Board of Zambia
BSF	Black Soldier Fly
CAGR	Compound Annual Growth Rate
DRS	Deposit Return System
EFSD	European Fund for Sustainable Development
EIA	Environmental Impact Assessment
EPR	Extended Producer Responsibility
ERB	Energy Regulation Board
EUR	Euro
E4A	Energy for Agriculture project
FSM	Faecal Sludge Matter
GRZ	the Government of the Republic of Zambia
IPP	Independent Power Producer
LPG	Liquefied Petroleum Gas
LWSC	Lusaka Water and Sewerage Company
MFA	Ministry for Foreign Affairs
MLGRD	Ministry of Local Government and Rural Development
MRF	Materials Recovery Facility
MSMEs	Micro, Small and Medium-Sized Enterprises
MSW	Municipal Solid Waste
NPK	Nitrogen (N), Phosphorus (P), Potassium (K)
NCZ	Nitrogen Chemicals of Zambia
PACRA	the Patents and Companies Registration Agency
PCW	Post Consumer Waste
PIN	People in Need
PPPs	Public-Private Partnerships
SMEs	Small and Medium Enterprises
SNV	Netherlands Development Organisation
WTP	Willingness to Pay
ZDA	Zambia Development Agency
ZESCO	Zambia Electricity Supply Corporation Limited
ZEMA	Zambia Environmental Management Agency
ZIPAR	Zambia Institute for Policy Analysis and Research
ZRA	Zambia Revenue Authority
8NDP	Zambia's 8th National Development Plan

1. Executive summary

This report is a deep dive into business opportunities in the circular economy, focusing on five value chains: **Municipal Solid Waste, fertiliser, biogas, mining, and textiles.** The report describes what is needed to unlock these opportunities and outline key recommendations and next steps. The report was commissioned by the Ministry for Foreign Affairs of Finland and conducted by the Embassy of Finland in Lusaka to support the development of the private sector in Zambia and to increase trade between Finland and Zambia. The report is a follow-up study on the 2023 circular economy study in Zambia also published by the Ministry for Foreign Affairs of Finland, which identified 11 business opportunities in the Zambian circular economy.

Finland is a forerunner in the circular economy, offering leading innovation and technology along with supporting policies. Finland implemented the world's first national roadmap to circular economy (2016-2025). The Finnish Innovation Fund Sitra is a global catalyst in the circular economy providing information that helps influence and accelerate the change towards sustainable well-being and providing a platform for both private and public sector engagement. Sitra has developed multiple useful tools for driving the change towards sustainability, including a guide on How to create a national circular economy road map.

This report primarily targets circular economy businesses in Finland and private sector stakeholders in Zambia. However, it also aims to engage all relevant stakeholders in Zambia's circular economy, including the public sector, civil society, international organisations, and global investors.

Key data on Zambia

Zambia is a landlocked nation in sub-Saharan Africa with an estimated population of 20.5 million in 2023[1]. With a GDP of **USD 28.16 billion**[2], the economy heavily relies on mining, particularly copper, which serves as its primary source of foreign income. Sharing borders with eight countries, Zambia has significant trade potential with its neighbours.

Recently the government has focused on economic diversification aligned with Zambia's 8th National Development Plan (8NDP), aiming to drive transformation through four key sectors: mining, agriculture, manufacturing, and tourism. This strategic focus is intended to diversify the economy and enhance resilience against external shocks, particularly in light of recent challenges such as climate change and global economic fluctuations. In particular, the National Green Growth Strategy (2024-2030) aims to transition the country to a low-carbon, resource-efficient, resilient, and socially inclusive economy by integrating environmental sustainability into national development while addressing climate change and promoting economic growth.

Zambia's economy is gradually recovering from past crises, with real GDP growth being 5.8% in 2023[3]. However, Zambia faced a current account deficit in 2023 due to declining copper production and exports, which has affected foreign currency earnings. The depreciation of the Zambian kwacha has also contributed to rising inflation, surpassing the Bank of Zambia's target range. The cholera epidemic and severe drought in 2024 has hindered growth, and growth projections for 2024 have been revised down to 2.3 percent[3,4].

Despite these challenges, ongoing debt restructuring efforts and a recent agreement with bondholders are expected to stabilise the exchange rate and improve macroeconomic conditions.

Overview of opportunities in the five value chains

Significant business opportunities exist in the five value chains that, if realised, could contribute significantly to job creation and add **USD 4.23 billion** to Zambia's economy - a **15%** increase in GDP. While the circular economy in Zambia is still in its early stages, it offers business opportunities for innovative tailored solutions that suit the local context. Here are some highlights from the five value chains:

1 World Bank, World Bank Database, accessed August 2024, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=ZM.
2 World Bank, World Bank Database, accessed August 2024, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=ZM.
3 World Bank, World Bank Database, accessed August 2024, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=ZM.
4 IMF, Zambia: IMF Executive Board Completes Third Review Under the Extended Credit Facility and Approves Augmentation of the Arrangement, Press Release, June 26 2024, International Monetary Fund, 2024.

Municipal Solid Waste (MSW)

With approximately 3.9 million tonnes[5] of waste generated annually, and only 45%[6] formally collected, current MSW management practices (including informal disposal methods like burning and illegal dumping)[7] pose environmental and public health risks. This presents a wasted economic opportunity as over 85% of the materials in these waste streams are valuable. Although current recycling rates are low at around 6%, there is growing recognition of the potential to enhance recycling and waste valorisation activities. Opportunities for improvement in the MSW value chain are estimated at **USD 340 million** annually and include (1) waste separation at source, (2) optimised collection logistics, and (3) establishing Materials Recovery Facilities (MRFs) to support recycling and waste-to-energy initiatives.

Biofertiliser

Zambia relies mainly on imported fertilisers and only 25-30%[8][9] of the estimated consumption is produced locally due to limited production capacity. Locally produced biofertiliser could fill the market gap and offer an environmentally sustainable solution. Circular business opportunities worth an estimated **USD 1.76 billion** per year include (1) production of biofertiliser from animal manure (e.g. chickens), (2) decentralised composting from agriculture residues, and (3) extraction of Nitrogen, Phosphorus, Potassium (NPK) from sewage waste. These opportunities add up to a potential value of USD 746 million.

Biogas

Zambia has significant potential for biogas production, particularly from cattle manure, with an estimated 4.7 million head of cattle available to feed anaerobic digestion facilities[10]. This process could generate renewable energy for heating, cooking and lighting and also produce bio-slurry that enhances soil fertility. With an estimated payback period of 3.25 - 3.75 years, biodigesters are an attractive technology for farmers[11]. Additionally, converting biowaste from Municipal Solid Waste (MSW) streams into biogas can address waste management challenges while generating renewable energy. Furthermore, sewage treatment facilities can harness anaerobic digestion to produce biogas, while improving wastewater management and reducing operational costs. Overall biogas opportunities could be worth **USD 753 million** annually.

Mining

Zambia's mining value chain presents substantial business opportunities, particularly in the copper industry as the ninth-largest copper producer globally: annual production is currently around 800,000 metric tonnes with plans to increase to 3 million tonnes by 2032. Over 70% of Zambia's export earnings are generated from copper with significant potential for value addition and circular economy as currently over 95% of copper is exported in raw form[12]. The mining sector's value chain includes extraction, smelting, refining, and limited manufacturing. There is increasing interest in expanding the value chain through circular economy practices. Key opportunities valued at **USD 1.25 billion** per year include (1) reprocessing and repurposing of tailings, (2) sulphuric acid production from sulphur dioxide, and (3) value addition and e-waste recycling.

Textiles

The Zambian textile value chain is relatively small and has faced challenges since the country's economic liberalisation. This study identified two key opportunities within the sector. Zambia generates an estimated 149,000 tonnes of textile waste annually[13]. This available textile waste and second-hand clothing offers an opportunity for textile-to-textile recycling, worth a potential **USD 94.5 million** per year. Local organic cotton production and local spinning offer further business opportunities as global demand for organic cotton is constantly increasing.

Finland is highly advanced in circular economy practices, boasting material innovations and recycling technologies in all five value chains, and is therefore well-positioned to be a leading partner for the circular economy in Zambia.

---

5 Calculated based on 2024 population, updated from MFA Finland, Zambia Circular Economy Market Study, 2023.
6 Lusaka City Council, 2024.
7 MFA Finland, Zambia Circular Economy Market Study, 2023.
8 CCPC, Agro-input (Fertiliser) value chain study in Zambia, 2019.
9 Building competitive agricultural markets for Zambia: Unlocking export potential, 2023.
10 Ministry of Fisheries and Livestock & Ministry of Finance and National Planning, Livestock Survey Report, 2022. https://www.zamstats.gov.zm/wp-content/uploads/2023/11/The-2022-Livestock-Survey.pdf.
11 Kaywala, I., Oppenoorth, H., Chiwama, K., Mwanza, K., Khatiwada, E., & Ter Heege, F., Domestic Biogas Programme in Zambia. Netherlands Development Organisation (SNV), 2022.
12 Ministry of Green Economy and Environment, National Green Growth Strategy, 2024.
13 Calculated based on 2024 population, updated from MFA Finland, Zambia Circular Economy Market Study, 2023.

Challenges to unlock opportunities

Challenges include unclear stakeholder roles, lack of scale and infrastructure, underdeveloped local markets, and unreliable energy supply. Several circular economy opportunities exist in Zambia, however various barriers continue to hinder their full realisation, including:

- **Unclear stakeholder roles:** Companies, especially new entrants, can find it difficult to navigate space and determine which entity coordinates each by-sector in the circular economy, especially in terms of licensing and coordination around waste streams. Responsibilities between the Zambia Environmental Management Agency (ZEMA) and the Ministry of Local Government and Rural Development (MLGRD) have shifted recently, adding to the lack of clarity. In addition, there is a lack of clarity on the roles between public and private sector stakeholders[14].
- **Implementation and enforcement:** There are significant challenges with implementation and enforcement of existing legislation like the Environmental Management Act. In addition, the Extended Producer Responsibility (EPR) policy lacks operational guidelines, and the current system is restrictive and short-term. This discourages long-term investments and large-scale projects[12].
- **Lack of scale and infrastructure:** Circular economy remains underdeveloped in Zambia, characterised by limited infrastructure and coordination and reliant on manual labour and low-tech methods. Key challenges include a limited supply of recyclable materials, fragmented collection systems and a lack of markets for recycled products. Due to resource constraints, there is a lack of investment in advanced recycling technologies.
- **Underdeveloped local markets:** With a relatively small population of 20.5 million, and a small (but emerging) middle class, Zambia's domestic market is limited in size, which restricts the potential for businesses to scale up. On the other hand, Zambia is well-positioned to serve as a regional hub - bordering 8 other countries - it offers opportunities to tap into larger regional markets.
- **Unreliable energy supply:** Zambia is currently facing an energy crisis due to low water levels in the country's hydropower plants. The 2023/2024 drought has highlighted Zambia's vulnerability due to dependency on hydropower from Kariba Dam. In 2024, the government implemented a load shedding program to manage the power deficit, which has led many businesses to convert to solar power.
- **Data availability:** The lack of up-to-date and accurate data makes it challenging to plan, determine viability, and develop effective business and circular economy strategies.

[14] Zambia Institute for Policy Analysis and Research (ZIPAR), Stakeholder interview, June 2024.

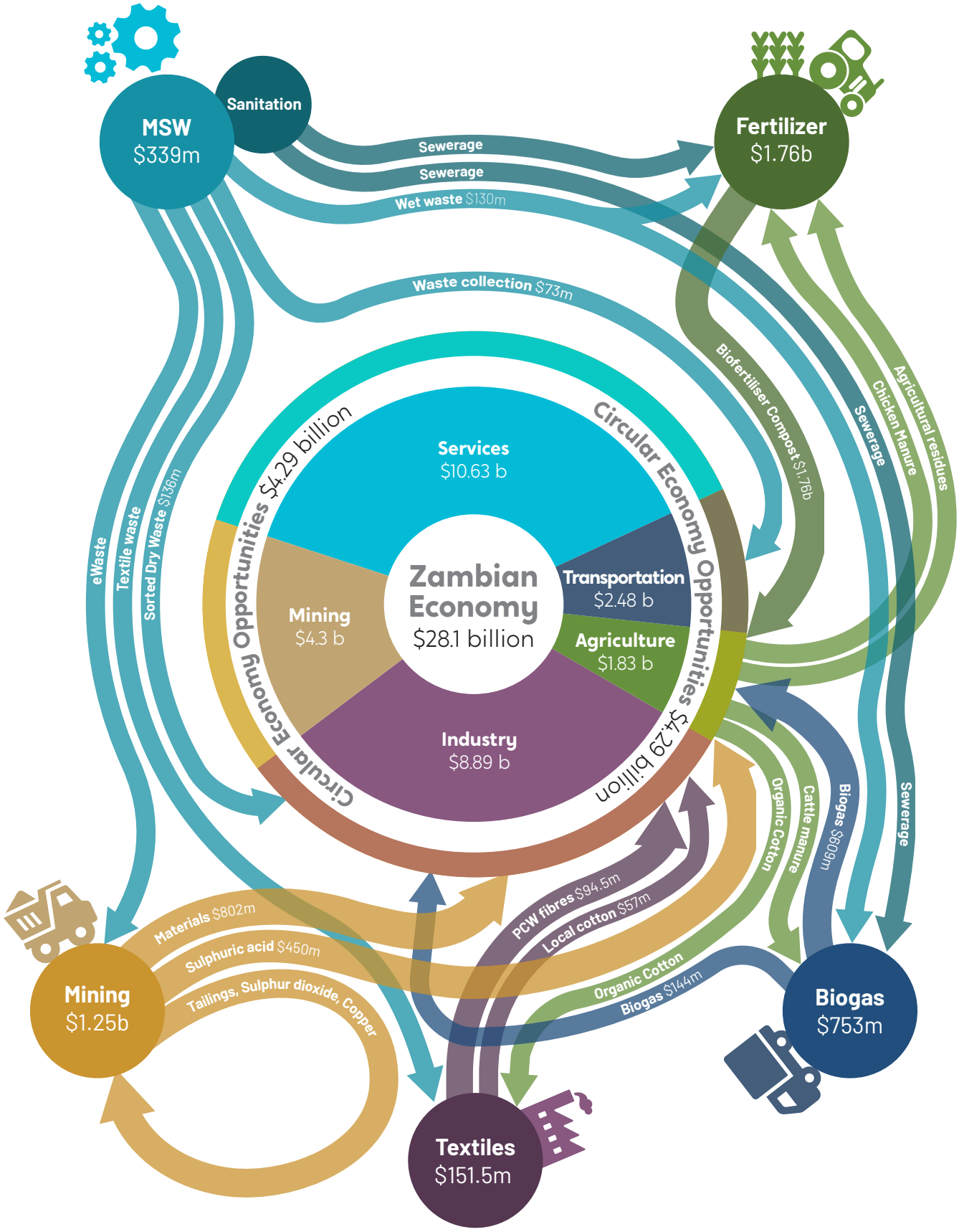
Financial and non-financial resources to support circular economy opportunities in Zambia

Several financial and non-financial resources exist to support the circular economy in Zambia and to support businesses in pursuing the identified opportunities. Resources include (but are not limited to):

- The **European Fund for Sustainable Development Plus (EFSD+)**, a pan-European initiative backed by a consortium of European development finance institutions (DFIs), aims to mobilise significant financial resources for inclusive economic development through guarantees, grants, and technical assistance.
- The **Green Recycling Enterprises Engaging in New Technology for a Circular Economy in Zambia (GREEN Tech4CE)**, a micro, small and medium-sized enterprises (MSMEs) development programme funded by the European Union with the objective of promoting and de-risking investment in green sustainable growth in Zambia. The programme will invest EUR 22.7 million in green businesses, provide grant-support to 550 start-ups and technical assistance to hundreds of other MSMEs over the next four years. The programme launched in July 2024.
- **Finnfund** is Finland's development financier and impact investor, mainly focusing on sectors that are critical to sustainable development. **Finnpartnership** is a business partnership programme financed by the Ministry for Foreign Affairs of Finland and managed by Finnfund. It promotes business between Finland and developing markets. Finnpartnership offers Finnish companies and organisations interested in developing markets financial support, guidance and contacts to help establish long-term business activities.
- **Switch to CE.** The European Commission has announced a EUR 40 million investment in the SWITCH to Circular Economy in East and Southern Africa (SWITCH-2-CE in ESA) programme, which aims to advance circularity in Eastern and Southern African countries as they shift from a linear to a circular economy. It will do so by creating an enabling environment for investment in circular business models and improving access to the necessary skills and finance.

- The **African Development Bank (AfDB)** funding opportunity is a multinational program called "**Integrated Development and Adaptation to Climate Change in the Zambezi River Basin**" (PIDACC Zambezi), which aims to promote sustainable development and climate change adaptation in the Zambezi River Basin. The funding will be used for activities related to integrated water resources management, climate-smart agriculture, and ecosystem restoration in the basin.
- **USAID's Digital Innovation and Growth Initiative in Zambia (DIGI Zambia)** solicitation showcases democratically-driven development progress to the people of Zambia by creating stronger investment opportunities and economic growth in technology and tech-enabled businesses that utilise open, secure, and inclusive digital technologies.
- **The USAID Alternatives to Charcoal program (A2C)** has been pivotal in fostering public and private sector collaboration in Zambia's biogas sector by supporting innovative companies and advocating for regulatory updates. A2C has successfully lobbied the government to create an enabling environment for companies promoting reduced taxes and VAT on essential equipment. Through these efforts, A2C enhances the viability of clean cooking solutions and alternative fuels, contributing to a significant reduction in reliance on charcoal and advancing environmental sustainability.
- **Zambia Export Development Fund (ZEDEF)** is run by the Zambia Development Agency (ZDA) and its purpose is to provide short-term low-cost trade finance to exporters of non-traditional export products.
- **Opportunity Driven Skills and VET in Africa (TEI OP-VET)** as part of the Global Gateway Investment Package (GGIP), the European Commission launched the Team Europe Initiative (TEI) 'Opportunity-Driven Skills and Vocational Education and Training in Africa (OP-VET)' in April 2024. It promotes a paradigm shift where the VET offer is reverse-engineered from concrete job opportunities stemming from public and private investments and related value chain developments. Deadline of submissions: November 3rd, 2024.
- **GET.invest** funding database for renewable energy projects and businesses with an up-to-date list of 250+ financing instruments for renewable energy projects and businesses. Financing instruments include grants, equity and debt.

2. Business opportunities across the five value chains

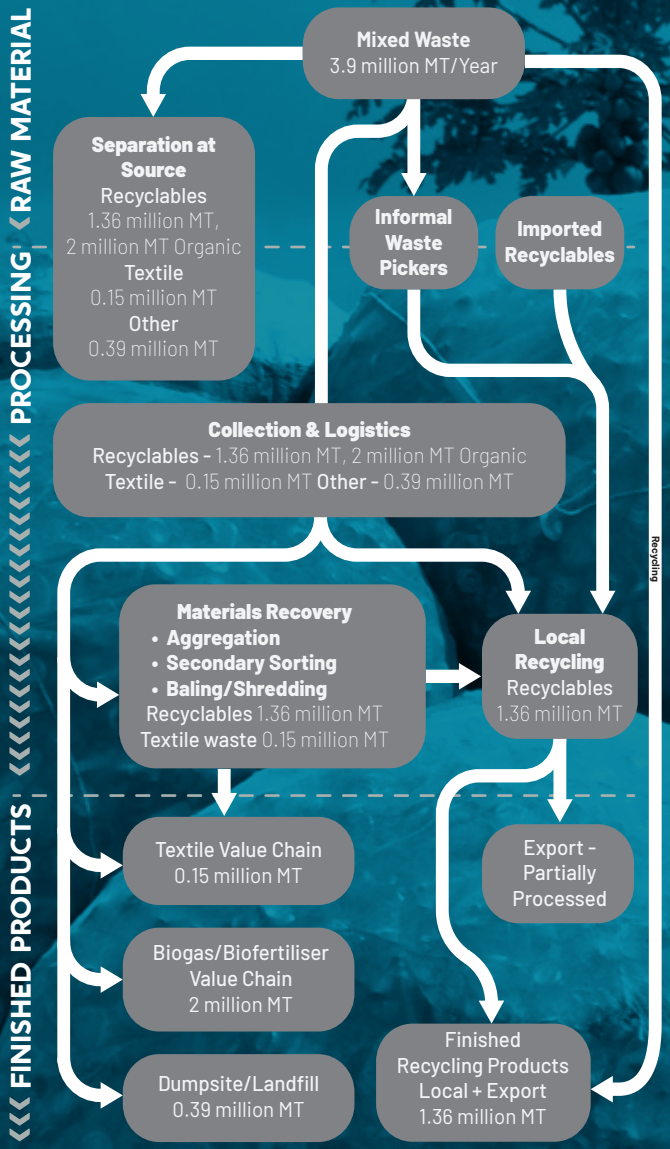


Municipal Solid Waste (MSW) Value Chain

The Municipal Solid Waste (MSW) value chain in Zambia presents significant challenges, but also substantial opportunities. Zambia generates approximately 3.9 million tonnes of waste annually[15], of which only 45% is formally collected[16]. This leaves a large portion unmanaged and often disposed of through informal means, such as burying, burning or illegal dumping. This inadequately managed waste not only poses environmental and public health risks but also represents a missed circular economy opportunity. If all the waste is separated at the source, collected and recovered this represents an opportunity of around USD 340 million.

The MSW value chain encompasses several critical stages, beginning with waste generation, which occurs across households, businesses, and institutions. Following generation, waste collection is managed by municipal authorities and private waste management companies that are subcontracted by municipalities. However, inefficiencies in logistics and infrastructure often lead to low collection rates, particularly in peri-urban and rural areas. After collection, the waste is either transported to the landfill or dump sites, where minimal separation occurs, typically by informal waste pickers who recover valuable materials such as plastics, metals, and paper for sale to recyclers[17].

Recycling and waste processing represent crucial points in the value chain where significant value can be added. Despite the low recycling rate of approximately 6%, there is increasing recognition of the potential to scale up these activities[15]. Key players in the MSW value chain include waste collection companies, informal waste pickers, waste aggregators, recycling firms, and regulatory bodies like the Zambia Environmental Management Agency (ZEMA). The flow of materials within this chain—starting from waste generators to collectors, processors, and ultimately end markets for recycled products—underscores the interconnectedness of these stakeholders and the need for coordinated efforts to enhance efficiency and resource recovery.



Given the challenges in the MSW sector, there is growing interest from both the government and private sector to improve waste management practices. Opportunities for growth within the value chain include separation at source, collection and logistics optimisation, and the establishment of MRFs to supply processors, such as recyclers and waste-to-energy (biogas) producers. By addressing the gaps in the current waste management system, Zambia can move closer to achieving a sustainable circular economy that not only mitigates environmental impact, but also generates economic value.

15 Lusaka City Council, 2024.
16 MFA Finland, Zambia Circular Economy Market Study, 2023.
17 Lusaka City Council, 2023.

Separation at Source: Dry & Wet

SNAPSHOT

- Approximately **3.3 million tonnes** of valuable materials.
- Value **USD 130 million** from wet waste.
- **USD 136 million** from dry waste.

Brief description of the opportunity: What, Where, Who, How

Separation at source in its simplest form involves segregating waste into wet (organic) and dry (inorganic) streams at the point of generation. This approach is crucial for effective waste management as it facilitates the recovery of valuable materials and reduces contamination. In Zambia, waste generators - including households, businesses, and institutions - are mandated by the Environmental Management Act (2011) to separate their waste. However, a lack of enforcement and inadequate infrastructure have been significant barriers to successful implementation.

The process requires public awareness campaigns to drive behaviour change, appropriate infrastructure, and the enforcement of regulatory frameworks mandating source separation.

Market potential

The market potential for separation at source is substantial. Currently, MSW is underutilised, but it has potential to benefit several sectors and local businesses. Zambia generates approximately **3.9 million tonnes** of MSW annually, with over **85%** of the waste consisting of valuable materials[18]. For instance, the value of the biowaste stream, if properly managed for compost production, is estimated at **USD 130 million**. Additionally, urbanisation and expansion trends across Zambia further increase the market potential for waste management services.

There is also significant potential for international collaboration, particularly if regulatory reforms are introduced to incentivize investment and streamline operations. By establishing effective waste separation at the source and organising a value chain that ensures a reliable supply of various waste streams, Zambia could effectively meet regional and cross-border trade demands[19].

What is needed to make it happen

To realise this opportunity, several essential investments and actions must be undertaken:

Investment in Separation Infrastructure

To facilitate effective waste separation, substantial investment in infrastructure is required. This includes specialised systems to handle both waste streams, deploying collection vehicles equipped to handle separated materials, and building dedicated waste sorting facilities.

Strengthening Policy and Enforcement

Robust policy measures must be put in place to mandate waste separation at the source. Clear regulations, coupled with strict enforcement, are essential to ensure compliance by households, businesses, and industries. Policies like the Environmental Management Act and the Solid Waste Regulation and Management Act are clearly outlined but poorly enforced. Additionally, there is a shortage of supporting Statutory Instruments, with the EPR (2018) being a key exception. However, it also lacks the necessary operational guidelines and is not currently enforceable. Enforcement through incentive models such as; the deposit return scheme and EPR are more likely to drive behaviour change and encourage the adoption of proper waste separation practices.

[18] Lusaka City Council, 2024.
[19] MFA Finland, Zambia Circular Economy Market Study, 2023.

Public Education Campaigns

Raising public awareness is key to the success of any waste separation initiative. Thus, widespread education campaigns are necessary to inform citizens about the importance of waste segregation, how to correctly separate waste, and the environmental benefits of participating. These campaigns should be ongoing to ensure sustained participation and understanding across all demographics. Since 2007, the government has initiated several campaigns to keep Zambia; clean, green, and healthy. Initially, these efforts produced positive outcomes, such as cleaner streets and reduced littering. However, the ongoing challenge has been maintaining a consistent campaign that effectively educates the public and fosters lasting change.

Public-Private Partnerships (PPPs)

Collaboration between the Government, municipal authorities, private companies, and NGOs is critical for scaling and sustaining waste separation efforts. The government can leverage private sector resources to enhance waste management in general.

Monitoring and Feedback Systems

Continuous monitoring and data collection are needed to assess the effectiveness of waste separation programs. This includes tracking the volume of waste separated, compliance rates, and areas for improvement. Regular feedback mechanisms should be established to refine policies and adjust operational strategies based on the data.

Collection & Logistics

SNAPSHOT

- Only **45%** of the waste is currently collected. Representing over 2.1 million tonnes of uncollected waste.
- Potential annual market of **USD 73 million**.

Brief description of the opportunity: What, Where, Who, How

Collection and logistics optimization focuses on improving the efficiency of waste collection routes and schedules to reduce operational costs and increase service coverage. This is particularly relevant in Zambia's urban areas, where waste generation is high, but current collection systems are often inefficient. The use of technology such as GPS tracking, route optimization software, and modern vehicles can significantly enhance the efficiency of waste collection.

Market potential

The market potential for optimised waste collection in Zambia is estimated at **USD 73 million** annually, based on potential revenue from waste collection fees[20]. Moreover, as urbanisation continues, the demand for waste collection services is expected to grow, further expanding the market. The opportunity to service the **55%** of waste currently not collected represents a significant market expansion[21].

What is needed to make it happen

To capitalise on this opportunity, several key investments and initiatives are essential:

Public Private Partnerships (PPPs): The Government can leverage private sector investment, technology, and expertise to enhance waste collection. The PPP model can shift the burden off the Government and lead to scalability, thus significantly improving operational efficiency and expanding the reach of waste collection services nationwide.

Investment in Technology: Implementing route optimization technology and GPS tracking systems is crucial for improving collection efficiency. These tools can help waste management companies plan optimal routes, reduce fuel consumption, and minimise operational costs. Some companies such as; eBusaka are innovating to develop logistics solutions for solid waste management in Zambia. These solutions are still quite early stage and mostly operating below city scale.

Fleet Expansion and Modernisation: Investing in modern waste collection vehicles, such as compactors, is necessary to enhance the capacity and effectiveness of waste collection efforts. These vehicles can handle larger volumes of waste and operate more efficiently than open trucks that are currently often used for waste collection.

Training for Operators and Drivers: Providing training for operators and drivers on the use of new technologies and processes is vital for ensuring successful implementation. Well-trained personnel are essential for maximising the benefits of technological advancements and improving service delivery.

Ongoing Data Collection and Analysis: Continuous data collection and analysis are required to monitor and refine collection routes. This ongoing evaluation will help identify areas for improvement, enabling waste management companies to adapt to changing urban dynamics and optimise their operations over time.

[20] Lusaka City Council, 2024.
[21] Lusaka City Council, 2024.

Materials Recovery Facility (MRF)

SNAPSHOT

- Potential to recover **940,486 tonnes** of recyclables annually.
- Representing a value of **USD 136 million** annually.

Brief description of the opportunity: What, Where, Who, How

MRFs are specialised facilities designed for the sorting, processing, and preparation of waste for recycling. In Zambia, establishing MRFs can significantly enhance the recovery of valuable materials from the waste stream, particularly organic materials for composting or biogas production. These facilities can be strategically located near urban centres where waste generation is high, making transportation to the facility cost-effective and efficient.

MRFs can serve as crucial hubs in the waste management system, allowing for the efficient separation of recyclables from general waste. By implementing advanced sorting technologies and processes, MRFs can optimise the recovery of materials such as plastics, metals, paper, and e-waste. This not only contributes to environmental sustainability, but also supports the local economy by creating jobs in waste management and recycling sectors.

Market potential

The potential revenue from valuable waste streams in Zambia – including plastics, metals, paper, and e-waste – is estimated at **USD 136 million** annually. Establishing MRFs would not only help capture this economic value, but also contribute to local economic development by creating employment opportunities in sorting, processing, and logistics. Additionally, by diverting waste from landfills and processing it into valuable resources, MRFs would play a crucial role in advancing Zambia's circular economy.

What is needed to make it happen

Significant capital investment is required to establish and equip MRFs with the necessary infrastructure, including sorting lines, balers, and composting or biogas facilities. Technical expertise in waste sorting and processing is essential to maximise the efficiency and profitability of MRFs. Government support through favourable policies and incentives, secure supply of waste streams, as well as efforts to develop markets for recycled materials and organic products, will be critical for the success of MRFs.

To successfully establish and operate MRFs in Zambia, several key components are essential:

Capital Investment: Significant capital investment is required to establish and equip MRFs with the necessary infrastructure. This includes sorting lines, balers, and composting or biogas facilities, all of which are important for efficient waste processing.

Technical Expertise: Employing skilled personnel with expertise in waste sorting and processing is essential to maximise the efficiency and profitability of MRFs. Training programs should be developed to ensure staff are familiar with the latest technologies and best practices in waste management.

Government Support: Government support through favourable policies and incentives is critical for the success of MRFs. This could include tax breaks or subsidies to encourage investment in waste management infrastructure. PPPs could also provide security for supply of waste streams for a duration that aligns with the life of the investment is also essential to encourage private sector investment. Policies such as EPR and DRS can incentivise individuals to separate waste for recycling and return specific packaging (e.g. PET bottles) to drop off points or MRFs.

Market Development: Efforts to develop markets for recycled and organic materials are necessary to ensure the economic viability of MRFs. Establishing partnerships with local businesses and industries that can utilise recycled materials will enhance the overall effectiveness of the recycling process.

Public Awareness Campaigns: Linking into Separation at Source campaigns, raising public awareness about the importance of recycling and the role of MRFs in waste management can help drive community participation and support for these facilities. Educational initiatives can encourage residents to separate their waste at the source, improving the quality and quantity of materials available for recovery.

Challenges in the MSW Value Chain

Infrastructure Deficiencies: One of the most significant barriers to effective waste management in Zambia is the lack of adequate infrastructure. Zambia's waste collection systems are often inefficient, particularly in peri-urban and rural areas where roads and other critical infrastructure may be underdeveloped. This results in low collection rates, with only **45%** of the waste being formally managed . Moreover, the limited availability of specialised vehicles and equipment, such as waste compaction trucks and bins for segregated waste, hinders the effectiveness of waste separation at the source and collection efforts.

Financial Constraints: The implementation of advanced waste management systems and the establishment of MRFs require substantial capital investment. However, financial resources are often limited, particularly for municipal authorities and SMEs operating in this sector. Access to financing is further constrained by the perceived risks associated with investing in waste management infrastructure, which can be capital-intensive and have long payback periods.

Lack of Public Awareness and Participation: Public awareness and participation are crucial for the success of waste separation at the source and other waste management initiatives. There is a general lack of understanding and engagement among the public regarding the importance of waste segregation and recycling. This lack of awareness leads to low participation rates in waste separation programs and contributes to the contamination of recyclable materials, reducing their value and recyclability.

Regulatory and Policy Challenges: While Zambia has a regulatory framework for waste management, including the Environmental Management Act and the Solid Waste Regulation and Management Act, enforcement remains limited. The lack of sector-specific regulations and clear guidelines for implementing circular economy principles across the waste value chain further complicates efforts to improve waste management practices. Additionally, inconsistent enforcement of existing regulations, such as EPR regulations, limits their effectiveness in driving change.

Market Development and Value Chain Coordination: Developing robust markets for recycled materials and other products derived from waste is essential for the sustainability of waste management initiatives. However, the market for recycled materials in Zambia is still underdeveloped, with limited demand and price volatility posing risks to recyclers and waste processors. Furthermore, the lack of coordination across the waste value chain— from waste generators to collectors, processors, and end markets—hampers the efficient flow of materials and reduces the overall effectiveness of waste management efforts.

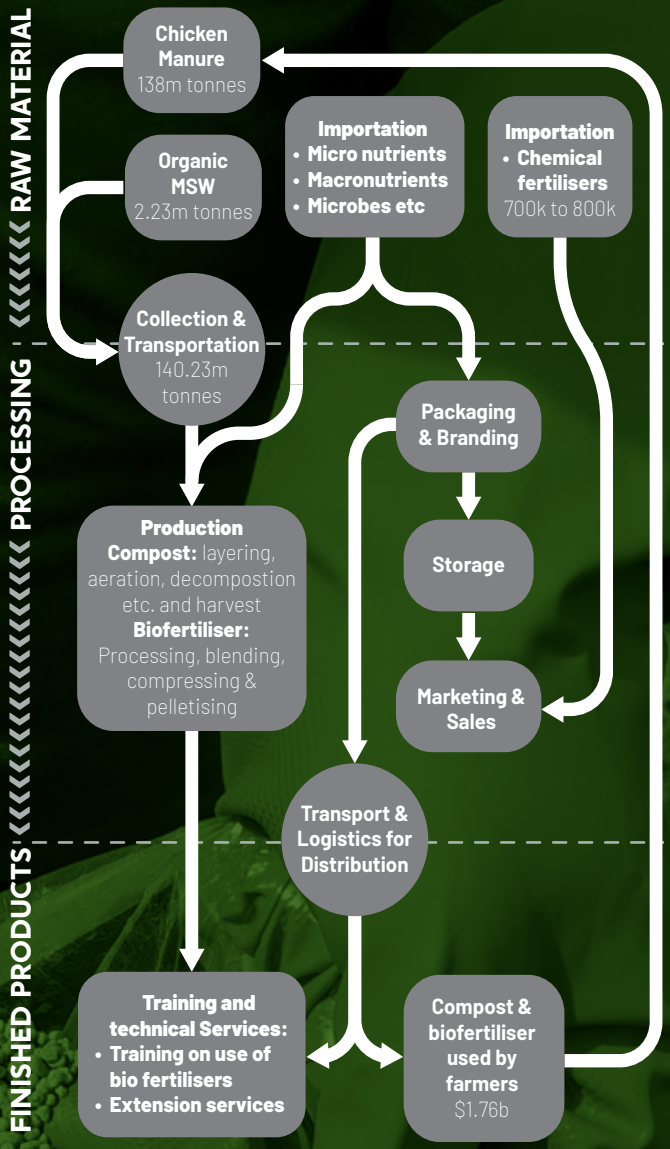
Willingness to Pay (WTP): In many Zambian communities, the willingness or ability to pay for waste management services remains limited, posing a challenge to the financial viability of waste collection and logistics operations. This low compliance rate affects the sustainability of such services. To address this, innovative solutions like deposit return schemes can be introduced. These schemes incentivize waste separation and recycling by offering a rebate for returning recyclable materials, thereby encouraging greater public participation.

Fertiliser Value Chain

Zambia's fertiliser industry began with the establishment of Nitrogen Chemicals of Zambia (NCZ) in 1970[22], aimed at producing fertilisers to support the agricultural sector. However, NCZ has faced significant challenges, including insufficient funding and outdated machinery, which have limited its production capacity and ability to meet the growing demand for fertilisers. Agriculture supports the livelihoods of 85%[23] of Zambia's population in 2024 of **20.6 million** people[24]. If effectively harnessed and processed, available waste materials such as chicken manure, agricultural residue, and faecal matter present an opportunity valued at USD 1.76 billion.

Zambia's growing demand for agricultural productivity and sustainable farming practices presents circular economy business opportunities in the fertiliser value chain. The value chain involves extracting and processing raw materials, blending and producing tailored fertiliser formulations, and distributing to agro-dealers, cooperatives, and farmers. The agriculture sector needs development and modernisation to boost local production, reduce reliance on imports, and meet local demand. Historically reliant on imported chemical fertilisers, Zambia is vulnerable to global price fluctuations and supply chain disruptions.

Zambia's fertiliser market is dominated by several key players, including United Capital Fertiliser (UCF), Fertilisers Seed Grain (FSG) Zambia, Yara Zambia, Nitrogen Chemicals of Zambia (NCZ), and Omnia. UCF, located in Chilanga District, is a relatively new entrant. FSG, part of the Meridian Group, distributes fertilisers nationwide. Yara Zambia, a subsidiary of Yara International, offers nutrient-specific fertilisers tailored for Zambian farmers. NCZ is one of the country's five main fertiliser manufacturers, while Omnia has a widespread distribution network. Other notable companies include Nyiombo, Greenbelt, ETG, Falcon Fertilisers, Neria Investments, Twala Farms, Albida Agriculture and Nyimba Investments, all contributing significantly to Zambia's agricultural productivity through the supply of both organic and inorganic fertilisers.



Potential areas for investment include producing environmentally friendly alternatives to chemical fertilisers, such as biofertiliser and compost from biowaste, establishing public-private partnerships to enhance fertiliser accessibility, and introducing innovative fertilisation technologies.

22 Nyirenda, James, and Harriet Malabo. "Mineral and bioresource exploitation for transformation and sustainability of the chemical industry in Zambia." Humanities and Social Sciences Communications 11, no. 1(2024): 1-14.
23 Global Yield Gap Atlas, Description of Cropping Systems, Climate, and Soils in Zambia, 2024, https://www.yieldgap.org/zambia
24 World Bank, World Bank Database, accessed August 2024, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=ZM.

Biofertiliser from Animal Manure (Chickens)

SNAPSHOT

- The Fertiliser import substitution potential of **USD 1.57 billion**[25].
- **137.6 million tonnes** of available chicken manure waste.

Brief description of the opportunity: What, Where, Who, How

The production of biofertiliser from chicken manure offers opportunities for farmers and fertiliser companies in Zambia to reduce the country's reliance on imported fertilisers. With over **30.6 million chickens**[26], including both free-range and caged birds, Zambia generates large volumes of chicken manure, most of which remains underutilised with potential to produce biofertiliser to meet the ever-growing demand.

Zambia imports most of its fertiliser, primarily due to insufficient local production[27]. Nitrogen (N), which accounts for around 70% of global fertiliser usage, is the most vital plant nutrient, while phosphate (P) and potassium (K) are the other key components, often supplied in various forms, including NPK blends[28].

The fertiliser industry in Zambia is dominated by imported chemical fertilisers and fertiliser prices have consistently exceeded world benchmark prices. From 2021 to 2023, global fertiliser prices surged, with urea reaching approximately **USD 900 per ton** due to rising natural gas costs, while in Zambia prices exceeded **USD 1400 per ton**. Despite a decline in global prices to around **USD 300 per ton** in early 2023, Zambian prices have remained above **USD 900 per ton**, resulting in significant costs for government subsidy efforts[8].

As fertiliser prices rise, smallholder farmers are increasingly using organic materials and animal manure for crop production, supported by conservation farming practices. However, the use of chicken manure is limited to only a few companies like Zambian Fertilisers and Zambeef, presenting a promising opportunity for developing sustainable, locally produced fertiliser options in Zambia.

Market potential

The global fertiliser market is a multi-billion dollar industry, valued at approximately **USD 212.8 billion** in 2023, and projected to grow at a Compound Annual Growth Rate (CAGR) of 3.30% to reach **USD 285.01 billion** by 2032[29] This growth reflects the essential role fertilisers play in enhancing agricultural productivity and food security worldwide.

In Zambia, the fertiliser market is estimated to range between **USD 950 million** annually[30], influenced by factors such as imports, exports, and local production capabilities. Recent data indicates that **70%** to **85%** of the fertilisers used in Zambia are imported, with annual imports **700,000 - 800,000 tonnes** of fertiliser annually, valued at **USD 693.43 million**[19]. This heavy reliance on imports stems from the limited local fertiliser production capacity.

---

25 UN Comtrade, UN Comtrade Data, accessed August 2024, https://comtradeplus.un.org/

26 Ministry of Fisheries & Livestock Zambia Statistics Agency, The 2022 Livestock Survey Report, 2022, https://www.zamstats.gov.zm/wp-content/uploads/2023/11/The-2022-Livestock-Survey.pdf

27 Nsomba & Roberts, Building competitive agricultural markets for Zambia: Unlocking export potential, IGC, 2023, https://www.theigc.org/sites/default/files/2023-11/Nsomba%20and%20Roberts%20Final%20report%20November%202023.pdf

28 SCISPACE, What is the importance of NPK in plant growth? accessed August 2024, https://typeset.io/questions/what-is-the-importance-of-npk-in-plant-growth-335t1o26n6.

29 Sharma Y., A Comprehensive Industry Analysis of Global Fertiliser Market, Fertiliser Market Analysis, May 2024.

30 Stakeholder Interviews reported an estimate of USD 600 million to USD 1.3 billion.

When comparing the Zambian fertiliser market to the global sector, Zambia's market size represents less than **0.5%** of the global market value in 2023. This percentage highlights Zambia's significant dependence on external sources for its fertiliser needs while also indicating potential growth opportunities for companies such as Albida Agriculture and others to grow within the local market.

Further, Zambia has a substantial capacity for producing biofertiliser from chicken manure, generating over **137.6 million** tonnes annually. If collected and processed into biofertiliser presents an opportunity valued at **USD 1.57 billion**. However, logistical challenges associated with sourcing and transporting this raw material could impact its viability as a competitive alternative to chemical fertilisers.

What is needed to make it happen

To effectively produce biofertiliser from chicken manure in Zambia, several key factors and components are essential:

Infrastructure and Technology: Establishing processing facilities and equipment is crucial, and must be designed to efficiently handle large volumes of chicken manure. Also, utilising biogas technology can enhance the biofertiliser production process by generating energy through anaerobic fermentation while simultaneously producing biofertiliser, linking into agricultural residue and MSW streams.

Quality Control: Implementing monitoring and testing measures ensures that the produced biofertiliser meets agricultural standards, including testing for nutrient content and the absence of pathogens.

Education and Training: Farmer training programs to educate farmers on the benefits and application methods of biofertilisers can significantly increase adoption rates. These programs could focus on the effective use of chicken manure and advantages of organic fertilisers over synthetic options. In addition, feedback from stakeholder interviews highlighted the need for leveraging **digital applications** to improve the dissemination of agronomic information in the fertiliser sector. A significant challenge identified was the insufficient **transfer of knowledge** from government sources, which hampers farmers' decision-making regarding fertiliser use and crop management. Developing mobile applications can provide timely advice on fertiliser application and product recommendations, enhancing access to vital agricultural information and enabling farmers to adopt more effective practices.

Market Development and Incentives: Awareness campaigns to drive demand, while collaboration with agricultural cooperatives and extension services to facilitate this process. Also, competitive pricing of biofertilisers relative to chemical fertilisers is necessary to encourage farmers to switch to organic options.

Sustainable Practices: Proper management of chicken manure is essential to prevent environmental pollution, and strategies should include effective collection and storage methods to minimise methane emissions and nutrient runoff.

Government Support and an Enabling Environment: This would further enhance the production of biofertilisers. Policies that promote organic farming and provide incentives for using biofertilisers can significantly boost production and usage. Establishing a regulatory framework that supports the production and sale of biofertilisers will help create a stable market environment.

Partnerships and Collaborations: Collaborating with universities and research institutions can aid in developing improved methods for biofertiliser production and application. Also, working with NGOs focused on sustainable agriculture can provide valuable resources and expertise.

Decentralised Composting from Agriculture Residue

SNAPSHOT

- **151 thousand tonnes** of crop residues available annually.
- Potential to produce **29.7 thousand tonnes** of organic compost.
- Equivalent to **5,033 truckloads** of chemical fertiliser.
- **USD 33 million** in potential savings over chemical fertilisers.

Brief description of the opportunity: What, Where, Who, How

Composting aligns well with biofertiliser, as it promotes regenerative agriculture and soil health improvement through addition of organic matter by utilising existing biowaste streams. The rising costs of chemical fertilisers in Zambia, combined with unsustainable linear farming practices, have contributed to a decline in soil fertility. As a result, farmers, particularly smallholders, require cost-effective solutions to restore soil health and nourish their crops[31].

In Zambia, crop residues often remain in fields after harvest and are commonly burned during the dry season as part of land preparation for the next planting cycle. This practice results in the loss of valuable organic material that could otherwise enhance soil fertility[32].

The opportunity lies in offering decentralised composting facilities to address the logistical challenges associated with sourcing and transporting inputs to a central location. These facilities can also offer products and services to farmers to convert crop residues into compost, vermicast, or other soil conditioners, thereby improving soil fertility and health. Further products include compost turners, silage bags, worm composters, and Black Soldier Fly (BSF) units[33].

Market potential

In 2023, the ZDA estimated that the market demand for organic fertiliser is approximately **400,000 tonnes** annually[34]. This figure highlights the growing interest in and need for sustainable agricultural practices in Zambia, particularly considering the increasing trend toward organic farming and the demand for environmentally friendly fertilisers[35].The input costs for producing organic fertilisers are minimal, as the necessary input materials come from readily available agricultural residues. An estimated **151,000 tonnes**[15] of crop residues are generated annually across Zambia, which could produce **29,700 tonnes** of organic compost on farms across the country - equivalent to **5,033 truckloads** of chemical fertiliser. If achieved at national scale, this could save around **USD 33 million** on chemical fertilisers, based on average market prices during the 2022-2023 season.

---

31 Borgen Project, Sustainable Agriculture in Zambia: Creating Green Entrepreneurs. January 2018. https://borgenproject.org/sustainable-agriculture-in-zambia/

32 Nash, Julie, Uwe Grewer, Louis Bockel, Gillian L. Galford, Gillian Pirolli, and Julianna M. White. "Better Life Alliance in Zambia: Climate change mitigation as a co-benefit of improved landscape, agroforestry, soil, and fertiliser management." CCAFS Info Note, 2016.

33 MFA Finland, Zambia Circular Economy Market Study, 2023.

34 ZDA, Zambia Organic Fertiliser Manufacturing, Investment Proposal, https://www.zda.org.zm/wp-content/uploads/2021/09/Name-of-Project-Zambia-Organic-Fertiliser-Manufacturing.pdf

35 ZDA, Italian Investors set to establish Organic Fertiliser Plant in Zambia, 2024, https://www.linkedin.com/posts/zambia-development-agency_italian-investors-set-to-establish-organic-activity-7157982855430586368-uJoR/

What is needed to make it happen

Composting Equipment and Technical Skills, combined with market uptake by an estimated **1.6 million** smallholder farmers[36], present significant opportunities for growth in this sector. However, achieving widespread adoption will require overcoming entrenched beliefs among smallholder farmers that chemical fertilisers are more beneficial for plant growth[15]. The following factors are key in order to realise this opportunity:

- **Local Government Permits:** Obtain the necessary permits from local authorities, particularly for the use of MSW.
- **Environmental Impact Assessment (EIA):** Obtain approval from the Zambia Environmental Management Agency (ZEMA) to evaluate the potential environmental impacts of the biofertiliser facility.
- **Farmer Education** is crucial in encouraging the practice of using crop residue as a resource following harvest instead of burning it. Breaking behavioural patterns can take a significant amount of time.
- **Waste Collection System:** Establish a reliable waste collection system to source biowaste from agricultural operations.
- **Composting Facility Design:** Ensure the facility is suitable for processing biowaste, with adequate space for composting, storage, and processing equipment.
- **Technology Selection:** Choose appropriate composting technologies, such as aerobic composting or vermicomposting, based on the types of biowaste being processed and the scale of operations.
- **Promoting Regenerative Agriculture Practices**, such as cover cropping, including forestry and livestock can help improve soil health while also providing the residues for composting.
- **Incentives** for farmers to improve practices, for example carbon credits for avoiding burning crop residues, agroforestry, and application of compost and biochar to soils.

By addressing the barriers to adoption and leveraging the available resources, the composting value chain in Zambia can contribute to the sustainable intensification of agriculture, improve soil health, and reduce reliance on chemical fertilisers.

[36] PMRC, Delivery of Farming Inputs in Agricultural Strongholds. Research Report, 2015, https://www.pmrczambia.com/wp-content/uploads/2016/03/Delivery-of-Farming-inputs-in-Agricultural-strongholds.pdf

Extraction of NPK from Faecal Sludge Matter (FSM)

SNAPSHOT

- 1 tonne of FSM = 22 kg NPK: 15 kg (N), 4 kg (P), 3 kg (K).
- **645,000 tonnes** of FSM generated annually.
- **USD 26 thousand** import substitution annually.

Brief description of the opportunity: What, Where, Who, How

NPK - Nitrogen (N), Phosphorus (P), and Potassium (K) - is a crucial combination of nutrients that are essential for various aspects of plant growth, including photosynthesis, root development, and disease resistance. By providing the right balance of NPK through fertilisers, farmers and gardeners can promote healthy plants, achieve higher yields, and improve crop quality[37].

Zambia generates about **645,000 tonnes** of human excrement annually, based on an estimated global recoverable rate of **1.06 kg** per person per day[38]. The volume of NPK that can be extracted from sewage is low (**3-4%** of demand) and given Zambia's limited sanitation systems and small population it is not very attractive for very large operations. However, it is an opportunity for various stakeholders involved in nutrient recovery. Potential candidates for extracting NPK from sewage waste include the Lusaka Water and Sewerage Company (LWSC), local universities, private waste management companies, environmental NGOs, and government agencies. Collaborative efforts among these stakeholders can enhance the efficiency of nutrient recovery processes, contributing to import substitution and improved sanitation in urban areas. The opportunity here would be to process FSM and extract NPK, with **1 tonne** of FSM yielding an estimated **22 kg** of NPK[39],[40].

Market potential

The global NPK fertiliser market was valued at **USD 4.2 billion in 2022** and is expected to grow to around **USD 6.4 billion by 2030,** reflecting a CAGR of 5.5% during the forecast period from 2023 to 2030[41]. In Zambia, the annual demand for NPK exceeds 450,000 tonnes[8], and is currently met entirely through imports. While utilising FSM to extract NPK offers a relatively modest opportunity for reducing imports at present (~**USD 26,000** annually), it has potential to become a significant opportunity in the future. This underscores the importance of both private and public sector investing in research, piloting, and refining the process.

What is needed to make it happen

Establishing and Upgrading Sewage Treatment Facilities: Nutrient recovery systems are essential for efficiently extracting NPK from waste, utilising advanced technologies such as anaerobic digestion, struvite precipitation, and composting.

Collaboration with Key Stakeholders, including LWSC, private sector partners, and research institutions, is crucial for providing infrastructure, expertise, and market access.

---

37 SCISPACE, What is the importance of NPK in plant growth?, accessed August 2024, https://typeset.io/questions/what-is-the-importance-of-npk-in-plant-growth-335t1o26n6.

38 Berendes, D. M., Yang, P. J., Lai, A., Hu, D., & Brown, J., Estimation of global recoverable human and animal faecal biomass. Nature Sustainability, 2018, 1(11), 679-685. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10922008/

39 Häfner, F., Monzon Diaz, O. R., Tietjen, S., Schröder, C., & Krause, A., Recycling fertilisers from human excreta exhibit high nitrogen fertiliser value and result in low uptake of pharmaceutical compounds. Frontiers in Environmental Science, 10, 1038175, 2023.

40 Harder, R., Wielemaker, R., Larsen, T. A., Zeeman, G., & Öberg, G., Recycling nutrients contained in human excreta to agriculture: Pathways, processes, and products. 2019, Critical Reviews in Environmental Science and Technology, 49(8), 695–743, 2019, https://doi.org/10.1080/10643389.2018.1558889

41 Global NPK Fertilisers Market Poised for Significant Growth by 2030.

Supportive Policies, Quality Standards, and Public Awareness Campaigns are needed to promote the use of sewage-derived NPK fertilisers, ensure product safety, and address public concerns. Additionally, implementing proper waste management practices is vital to prevent environmental pollution and ensure the sustainability of the initiative.

Challenges in the Fertiliser Value Chain

While production of biofertiliser, compost and NPK offers business opportunities, some obstacles remain in the way of leveraging them. These include:

Scaling Challenges: Organic fertilisers require larger volumes to meet plant nutrition needs, making it difficult to achieve the same level of efficiency as chemical fertilisers and to meet large-scale agricultural demands.

Educational Challenge: Farmers believe that chemical fertilisers are better than biofertilisers, which is not entirely the case. Educating farmers that chemical fertilisers are more efficient for immediate nutrient delivery and yield increases but pose significant risks to environmental sustainability if used excessively, and showing them that biofertilisers contribute to long-term soil health and sustainability are key in helping change the perceptions.

Logistical Challenges: Logistics remain a considerable challenge, from sourcing and preparing inputs to transporting the finished product. Transporting raw materials over long distances complicates logistics, making it more efficient to move finished products rather than raw inputs. This limitation hinders the scalability of businesses that rely on decentralised sources of raw materials. The larger volume of organic fertiliser compared to chemical fertilisers can be particularly challenging for farmers accustomed to applying smaller quantities of chemical fertilisers over extensive areas.

Economic Viability: The costs associated with centralising raw materials for production can undermine the economic viability of circular economy businesses. The high expense of gathering and processing raw materials makes it challenging to establish sustainable business models.

Cost Competitiveness: For organic fertilisers like compost to gain widespread acceptance, their retail prices must be competitive with chemical fertilisers. Ensuring cost competitiveness is essential to motivate farmers to transition to compost.

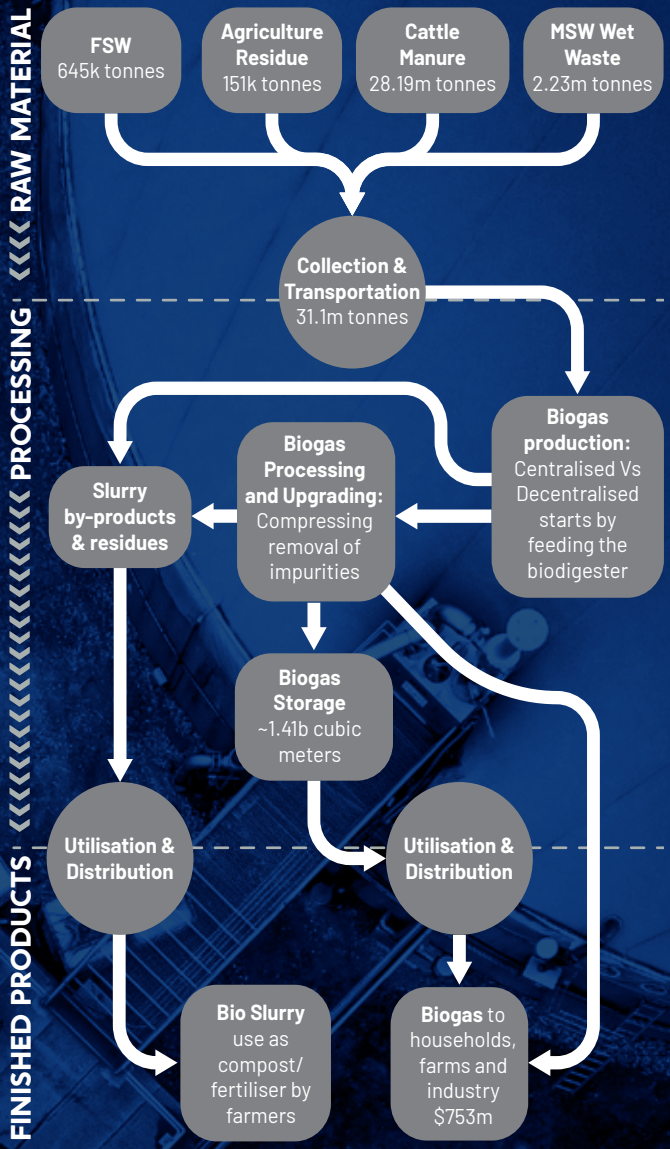
The challenges in extracting NPK from sewage waste include the need for significant **infrastructure upgrades** to sewage treatment facilities, the implementation of advanced **nutrient recovery technologies**, and effective **collaboration with key stakeholders**. Regulatory hurdles and the necessity for supportive policies also pose obstacles, along with public scepticism regarding the safety and quality of sewage-derived fertilisers.

Biogas Value Chain

Zambia has great potential for biogas with anaerobic digestion of animal manure, especially cattle manure, being considered a "low hanging fruit". With an estimated **4.7 million** heads of cattle[42], the country can leverage anaerobic digestion to convert manure into biogas. This process not only provides a renewable energy option for cooking, heating and lighting but also produces bio-slurry, a valuable agricultural input which enhances soil fertility. The economic feasibility is promising, with a payback period of **3.25 - 3.75 years** for biodigesters, making them viable for farmers with sufficient livestock. However, challenges such as high installation costs and limited access to credit need to be addressed to stimulate adoption and market growth[43]. If utilised to their fullest crop leftovers, MSW and animal dung have immense potential and present an opportunity valued at USD 750 million.

Conversion of biowaste from MSW into biogas is another promising opportunity in Zambia. The country faces significant waste management challenges, and utilising biowaste from households can mitigate these issues while generating energy. Local projects like those supported by SNV (Netherlands Development Organisation) and People in Need (PIN) have demonstrated the benefits of biogas plants in rural areas, providing clean energy alternatives. SNV and PIN are organisations actively working to develop the biogas market in Zambia, focusing on increasing access to renewable energy for households and businesses. SNV has trained local masons in bio-digester construction and is involved in projects like Energy for Agriculture (E4A), which promotes biogas technology to improve livelihoods[44]. This does not only address energy needs but also contributes to environmental sustainability by reducing deforestation rates and improving public health outcomes[45].

The final opportunity identified is sewage tr eatment facilities which also represent a viable opportunity for biogas production in Zambia. There is potential to harness anaerobic digestion of sewage sludge to generate biogas, which can be used for electricity generation or heating. This approach not only



improves wastewater management but may reduce operational costs for treatment plants by providing a renewable energy source. Further, the digestate produced can be utilised as organic fertiliser, enhancing agricultural productivity and contributing to food security in rural communities[46].

The biogas value chain in Zambia includes key players such as feedstock suppliers (smallholder and commercial farmers), biogas technology providers (companies, NGOs like SNV, Hivos, PIN), service providers (training organisations and financial institutions), biogas producers (households and farms), and end users (local communities and some businesses).

42 Ministry of Fisheries and Livestock & Ministry of Finance and National Planning, Livestock Survey Report, 2022, https://www.zamstats.gov.zm/wp-content/uploads/2023/11/The-2022-Livestock-Survey.pdf

43 Kaywala, Ilitongo, Harrie Oppenoorth, Kasongo Chiwama, Kaoma Mwanza, Ekanath Khatiwada, and Felix Ter Heege. Domestic Biogas Programme in Zambia. Netherlands Development Organisation (SNV), 2012. https://www.academia.edu/70421658/Domestic_Biogas_Programme_in_Zambia

44 SNV, Building the biodigester market in Zambia, accessed September 2024, https://www.snv.org/update/building-bio-digester-market-zambia

45 Shane, Agabu & Gheewala, Shabbir & Kasali, George, Overview and status of biogas production in Zambia, 2014.

46 UNCTAD, Biogas technology assessment in Zambia, Technical cooperation outcome, 2024, https://unctad.org/system/files/official-document/tcsdtlinf2024d2_en.pdf

Biogas from Animal Manure (Cattle)

SNAPSHOT

- **4.7 million head** of cattle nationwide.
- Generating **28 million tonnes** of manure annually.
- Estimated value **USD 608 million** per year.

Brief description of the opportunity: What, Where, Who, How

Biogas production from cattle manure is a sustainable way to generate clean energy for cooking, lighting, and heating. The process involves anaerobic digestion of cattle manure in a sealed digester, which produces methane-rich biogas. The remaining digestate can be used as a nutrient-rich organic fertiliser for crops.

Zambia has a large cattle population, and rural areas with high concentrations of livestock farms are well-positioned to take advantage of this opportunity, making smallholder farmers and rural households the primary beneficiaries. Activities by organisations like SNV and PIN are key examples that support the installation of small biodigesters around Zambia, demonstrating the viability of this technology for households.

By leveraging the abundant supply of cattle dung and supporting the adoption of biogas technology, Zambia could utilise this opportunity to provide clean energy, reduce greenhouse gas emissions, and enhance food security in rural areas.

Market potential

The global biogas market was estimated at **USD 65.53 billion in 2023** and is projected to reach **USD 87.86 billion by 2030,** growing at a CAGR of **4.2%** from 2024-2030[47]. This growth underscores the increasing recognition of biogas as a sustainable energy source that effectively manages agricultural waste while mitigating climate change.

In Zambia, the potential for biogas production from **28 million tonnes** of cattle dung could yield an estimated market value of **USD 608 million** if properly managed through biodigesters. However, realising this potential requires significant investments in infrastructure and improvements in manure management practices. Currently, Zambia's biogas sector represents less than 1% of the global market size, highlighting both its untapped opportunities and the challenges it faces in aligning with global renewable energy trends. A few examples of some activities in the market are highlighted below.

The Energy for Agriculture (E4A) project, implemented by SNV Zambia between 2015 and 2019, successfully delivered **5,000** small biodigesters across the country, most common sizes ranging 4 m^3 and 6 m^3, promoting household-level biogas production. This initiative significantly contributed to the market development for biodigesters in Zambia[48]. Interviews with stakeholders indicate that only about 60% of these biodigesters are still operational, highlighting the need for improved maintenance and support systems by both the public and private sectors.

There is limited information available about large biodigesters in Zambia. However, ongoing projects, such as those supported by ENGIE Energy Access[49], are expected to scale up access to biodigester technology, indicating a growing interest in larger systems to serve more extensive agricultural needs.

---

47 Grand View Research, Global Biogas Market Size, Share and Growth Report, 2023, https://www.grandviewresearch.com/industry-analysis/biogas-market

48 SNV, Lessons Learnt from the Energy for Agriculture Project, Household Biodigester Market Development in Zambia, 2021, https://a.storyblok.com/f/191310/51c3bf2b2d/biodigester-20market-20development_lessons-20learnt-20zambia.pdf

49 Modern Cooking Facility for Africa, Over half a million Zambians to receive access to clean cooking solutions through first cohort of companies, Press Release, 17 January 2024, https://engie-energyaccess.com/uploads/news/2024117_MCFA-release_ENGIE-and-event-in-Zambia_EN.pdf

Decentralised biogas systems, particularly in regions like Southern Province with abundant livestock manure, offer cost-effective alternatives to centralised facilities. These systems could support thousands of homes and small-scale biodigesters, while commercial farms in areas like Mkushi located in Central Province have opportunities to utilise nearby crop residues in addition to cattle dung. Improved storage and packaging facilitates sales, extends shelf life, and improves management. Some small-scale biogas operators offer biogas at **USD 6.5** for a 3 kg cylinder.

What is needed to make it happen

Promote Awareness and Education about biogas technology among farmers and rural communities. Local knowledge development is essential, and market educational campaigns would be needed to address misconceptions about biogas and build trust among farmers who may be sceptical of this technology and use of slurry as a valuable fertiliser, which can help shift attitudes and increase adoption.

Financial Support and access to credit lower the entry barrier to help farmers install biodigesters, which can have a payback period of 3-4 years. Accessible financing models, such as microloans and subsidies, are also necessary to reduce the high upfront costs associated with biodigester installation, particularly for smallholder farmers.

Develop Local Markets for biogas technology by ensuring the availability of components, construction services, and maintenance support. Encourage the use of biogas for cooking, lighting, and heating in rural households to reduce reliance on traditional biomass fuels like firewood and charcoal. Utilise the digestate as an organic fertiliser to improve soil fertility and agricultural productivity.

Develop Local Technical Capacity by ensuring the long-term reliability of biodigesters through robust after-sales support, including warranties and repair services, which will also help build confidence in the technology.

Regulatory Support is also key. Establishing clear biogas production standards through the ERB will provide a stable operating framework. To make biogas more affordable, reducing import duties and VAT on digester components or encouraging local manufacturing through tax incentives is necessary. Fostering partnerships between the government, private sector and international donors would be key to create a cohesive strategy for scaling biogas technology across Zambia. Potential PPPs could be sought between the private sector and government in the Southern and Central provinces, which are among those with large livestock populations.

Biogas from MSW (especially Food Waste)

SNAPSHOT

- **1.2 million tonnes** of food waste are available.[15]
- Potential revenue of **USD 123.8 million.**

Brief description of the opportunity: What, Where, Who, How

The opportunity to produce biogas from municipal solid waste (MSW), particularly food waste, in Zambia is considerable and can significantly address energy needs and waste management challenges. Biogas production from MSW involves anaerobic digestion of biowaste, primarily food scraps, to generate methane-rich biogas. This biogas can be utilised for cooking, heating, or electricity generation, while the remaining digestate serves as a high-quality organic fertiliser.

Zambia's urban areas, such as Lusaka and the Copperbelt region, generate large quantities of food waste. It is estimated that urban areas produce around **2.2 million tonnes** of MSW annually, with over 50% composing biowaste[15]. Municipal authorities, waste management companies, and local communities are key stakeholders who can benefit from this opportunity. Organisations like PIN are already implementing projects to promote biogas technology, aiming to construct 130 biogas plants in the Western Province to support local households with improved waste management and provide renewable energy[50].

Market potential

In Zambia, if all the 1.2 million tonnes of food waste from the MSW streams were effectively captured and fed into biodigesters, the country could unlock close to **USD 123.8 million** in potential revenue from biogas sales. This is enough to supply nearly 233,000 households.

What is needed to make it happen

Waste Segregation: Implement effective waste segregation practices to separate biowaste from other types of MSW, enhancing the efficiency of biogas production.

Establish Biogas Facilities: Develop centralised anaerobic digestion facilities that can process the collected biowaste. These facilities can convert approximately 30-40% of the bio waste into biogas.

Utilise Generated Biogas: Use the biogas for electricity generation, heating, or upgrading to vehicle fuel, potentially replacing traditional biomass fuels that contribute to deforestation and health issues.

Promote Organic Fertilisers: Apply the digestate as an organic fertiliser to improve soil fertility and enhance agricultural productivity, benefiting farmers and improving food security.

Supportive Policies: Develop policies and financial incentives to encourage investment in biogas projects from MSW, ensuring sustainability and scalability.

Potential linkages for PPPs could include innovative projects like the one spearheaded by PIN, which aims to establish a large-scale biogas facility at Soweto Market located in Lusaka in partnership with local authorities. This initiative envisions transforming municipal solid waste from the market into biogas, providing market vendors with a sustainable energy source for cooking while they conduct their business.

[50] People In Need, Zambia Climate Resilience, Humanitarian Aid and Development, accessed September 2024, https://www.peopleinneed.net/what-we-do/humanitarian-aid-and-development/zambia/climate-resilience

Biogas from Municipal Sewage Streams

SNAPSHOT

- **645,000 tonnes** of FSM produced annually.
- Potential revenue of **USD 13.9 million** per year.

Brief description of the opportunity: What, Where, Who, How

Biogas production from municipal sewage streams provides an opportunity for renewable energy generation, as a precursor to nutrient extraction from FSM. Zambia faces environmental issues related to limitations in the existing sanitation infrastructure. For instance, the Dambwa municipal wastewater treatment facility in Livingstone, Southern province of Zambia, has shown potential for biogas production through the anaerobic digestion of sewage, contributing to local energy needs while reducing greenhouse gas emissions[51]. It is estimated that sewage waste in Zambia emits approximately 2,302 Gg CO_2 equivalent of non-CO2[52] emissions annually, highlighting the urgent need for sustainable waste treatment solutions.

Although not currently widely utilised in Zambia, sewage treatment plants can harness the organic matter in wastewater to produce biogas, which primarily consists of methane. This biogas can be used for electricity generation, heating, or as a vehicle fuel, providing a renewable energy source that can help reduce reliance on fossil fuels. Studies[53][54] indicate that municipal wastewater has significant potential for methane production, which can be effectively captured and utilised[55].

Key stakeholders include municipal authorities, waste management companies, and private investors. Collaborative efforts are essential to develop the infrastructure for sewage treatment and biogas production. Implementing biogas technology can enhance energy security, improve waste management practices, and contribute to environmental sustainability.

Market potential

The global market potential for biogas aligns with the figures discussed in previous sections. Locally, Zambia generates **645,000 tonnes** of human excrement annually, based on an estimated global recoverable rate of 1.06kg per person per day[56], considering the current population. If collected and processed correctly in a biodigester, this has an estimated potential revenue generation value of **USD 13.9 million per year**.

What is needed to make it happen

Infrastructure Development: Upgrading and expanding existing facilities to include anaerobic digestion capabilities is crucial for processing sewage into biogas.

Technology Adoption: Utilising low-tech anaerobic digesters and biogas engines, such as the 45 kW Cummins 6 BT, can effectively convert biowaste into biogas and electricity, enhancing energy recovery.

Financial Support: Securing funding from investors, government programs, NGOs, or international donors, alongside encouraging PPPs, is vital to cover initial setup costs and ensure shared responsibility.

---

51 Simwambi, A., Yamba, F., Hibler, S., & Mulenga, K., Renewable Energy Potential of Sewage in Zambia. Open Journal of Applied Sciences, 2020, 10(6), 328-350.

52 The high level of non-CO2 greenhouse gas emissions from biomass waste in Zambia, equivalent to 2,302 Gg of CO2, is an environmental concern that should be mitigated. Reducing these emissions, for example through biogas production from waste, can help lower the country's overall carbon footprint and contribution to climate change.

53 Simwambi, A., Yamba, F. , Hibler, S. and Mulenga, K., Renewable Energy Potential of Sewage in Zambia. Open Journal of Applied Sciences, 2020, 10, 328-350. doi: 10.4236/ojapps.2020.106025. https://www.scirp.org/journal/paperinformation?paperid=101230

54 Song C, Zhu JJ, Willis JL, Moore DP, Zondlo MA, Ren ZJ. Methane Emissions from Municipal Wastewater Collection and Treatment Systems. Environ Sci Technol. 2023 Feb 14;57(6):2248-2261. doi: 10.1021/acs.est.2c04388. Epub 2023 Feb 3. PMID: 36735881; PMCID: PMC10041530. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10041530/

55 Song, Cuihong, Zhu, Jun-Jie, Willis, John L., Moore, Daniel P., Zondlo, Mark A., Ren, Zhiyong Jason, Methane Emissions from Municipal Wastewater Collection and Treatment Systems, 2023, Environmental Science & Technology, 2248, 2261, 57, 6, American Chemical Society, 0013-936X, doi: 10.1021/acs.est.2c04388, https://pubs.acs.org/doi/10.1021/acs.est.2c04388

56 Berendes, D. M., Yang, P. J., Lai, A., Hu, D., & Brown, J. (2018). Estimation of global recoverable human and animal faecal biomass. Nature Sustainability, 1(11), 679-685. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10922008/

Capacity Building: Providing technical training for local operators and engaging communities in awareness campaigns will promote the sustainability and acceptance of biogas initiatives.

Policy and Regulatory Framework: Developing supportive policies and offering incentives, such as feed-in tariffs, will create a conducive environment for biogas projects, driving investment and growth in the sector.

Research and Monitoring: Conducting feasibility studies and implementing monitoring systems will help optimise biogas production and ensure facilities meet energy targets efficiently.

Challenges in the Biogas Value Chain

Organisations looking to implement biogas production from animal manure and MSW in Zambia should be aware of the following challenges:

Limited Local Expertise and Technical Knowledge: There is a shortage of skilled personnel capable of constructing and maintaining biogas systems in Zambia. This gap hampers the effective implementation and sustainability of biogas business models, as many potential users may lack the necessary technical knowledge to operate, maintain and repair these systems.

High Capital Investment required for setting up biogas plants, combined with limited financing options and high import taxes on biodigesters (40% duty and 16% VAT, totalling nearly half the cost of the equipment), makes it difficult to grow and scale the business. Large upfront payments especially pose a barrier for smallholder farmers. Additionally, there is a lack of after-sales support and awareness creation, particularly within the private sector. Quality concerns regarding fixed dome digesters also hinder their reliability and long-term use.

Limited Access to Financing: Access to credit and financing options for municipalities or sewerage treatment plant operators remains a significant barrier. Without adequate financial support, many potential users cannot invest in biogas technology, limiting the overall growth of the biogas market in Zambia.

Regulatory Challenges, such as the absence of supportive guidelines from the ERB, force companies to rely on liquefied petroleum gas (LPG) standards. Additionally, market perception and misconceptions about biogas safety further complicate adoption.

Inadequate Infrastructure: The existing waste management and sanitation infrastructure is often insufficient, making it challenging to gather the necessary feedstock for biogas production. Poor waste management practices often lead to contamination and reduce the quality of the organic material available for digestion.

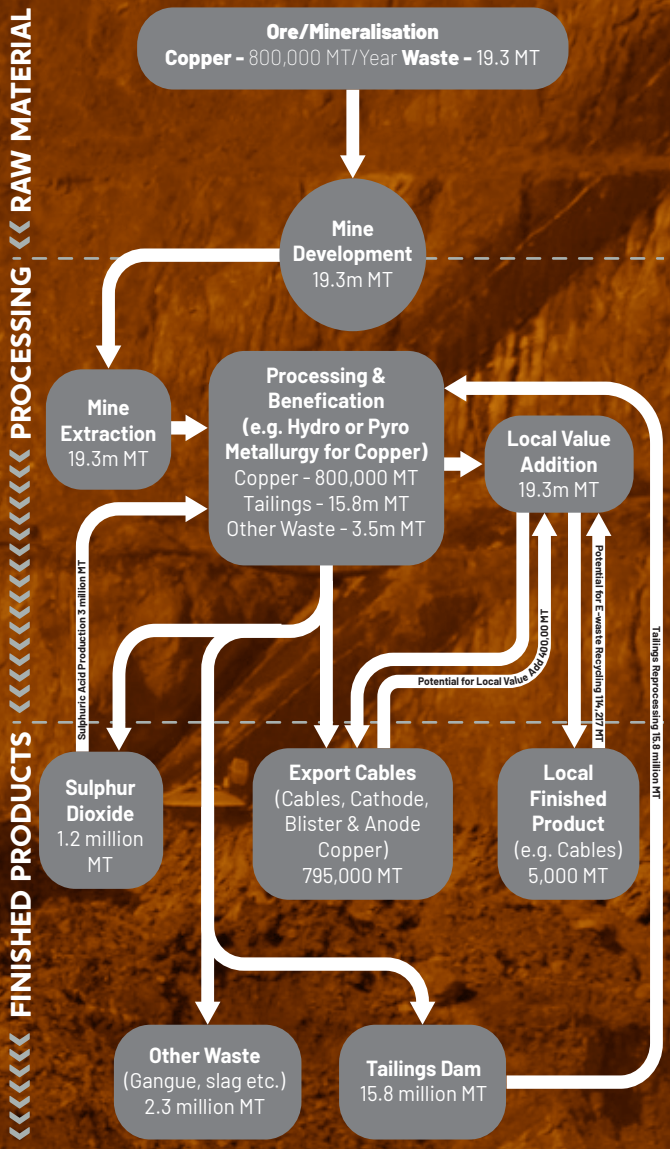
Mining Value Chain

Circular economy business opportunities in the Zambian mining value chain are considerable, with an annual estimate of USD 1.25 billion potential revenue, from; repurposing of tailings, production of sulphuric acid from waste sulphur dioxide and e-waste recycling coupled with blister copper local value addition. The copper industry remains central to the country's economy. Zambia is the world's ninth-largest copper producer[57], and copper contributes over 70% of the country's export earnings[58]. However, the sector has faced challenges that limit the potential for value addition and circular economy practices.

Zambia produces around 800,000 metric tonnes of copper annually with an ambitious aim of increasing the annual production to 3,000,000 metric tonnes by 2032[59]. Despite this, more than 95% of this copper is exported in raw form as cathode, blister, or anode, leaving significant room for growth in downstream manufacturing and recycling, which are currently underdeveloped. In 2022, Zambia produced approximately 350,000 metric tonnes of copper cathode, with the remaining copper exported in less processed forms.

The mining value chain includes key stages such as extraction, smelting, refining, and limited manufacturing. Companies like ZAMEFA and Neelkanth Cables operate in the downstream segment, but they utilise less than 50% of their production capacity due to constraints such as limited scrap availability and competition from established regional players[60].

Despite these challenges, there is increasing interest in expanding the value chain through circular economy practices. Key opportunities include the repurposing of tailings, value addition to copper cathodes, and the expansion of recycling initiatives. These initiatives could significantly boost Zambia's economic output, create jobs, and reduce environmental impact.



57 Statista, Major countries in copper mine production worldwide in 2023, Mining Metals and Minerals, accessed September 2024, https://www.statista.com/statistics/264626/copper-production-by-country/

58 Forbes, Top Mining Companies Commit Billions to Zambia's Copper Industry, 2024, https://www.forbes.com/sites/greatspeculations/2024/07/02/top-mining-companies-commit-billions-to-zambias-copper-industry/

59 Ministry of Green Economy and Environment, National Green Growth Strategy- 2024- 2030, 2024, https://www.mgee.gov.zm/wp-content/uploads/2024/04/2NATIONAL-GREEN-GROWTH-STRATEGY-2024-2030-6.pdf

60 Africa Rise, Zambia Copper Wire and Cable Market Assessment, 2024.

Reprocessing/ Repurposing of Tailings

SNAPSHOT

- **15.8 million tonnes of tailings produced annually from mining activities[61].**
- **Valued at USD 719 million in potential annual revenue.**
- **USD 86 billion in potential revenue from the over 1.9 billion tonnes of historical waste tailings[62].**

Brief description of the opportunity: What, Where, Who, How

To date, Zambia's mining sector has accumulated an estimated **1.9 billion tonnes** of copper-bearing mine waste dumps and tailings piles, predominantly located in the Copperbelt and North-Western provinces. These waste dumps and tailings piles present a significant opportunity for repurposing. Other waste materials, such as slag, can be converted into construction materials like aggregates for road construction or water filtration. The tailings offer a higher economic potential as they can be reprocessed to recover residual metals like copper and cobalt. This not only reduces environmental impact, but also creates new revenue streams.

Market potential

The market potential for reprocessing tailings is substantial. As global demand for electric vehicles and renewable energy surges, the reprocessing of the historical tailings piles could yield approximately **7 million tonnes** of copper, potentially providing new sources of supply for local manufacturers. This opportunity aligns with global trends toward sustainability and resource efficiency. The estimated market value from the reprocessing of tailings is **USD 86 billion**, encompassing the recovery of both copper and cobalt.

What is needed to make it happen

To capitalise on this opportunity, several key investments and initiatives are essential:**Government Support in Identifying and Quantifying Tailings:** The Government must play a pivotal role in spearheading the identification of historic mine and smelter tailing piles, quantifying the tonnages, and conducting thorough sampling and metallurgical tests. This information will instil confidence in potential investors and create a clear picture of the resources available for reprocessing.

Government Policies and Incentives that support and incentive circularity in mining are necessary to attract investment in tailings reprocessing. Offering tax breaks or subsidies to companies engaging in these activities can drive wider adoption of tailings reprocessing technologies and foster industry growth.

Strategic Partnerships in the form of PPPs or private collaborations between mines and companies specialising in tailings reprocessing are essential for accelerating market development. These partnerships, particularly between local companies owning tailings and international firms with advanced reprocessing technologies, are key to unlocking value. For example, Jubilee Metals Group, already operating in Zambia with rights to 300 million tonnes of tailings, demonstrates the potential of such collaborations.

Continuous Data Collection and Evaluation is essential to track the progress of tailings reprocessing. Monitoring processed volumes, recovery rates, and environmental impact will help refine processes, promote sustainability, and attract further investment.

---

61 Tandem Calculations based on production volumes (2024).
62 Tandem Calculation based off: Africa Rise, Zambia Copper Wire and Cable Market Assessment, 2024.

Sulphuric Acid Production from Sulphur Dioxide

SNAPSHOT

- **Currently 1.9 million tonnes of sulphuric acid is produced annually, from mining by-products[63] .**
- **Installed capacity can produce over 3 million tonnes. Valued at USD 450 million in export revenue.**
- **A potential USD 1.26 billion worth of phosphate fertiliser can be produced annually from the 3 million tonnes of sulphuric acid and reduce reliance on fertiliser imports of around 2.1 million tonnes.**

Brief description of the opportunity: What, Where, Who, How

Zambia's copper mining industry produces substantial quantities of by-products, including sulphur dioxide, which is a precursor for sulphuric acid production. Sulphuric acid is a critical industrial chemical with widespread applications in mining, particularly in the extraction and processing of metals, as well as in fertiliser production. Zambia is a net exporter of sulphuric acid, and its production is directly proportional to mining productivity[64]. By taking advantage of this opportunity, Zambia can produce sulphuric acid for mining, agriculture and other sectors.

Zambia imported **USD 693.43 million** worth of fertiliser in 2023, presenting a valuable opportunity for local production, as a significant part of this could have been produced locally using the acid from the mining sector[65]. Zambia can capitalise on regional exports given its proximity to DRC and it being landlocked (surrounded by 8 countries). Currently, this opportunity is not maximised, as the production of sulphuric acid is not the core business for mining firms. Thus, there is an opportunity for partnerships to explore additional markets for sulphuric acid, both domestically and internationally.

The surplus sulphuric acid presents a significant opportunity for local fertiliser manufacturing. By treating phosphate rock with waste sulphuric acid, phosphoric acid can be produced, which is essential for various phosphate fertilisers, including Single Super Phosphate (SSP), Triple Super Phosphate (TSP), and Diammonium Phosphate (DAP). Additionally, sulphuric acid can be utilised to manufacture zinc sulphate, an important fertiliser for zinc-deficient soils[66], [67].

Leveraging waste sulphuric acid for fertiliser production not only adds value to mining by-products but also supports sustainable agricultural practices, addressing the growing demand for fertilisers in Zambia to enhance crop yields and food security. Furthermore, optimising the production volume of waste sulphuric acid through machinery upgrades, sulphur fixation technologies, and strategic partnerships could increase output, expanding its economic uses beyond export and meeting the country's agricultural needs.

---

63 Muchiya T., Annual sulphuric acid production reduce by 9%, Zambia Business Times, April 14 2023, https://zambianbusinesstimes.com/annual-sulphiric-acid-production-reduce-by-9/

64 ZDA, Zambia Trade & Investment Opportunities, 2024, https://drive.google.com/file/d/1cqZXsuTq6_x6Q0w21ovuz89F-CYj3FEs/view?usp=drive_link

65 https://tradingeconomics.com/zambia/imports/fertilisers

66 Global Africa Network, Sulphuric acid off-take opportunities including establishment of complete value chain, Agriculture Forestry and Fishing, February 16 2023, https://www.globalafricanetwork.com/transportation-logistics/sulphuric-acid-off-take-opportunity-in-the-namakwa-sez/

67 Konkola Copper Mines plc, Acid, accessed September 2024, http://kcm.co.zm/our-products/by-products/acid/

Market potential

The global sulphuric acid market was valued at **USD 13.20 billion in 2023** and is projected to reach around **USD 56.36 billion by 2032**, with a CAGR of **17.5%** from 2024 to 2032. There are also potential new markets in electronics manufacturing, water treatment, and energy storage [68], [69].

In Zambia, while the exact potential production figure can vary on a year-to-year basis, under optimal conditions, the country's installed capacity could comfortably produce over **3 million tonnes** of sulphuric acid annually as a by-product of its mining activities. The export potential to neighbouring DRC is around **USD 208 million** for mining purposes[70]. Zambia could produce approximately **2.1 million tonnes**[7172] of phosphate fertiliser which is **USD 1.26 billion**[73] in value from this volume of sulphuric acid. However, the production and supply of sulphuric acid for fertiliser production and other markets remain largely untapped.

By expanding the local production of sulphuric acid, Zambia can meet the rising demand within its own industries and potentially export to neighbouring countries like the DRC, as well as international markets in Brazil, Chile and India[74]. Additionally, with the anticipated growth in copper extraction and the need for more efficient and cost-effective processing methods, the demand for sulphuric acid is expected to increase further, providing a stable and growing market for local producers.

What is needed to make it happen

Investments in Infrastructure and Technology needed to capture and convert sulphur dioxide emissions from smelting into sulphuric acid are essential. This involves setting up or expanding acid plants near smelting operations. Finnish companies like Metso have experience in this area and have successfully set up sulphuric acid production plants in Zambia.

Aligning these Innovations with Environmental Regulations and sustainability goals will be essential, as this not only mitigates pollution, but also enhances the economic viability of sulphuric acid production.

Government Support in the form of incentives and policies that encourage local production, along with partnerships with international firms that have expertise in chemical processing, will further bolster this initiative.

Building Strong Distribution Networks to efficiently supply sulphuric acid to domestic and regional markets is key to ensuring the success of this venture.

68 Zion Market Research," Sulfuric Acid Market Size, Share, Industry Analysis, Trends, Growth, Forecasts 2032", accessed August 2024, https://www.zionmarketresearch.com/report/sulfuric-acid-market

69 Future Market Insights, "Sulfuric Acid Market Outlook", accessed August 2024, https://www.futuremarketinsights.com/reports/sulphuric-acid-market

70 ITC, Export Potential Map, accessed August 2024, https://exportpotential.intracen.org/en/markets/analyze?fromMarker=i&exporter=894&whatMarker=k&what=280700&toMarker=j

71 Jica, "Fertiliser Industry and Raw Materials Availability in the Republic of Argentina", https://openjicareport.jica.go.jp/pdf/10300184_02.pdf

72 Wagh, A. S., Chemically bonded phosphate ceramics: twenty-first century materials with diverse applications, Elsevier, 2016, https://www.sciencedirect.com/topics/materials-science/phosphate-fertiliser

73 Tandem Calculations, 2024.

74 Walker S., African Acid: Turning the Market Around, Engineering and Mining Journal, March 2015, https://www.e-mj.com/features/african-acid-turning-the-market-around/

Value Addition & E-Waste Recycling

SNAPSHOT

- **USD 72 million potential earnings from processing blister Copper.**
- **E-waste recycling valued at USD 11 million[75].**

Brief description of the opportunity: What, Where, Who, How

The Zambian mining industry primarily exports raw copper in the form of cathode, blister, or anode, with limited value addition taking place domestically[76]. While local manufacturers do produce some higher-value products, such as copper rods, wires, and cables, there is significant potential to increase local processing of copper cathodes. By doing so, Zambia could capture more value within the country and reduce its dependence on raw exports.

With global demand for recycled copper on the rise, Zambia could expand its recycling operations to reduce waste and supply the market with valuable recycled copper. Establishing a more organised recycling sector could also help meet local demand for copper products, reducing the reliance on imports.

Market potential

The market potential for value-added copper products is significant, especially in light of a projected global shortfall of **5 million tonnes** of refined copper by 2030[77]. By expanding production capabilities, Zambian manufacturers could increase their share of regional and global markets and unlock further value through processing and manufacturing end products. Zambia exports around **400,000 tonnes** of Copper annually in either blister or cathode form, if processed further it is estimated that a total of around **USD 72 million**[69] worth of Copper & Cobalt can be recovered.

However, a report by the World Bank suggests that Zambia currently lacks sufficient domestic and regional demand for copper fabrication[78]. This is evidenced by the underutilised ZAMEFA and Neelkanth Cables, which have produced around the same tonnage for over a decade. Nevertheless, the growing demand for electric vehicles and renewable energy is changing the dynamics of the market[79]. This presents Zambia with an opportunity to tap into the growing demand for copper products in sectors such as electronics, construction, and renewable energy.

The global market for recycled copper is expected to grow as industries seek more sustainable materials. Additionally, recycling could provide a steady supply of copper for local manufacturers, supporting the broader goal of increasing domestic value addition. This would also open up opportunities in the copper scrap and the e-waste recycling markets, which are currently valued at approximately **USD 11 million** annually.

Investments in Technology and Infrastructure are required. This includes modernising existing manufacturing facilities and adopting advanced production techniques.

Forming Partnerships with international companies could also bring in the necessary expertise and market access.

Government Incentives could play a pivotal role for value addition and reducing barriers such as high energy costs and logistical challenges. Implementing supportive policies and regulations to streamline recycling operations and reduce costs will be essential.

---

75 Tandem Computation, 2024.
76 Stakeholder Interview, Ministry of Mines and Minerals Development, 2024.
77 Global SP. The Future of Copper: Will the Looming Supply Gap Short-Circuit the Energy Transition?. New York. 2022. https://cdn.ihsmarkit.com/www/pdf/0722/The-Future-of-Copper_Full-Report_14July2022.pdf
78 World Bank, What is the Potential for More Copper Fabrication in Zambia?, 2011, https://documents1.worldbank.org/curated/en/464461468178438692/pdf/623790ESW0P1070sclosed0Dec027020110.pdf
79 Lubamba, H., Copper Rich Zambia Has a Rare Opportunity to Harness its Critical Mineral Resources, 2024, https://corporateandinvestment.standardbank.com/cib/global/insights/copper-rich-zambia-has-a-rare-opportunity-to-harness-its-critical-minerals-resources

Investing in Centralised E-Waste Collection and recycling centres. Improving the scrap collection network and providing incentives for recycling could also encourage more businesses to enter the market.

Challenges in the Mining Value Chain

The circular economy opportunities in Zambia's mining value chain face several significant challenges and barriers that must be addressed to realise their full potential.

Repurposing Tailings is hampered by the technical complexity and high costs associated with the advanced technologies required for conversion, as well as environmental concerns and stringent regulatory requirements that may increase operational costs.

Value Addition and Recycling in the copper sector is constrained by inadequate infrastructure, particularly in transportation and energy, which drives up costs and reduces efficiency. Additionally, the lack of skilled labour for advanced manufacturing techniques further limits the ability to produce high-quality, competitive products. In the recycling sector, the limited supply of scrap copper and fragmented, informal collection systems create inefficiencies, making it difficult to establish a robust recycling industry.

Production of Sulphuric Acid is challenged by the risk of market saturation, environmental and safety concerns, and the difficulties in distribution due to underdeveloped infrastructure. Moreover, the close dependence of sulphuric acid production on the copper smelting industry means that any fluctuations in copper production could directly impact the viability of this opportunity.

Quality of the Phosphate Rock found in Zambia is generally considered low. For instance, the phosphate ore at Kaluwe (in the Rufunsa-Feira area of Zambia's Eastern Province) has an average phosphorus pentoxide (P205) content of only 2.5% to 3.5%, which is relatively low compared to higher-grade phosphate rocks found in regions like the Middle East. This low quality makes beneficiation - the process of improving the quality of the ore - uneconomical, limiting the viability of these deposits for large-scale fertiliser production[8081].

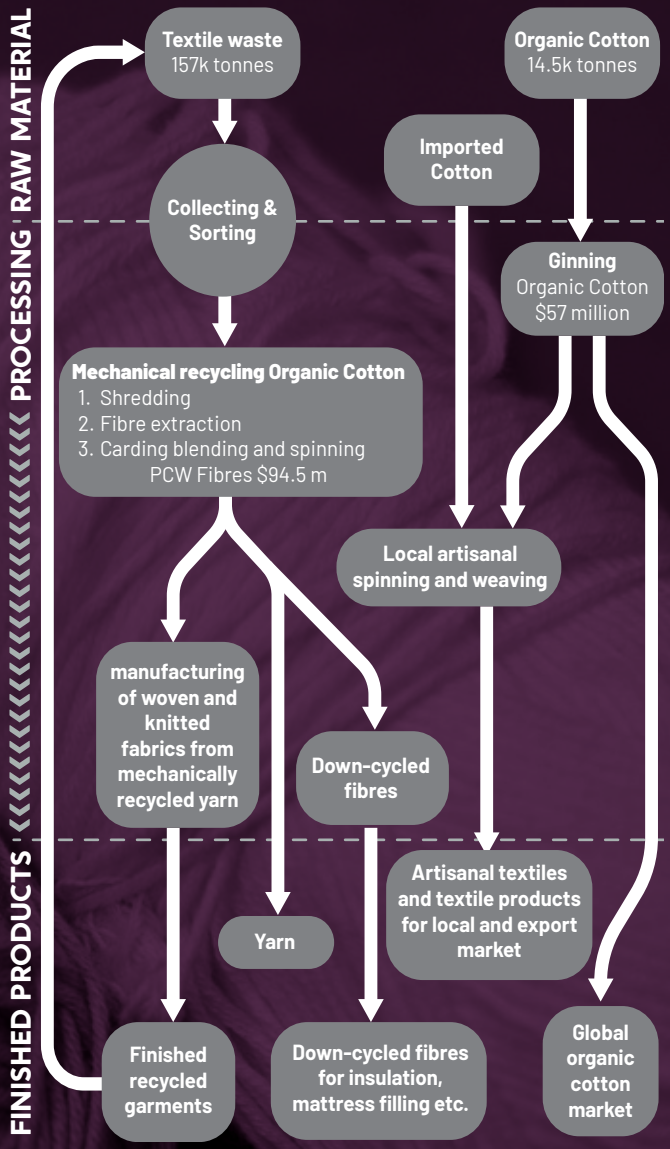
[80] Mapiki, A., & Singh, B. R., Agronomic potential of indigenous phosphate rocks as a phosphorus fertiliser in Zambia-Interim report, 1990.
[81] Jica, Features of Phosphate Reserves at Chilembwe, Zambia and Considerations for Use as Raw Materials for Phosphate Fertiliser Production, https://openjicareport.jica.go.jp/pdf/10403475_04.pdf

Textile Value Chain

Business opportunities in the Zambian textile value chain are limited, mainly as the Zambian textile industry has faced significant decline since its peak years in 1970s to early 1990s, when it benefited from substantial subsidies and protection against external competition. Since then, following liberalisation of the economy, Zambian cotton production has plummeted by 94%, dropping from 250,000 tonnes[82] to just 14,500 tonnes[83] in 2023. The spinning and weaving industry started to collapse in 1980, leaving only small-scale businesses that cater to niche high-end local and global markets, still in operation.

The textile value chain includes several key players, from cotton seed production to garment manufacturing. Cotton, the primary raw material, is predominantly grown by smallholder farmers. After harvest, the cotton is sold to ginners who process it into lint and seed. The ginners provide a portion of the seed back to farmers as input loans, while the rest is processed into oil, and the seed cake is sold to livestock feed producers. The lint is then spun into yarn, which is knitted or woven into fabric for garment makers. Other important players in the value chain include fabric and garment importers, as well as end consumers[8].

While cotton is primarily cultivated by smallholder farmers, the ginning process is largely controlled by a handful of large multinational companies. These cotton producers often find themselves as price takers, as the global market price for cotton fluctuates annually. Small-scale textile businesses primarily struggle with the lack of a robust local market and as a result, they heavily depend on gaining access to high-end export markets.



Despite the industry's collapse, there is increasing interest from the government to revitalise the sector. While the opportunities are limited, the study finds business potential in organic cotton given its higher market price and increasing global demand. Zambia's cotton production could generate around **USD 57 million** annually if it was certified organic[84]. Additionally, circular economy solutions in textile waste open up new opportunities. Recycling of Zambia's textile waste can generate **USD 94.5 million**[85] from Post Consumer Waste (PCW) fibres with potential for further value addition when processes and used for manufacturing of new garments.

82 Cotton Association of Zambia, The Production of Cotton in Zambia has declined by about 95 percent, Lusaka Times, 2023, https://www.cotton.org.zm/media.php

83 Tandem Calculation based on UN Comtrade data, 2023.

84 Calculated with an average price of $0.71 per pound with a premium of 150%, and with 2023 cotton production volumes. Estimates are based on averages and organic cotton prices can fluctuate significantly.

85 Tandem Calculation based on available textile waste in Zambia (2024 estimate).

Local Organic Cotton Production and Spinning

SNAPSHOT

- **96% of cotton produced in Zambia is exported.**
- **Textile industry focussed on niche, high-end markets.**

Brief description of the opportunity: What, Where, Who, How

Locally produced organic cotton is an opportunity for cotton farmers and ginneries. Organic cotton is cultivated using natural fertilisers and methods that minimise environmental impact. This approach reduces the reliance on harmful pesticides and fertilisers, helping to restore soil fertility and promote agricultural biodiversity. As consumers become more environmentally conscious, the demand for sustainably produced goods, including organic cotton, is on the rise.

In 2019, Zambia had 9 operating ginneries with a total ginning capacity of **400,000 metric tonnes** of cotton. The utilisation capacity was only **25,5 %** in 2018 with around **102,000 metric tonnes** of cotton being processed[8]. In 2024, the national cotton harvest is projected to only reach **9,000 metric tonnes** mostly due to the extreme drought[86]. Conventional cotton companies are working at low capacity. While the decline in cotton production is unfortunate, it also suggests that there is potential for a quick scale-up with the capacity already in place.

Zambian ginning companies offer seasonal input loans to cotton farmers, which are repaid at the end of the growing season through deliveries of seed cotton. In 2016, around **300,000 smallholder farmers** were growing cotton for local ginning companies[87].

Large-scale spinning and weaving companies closed operations during the downsizing of the industry, leaving no large-scale operational spinning companies in the country. Meaning that all yarn used in-country is imported, apart from smaller businesses spinning for their own use. Zambia imported cotton yarn for the total value of **USD 161,512** in 2023[88]. Smaller scale businesses serve a niche higher-end textile market and there is demand for these products both in-country and globally.

Market potential

Global organic cotton demand is continuously increasing. The year-over-year growth in production of organic cotton fibre is at **+37 %**[89]. This growth is driven by increasing consumer demand for sustainable products, particularly in the fashion and textile industries. The antibacterial properties and mild UV protection of organic cotton further enhance its appeal. In 2023 Zambia produced 14,500 tonnes[77] of cotton, if the cotton was certified organic it could generate around **USD 57 million** annually[90].

Currently, **96%** of cotton grown in Zambia is exported, leaving only small quantities for local spinners and weavers[91]. Local small-scale weaving companies prefer to source cotton locally but often resort to importing from neighbouring countries like South Africa, Zimbabwe and Tanzania, as well as Asian countries like India and China. Textile businesses would prefer using organic cotton, signalling there is demand for locally produced organic cotton.

86 Stakeholder interview, June 2024.
87 UNCTAD, Cotton and its by-products sector in Zambia. Background paper, 2017, https://unctad.org/system/files/official-document/sucmisc2017d2_en.pdf
88 UN Comtrade Database, Trade data on Cotton, accessed July 2024, https://comtradeplus.un.org/
89 Textile Exchange, Organic Cotton Market Report. October 2022.
90 Calculated with an average price of $0.71 per pound with a premium of 150%, and with 2023 cotton production volumes. Estimates are based on averages and organic cotton prices can fluctuate significantly.
91 Stakeholder interviews, July 2024.

Producing organic cotton requires large amounts of organic fertiliser. Sourcing it poses a challenge, as importing organic fertiliser is prohibitively expensive for viable cotton production. The logistics costs associated with organic fertiliser can significantly increase prices, and its bulkier volume compared to concentrated chemical fertilisers makes local sourcing essential. Also, seed quality matters for organic cotton to be competitive. Currently, only one government entity supplies seeds for organic cotton farmers, and while these seeds are relatively inexpensive, they often lack in quality.

Further business potential lies in small-scale weaving and textile production. This typically requires access to export markets. The Zambian company Tribal Textiles exemplifies this approach, successfully exporting its products worldwide while maintaining a strong local trade, with **60%** of its business directed toward local lodges[85]. Growth in the local organic cotton production could further feed into the artisanal textile space.

What is needed to make it happen

Organic Cotton Producers Need to Get Their Cotton Certified: To be legally sold as organic, raw cotton must be grown on a farm that is certified to its respective government-controlled organic standard. This process includes verifying that the cotton is grown without synthetic fertilisers or pesticides and adhering to established organic farming practices. Farmland usually needs to be free from prohibited synthetic substances for a period of three years before qualifying for organic certification. For ginneries wanting to produce organic cotton a successful completion of the certification process is vital. In addition to that the key global certification standards are:

- **Global Organic Textile Standard (GOTS)**: Ensures that textiles are made from organic fibres and meet environmental and social criteria throughout the supply chain.
- **Organic Content Standard (OCS)**: Focuses on tracking the content of organic materials in products and ensuring transparency in the supply chain.
- **Content Claim Standard (CCS)** is the foundation of all Textile Exchange standards. It is a chain of custody standard that provides companies with a tool to verify that one or more specific input materials are in a finished product.
- **OEKO-TEX® Organic Cotton Certification**: Verifies that products are made without genetically modified organisms and harmful substances, ensuring safety and sustainability.
- **Further Market Research and Development Research:** Businesses need to carry out further research on the opportunities and the feasibility of their business in the textile industry.
- **Investment in Machinery:** For businesses looking to enter the spinning and weaving side of the textile industry, setting up a small-scale spinning facility requires investment in machinery.
- **Establish Strong Cotton Supplier Relationships:** Establishing strong relationships with cotton suppliers is vital for businesses in spinning and weaving. Businesses need to research and select suppliers based on price, quality, and reliability to ensure a consistent supply of raw materials.

Textile to Textile Recycling

SNAPSHOT

- **149,000 tonnes of textile waste generated annually.**
- **Imports 32,740 tonnes of second-hand clothing.**
- **Mechanical recycling is versatile and scalable.**
- **Informal actors are a cost-effective option for sorting textile waste.**

Brief Description of the opportunity: What, Where, Who, How

Textile-to-textile recycling is the process of transforming textile waste into new fibres that can be used to produce new clothing and other textile products. This method includes both pre-consumer recycling, which involves materials discarded during manufacturing, and post-consumer recycling, which deals with waste generated by consumers after the product's lifecycle. This process can involve both mechanical and chemical recycling of textiles. The mechanical recycling process involves the following steps:

1. **Collection**: Gathering discarded textiles from various sources, such as households, retail stores, and recycling programs.
2. **Sorting**: Separating textiles based on material type, colour, and condition to ensure quality in the recycling process.
3. **Shredding**: Breaking down the sorted textiles into smaller pieces, which can be mechanically processed.
4. **Fibre Extraction:** The shredded textiles are processed through a garnett machine, which employs mechanical forces to separate the fibres. This machine uses sharp teeth mounted on rotating cylinders to tear the fabric apart, transforming it into individual fibres. The process is most effective on mono-fibre materials, such as 100% cotton, and is less effective with blended fabrics due to contamination issues
5. **Carding:** After fibre extraction, the fibres are aligned and disentangled in a carding process. This step prepares the fibres for spinning by ensuring they are uniformly aligned, which is essential for producing quality yarn.
6. **Blending**: The extracted fibres are often mixed with virgin fibres to enhance the quality of the final product. The proportion of virgin fibres used can significantly affect the fineness and strength of the yarn produced. For instance, adding more virgin fibres can help achieve a finer yarn, which is particularly important for applications requiring high-quality textiles.
7. **Spinning:** The blended fibres are then spun into yarn, which can be used for woven or knitted fabrics. The quality of the yarn is influenced by the length of the fibres; modern machines can recover fibres longer than 2 cm, allowing for better spinning outcomes.

The advantage of mechanical recycling of textiles is its low environmental impact. The process does not use water or chemicals and uses only small quantities of energy. Mechanical recycling is a versatile, proven and industrially available technology that is scalable with a steady input stream of textile waste. One downside with mechanical recycling is that it typically results in shorter fibres, which can limit the quality of the recycled material. Approximately **75 %** of the fibres' value is lost in this process[92] and thus the fibres are often downcycled into insulation material, wiping cloths, and other lower quality products. The decrease in quality can be controlled by blending with virgin fibres. In addition, new technologies enable mechanically recycled cotton to be mixed with polyester or manmade cellulosic. Another challenge is that the method requires high purity feedstock (raw material), putting pressure on sorting of textiles.

[92] EPRS, Environmental impact of the textile and clothing industry, European Parliamentary Research Service, January 2019.

Market potential

With **149,000 tonnes** of textile waste ending up at dumpsites in Zambia, there is potential for textile-to-textile recycling[93]. Recycling of the available textile waste can generate **USD 94.5 million**[94] from PCW fibres, which can then further be processed and manufactured into new garments. Currently, less than **1%** of global textiles are recycled into new clothing, highlighting a significant opportunity for growth in this sector[95]. Neighbouring eight countries, Zambia has potential to become a regional hub for textile recycling.

A relatively large pool of informal waste collectors creates opportunities for cost-effective sorting of textile waste and creation of green jobs. If well organised, informal waste collectors could offer a solution for the labour-heavy manual textile sorting process that mechanical recycling requires. Such efforts would also have greater socio-economic impacts in the society.

What is needed to make it happen

Market Research: Conducting thorough market research is crucial for businesses looking to invest in the textile recycling sector. By gaining detailed insights into local and regional market demands, companies can better assess the potential for their products or services and determine the long-term viability of their investments.

Effective Sorting System: Mechanical textile recycling typically requires manual sorting of textiles based on colour and type. The sorting process needs to be cost-effective and keep a high standard.**Clean and Steady Material Feeds:** Ensuring a steady flow of clean textile input is important for a successful mechanical recycling process.

Tax Incentives: Zambia Revenue Authority (ZRA) provides tax holidays to the cotton value chain as follows: a) **5-year tax holiday** on profit for local producers of cotton seed; b) **5-year tax holiday** on profit from ginning of cotton; and c) **10-year tax holiday** on profit made from spinning of cotton and weaving of thread[96].

Challenges in the Textile Value Chain

The textile industry in Zambia faces several challenges, including:

Power Supply Issues: Load shedding and an unreliable power supply, exacerbated by the 2024 drought, significantly impact businesses in the textile sector. Whilst solar power solutions are available, a lack of accessible funding and support for such investments remains a barrier.

Agricultural Subsidies: Zambian cotton is not subsidised, making it difficult to compete on the global market against cotton from countries where cotton is heavily subsidised.

Poor Quality Inputs: Lack of standardisation in input packs has a negative impact on yield and farmer attitudes towards cotton farming.

Small and Underdeveloped Market: Cheap textile imports and second-hand clothing are a significant barrier for the development of a lucrative local textile industry. Existing small-scale textile companies are dependent on a high-end export market.

93 Tandem estimates 2024 based on the initial Zambia Circular Economy Study, 2023.
94 Tandem Calculation based on available textile waste in Zambia (2024 estimate).
95 EPRS, Environmental impact of the textile and clothing industry. European Parliamentary Research Service. January 2019.
96 ZRA, 2024 Budget Highlights - Overview of Tax Changes, 2024, https://www.zra.org.zm/wp-content/uploads/2023/09/2024-Budget-Highlights-Booklet.pdf

3. Regulatory and Business Environment

A more conducive regulatory and business environment is taking shape for the circular economy in Zambia, with enabling policies as outlined below. Incentives such as tax breaks for priority sectors and renewable energy equipment, tax holidays for investors, and special economic zones encourage investment in green technology and CE. As highlighted previously, the combined opportunities could add **USD 4.23 billion** to the Zambian Economy and create significant numbers of jobs. In order to accelerate the shift towards Circular Economy in Zambia, these policies and incentives can be developed further to create an enabling environment for investment and unlock these opportunities.

Key pieces of legislation in waste management in Zambia include the following:

Environment Protection and Pollution Control Act, 1990 (Cap. 204) was amended in 1999 and repealed and replaced by the Environmental Management Act. 2011 (No. 12 of 2011). Provides for the protection of the environment and the control of pollution; to establish the Environmental Council (now ZEMA) and to prescribe the functions and powers of the Council; and to provide for matters connected with or incidental to the foregoing.

Hazardous Waste Management Regulations Statutory Instrument [No. 125 of 2001]. Provides rules for the control and management of hazardous waste, i.e. waste, including objects, articles or substances, which is poisonous, corrosive, irritant, explosive, inflammable, toxic or harmful to man, animal, plant or the environment.

Environmental Management Act, 2011 [No. 12 of 2011], Implemented by Environmental Management (Licensing) Regulations (S.I. No 112 of 2013) and Amended by Environmental Management (Amendment) Act [No. 10 of 2013). This Act replaced the Environmental Protection and Pollution Control Act (No. 12 of 1990). It makes provision for integrated environmental management and the protection and conservation of the environment and the sustainable management and use of natural resources and related matters.

Solid Waste Regulation and Management Act [No. 20 of 2018 353]. An Act to provide for the sustainable regulation and management of solid waste; general and self-service solid waste services; the incorporation of solid waste management companies and define their statutory functions; the licensing and functions of solid waste service providers, operators and self-service solid waste providers and provide for their functions; the regulation, operation, maintenance and construction of landfills and other disposal facilities; the setting and approval of tariffs for management of solid waste and provision of solid waste services; and matters connected with, or incidental to, the foregoing.

In 2018, Zambia introduced **Statutory Instrument (SI) No. 65** of 2018, known as the **Extended Producer Responsibility Regulation**, through the Ministry of Water Development, Sanitation, and Environmental Protection. Enforced by the ZEMA, this regulation requires producers and manufacturers to manage their post-consumer waste, especially if it poses environmental risks. Producers must implement systems for waste reduction through treatment, reclamation, reuse, recovery, or recycling. The regulation banned single-use plastics of 30 microns or less in formal retail outlets, although compliance in the informal sector is limited. It also led to the creation of Producer Responsibility Organizations (PROs).

The circular economy is also integrated into **Zambia's 8th National Development Plan (2022-2026)** playing a part in reversing unsustainable environmental and natural resources management practices through the **Integrated Environmental Management Strategy**.

National Green Growth Strategy 2024-2030 aims to transition the country to a low-carbon, resource-efficient, resilient, and socially inclusive economy. Launched on 24 April 2024, the strategy seeks to integrate environmental sustainability into national development while addressing climate change and promoting economic growth. It requires an estimated **$10.41 billion** in funding from local and international sources for implementation. The strategy is anchored on four pillars: resilient and climate-compatible growth, enhanced resource efficiency, improved natural capital, and increased inclusivity. Regarding circular economy, the strategy emphasises three key areas: (1) enhancing **resource efficiency** across sectors, promoting sustainable practices that minimise waste and maximise the use of existing

resources, (2) development of **systems for waste management and recycling**, including initiatives to recycle textiles and other materials, reducing landfill waste and environmental impact, and lastly (3) promoting the construction of **sustainable infrastructure** that supports circular economy principles.

The Zambian Renewable Energy Feed-in Tariff (REFiT) Policy was created to improve the country's electrical grid capacity and increase power production by attracting private investments in renewable energy projects, specifically those with capacities of up to 20 MW. The GET FiT Zambia program was established as the main tool to implement this policy, focusing on developing Independent Power Producer (IPP) projects in renewable sources like solar and small-scale hydroelectric energy[97].

Historically low electricity tariffs have haltered the electricity sector in Zambia. The state-owned national power utility, ZESCO, has subsidised electricity prices, resulting in market distortions and financial difficulties for the company. To address these issues, the Government (GRZ) is implementing tariff adjustments with gradual increase over five years with the ERB overseeing the implementation[98]. The new net metering regulations (2024) have the potential to stimulate investment in renewable energy and will enable consumers to feed any surplus electricity back into the grid.

The National Critical Minerals Strategy 2024-2028 is a strategic planning document that guides investments for exploration, mining development, mining, processing and supply of goods and services in the country. It presents the long-term vision, objectives to be achieved in the 5-year strategic period and priority strategies consisting of a set of interventions to achieve objectives and the strategies.

The National Three Million Tonnes Copper Production Strategy by 2031 was launched in July 2024. The Ministry of Mines and Minerals Development has set an ambitious goal to increase copper production from the current average of 800,000 tonnes to three (3) million tonnes per annum by 2031. The main interventions include maintaining a stable fiscal regime and an enabling environment to attract investments and expediting arbitration of mining - related matters. The strategy also emphasises country-wide geological mapping and mineral exploration, formalising Artisanal and Small-scale Mining (ASM), and enhancing the regulatory framework for transparency and efficiency.

Regulations in the Textile Value Chain: The Cotton Act of 2005 (No. 125 of 2001) regulates the production, marketing, and trade of cotton in Zambia, protecting the industry by overseeing the importation of cotton seeds, preventing the spread of diseases, and addressing related issues, with enforcement by the CBZ under the Ministry of Agriculture. Similarly, the **Customs and Excise Act** establishes the framework for the imposition, collection, and management of customs, excise, and other duties, regulating the licensing and oversight of warehouses for specific goods, managing imports and exports, facilitating negotiations for customs and trade agreements with other countries, and addressing forfeitures. Additionally, the **Plant Variety and Seed Act**, administered by the Seed Control and Certification Institute, governs the production, sale, and importation of seeds for sowing and their export, setting testing procedures and minimum standards for germination and purity while providing for seed certification.

While Zambia's policies support circular economy principles, exchanges with stakeholders indicate a need for more sector-specific legislation that provides guidance on circular economy practices throughout the entire supply chain. There is a need for clarity regarding public and private sector stakeholder roles[99].

97 UNECA, Regulatory Review of the electricity market in Zambia: towards crowding-in private sector investment. United Nations Economic Commission for Africa, 2021, https://repository.uneca.org/handle/10855/46746

98 Kukula Capital, The Zambian Landscape for Private Investment in Climate-Friendly Projects, Final Research Report, April 2024.

99 ZIPAR, Stakeholder Interview, June 2024.

4. Key Recommendations and Next Steps

This report presented opportunities in five circular economy value chains. Further opportunities exist in the circular economy for Zambia and are worth exploring. This section highlights recommendations and the way forward for businesses looking to explore opportunities in the specific value chains as well as general recommendations for Finnish and other international businesses interested in entering the Zambian market.

The Embassy of Finland in Lusaka[100] is hosting a business delegation from Finland to Zambia on **18-19 November 2024** for companies interested in exploring circular economy opportunities in Zambia and participating in the B2B networking programme. Kindly fill in this **form** by 4 November 2024 if you are a Finnish company looking to join the delegation from Finland or a Zambian company interested in meeting the Finnish business delegation.

For the MSW Value Chain

General Steps

Conduct a detailed Market Analysis to Understand the Local Waste Market. Get acquainted with Zambia's waste management policies/ regulations and the market players, from generators, waste pickers, collectors, processors and off-takers of recyclables and recycled products. A 2024 report by Climate Compatible Growth, titled 'From Waste to Resource Zambia' gives a more detailed analysis of regulations and policy that governs waste in Zambia.

Engage with the MLGRD, the local municipal councils, ZEMA and ZDA for guidance and investment incentives.

Separation of Waste: Dry & Wet

Partner with local governments, waste service providers and communities to implement a pilot of waste separation using separation at source systems and raise awareness. The MLGRD is responsible for overseeing waste management and local authorities or city councils have the mandate to manage waste within a city, town or municipality.

Register and formalise the business/ Operations with the Patents and Companies Registration Agency (PACRA). Get a waste management licence from the local municipality (Lusaka Integrated Solid Waste Management Company if in Lusaka). Obtain environmental compliance licences from ZEMA.

Ensure that collection and sorting systems are in place and there is a market for all sorted materials.

Implement Waste Separation: Start a pilot project for separating dry (recyclable) and wet (organic) waste.

Collection and Logistics

Partner with Zambian companies seeking Finnish technology to establish efficient waste collection systems and local logistics providers that can benefit from the technology.

Leverage Finnish digital tools for monitoring, data collection and route optimization.

Materials Recovery Facilities (MRFs)

Identify strategic locations for MRFs, as close as possible to the source or to existing waste management facilities.

Develop offtake with local recycling or regional companies for materials with existing markets and introduce advanced recycling technologies for materials without existing markets.

Leverage PPPs and engage with the Public Private Dialogue (PPD) Forum and the Presidential Delivery Unit (PDU).

[100] Companies can reach the Embassy of Finland in Lusaka via email on sanomat.LUS@gov.fi

General Scale Related Steps

Collaborate with local authorities through PPPs for large-scale waste projects.

Access funding through ZDA and multilateral development organisations. Some options are listed in the Executive Summary.

Explore export opportunities to regional or international markets. Work with Zambian export agencies for market access.

See how you can take advantage of existing incentives and legislation that is supportive of waste management activities, such as EPR.

For the Biofertiliser and Biogas Value Chain

General Steps

To capitalise on the biofertiliser and biogas value chains in Zambia, consider conducting a more detailed market assessment to gain insights into the demand for biofertilisers among smallholder farmers, cooperatives, and households, as well as businesses and farms for biogas. In addition, identify sources of biowaste, including animal manure and food waste.

Familiarise yourself with the compliance and regulatory requirements for sourcing and processing organic matter into biofertiliser by engaging with local authorities. This includes the Ministry of Agriculture, the Zambia Agriculture Research Institute (ZARI), the University of Zambia (UNZA) and others related to the value chains, ZEMA, the Ministry of Energy (MoE), the ERB, and the ZDA. These organisations can provide valuable guidance on the necessary processes and investment incentives[101], including tax exemptions for importing biogas equipment[102].

Register and formalise the business with PACRA. Get a licence from the local municipality and obtain environmental compliance licences from ZEMA.

For biogas, also get guidance from the MoE, Zambia Renewable Energy Association (ZARENA), ERB, and ZDA on what to look out for, available incentives and exemptions especially with regard to importation of equipment.

Securing Biowaste

To secure a reliable supply of biowaste materials like animal manure and crop residues for biofertiliser production, consider collaborating with local farmers, waste collection companies, and city councils in the areas where facilities will be set up. For biogas, partner with farms, hotels, waste collection companies, restaurants, and other biowaste generators to ensure a secure and consistent feedstock supply. Complement these partnerships with an efficient collection and transport system. When selecting technology, ensure it matches the scale and type of feedstock while complying with safety and environmental standards to effectively handle the volume of waste supplied. Start with a pilot project for collecting biowaste from farms and make necessary improvements to optimise the process efficiency over time.

Biofertiliser Production and Distribution

Before any product can go to market, engage research institutions, i.e. ZARI, UNZA to test the biofertiliser formulations and ensure they are tailored to local needs and to facilitate product certification. When the biofertiliser is ready, distribution networks through partnerships with agro-dealers and cooperatives will be key to get the product to the farmers. Conduct field trials and continue to collect data to monitor performance and demand for biofertiliser and make improvements based on market dynamics.

Biogas Production and Distribution

It is essential to establish distribution channels through partnerships with biogas distributors and invest in storage, distribution and transportation infrastructure. Engaging with industry associations like the ZARENA, government agencies i.e., ERB, Zambia Bureau of Standards (ZABS), and ZEMA, as well as the local community, is crucial for success.

---

101 Hazemba, M. and Clube, R., From Waste to Resource: Creating an Enabling Policy Environment for a Circular Economy in Zambia, https://climatecompatiblegrowth.com/wp-content/uploads/From-Waste-to-Resource-Zambia-1.pdf

102 UNCTAD, Biogas technology assessment in Zambia, Technical cooperation outcome, 2024, https://unctad.org/system/files/official-document/tcsdtlinf2024d2_en.pdf

For the Mining Value Chain

Reprocessing Tailings

Work with the ZDA and Ministry of Mines & Mineral Development to gather information on tailings: Ownership, locations, available tonnages, mineral composition, carry out your own mineralisation/ metallurgical tests to determine the economic viability of reprocessing.

Conduct a Feasibility Study

Start by evaluating the potential profitability and environmental impact of reprocessing tailings. At a minimum the study should cover the technical feasibility of extracting remaining minerals, market demand and the financial and cost analysis.

Decide on the Business Model

Based on findings, determine whether you will lease tailings sites from owners, acquire ownership of tailings and/ or partner with existing mining companies to share resources and profits.

Note: *To formalise a business in Zambia's mining industry, companies must follow several legal steps. First, register the business with the Patents and Companies Registration Agency (PACRA) to ensure legal operations, and register with the tax authority (Zambia Revenue Authority- ZRA). Then, obtain the appropriate mining licence from the Ministry of Mines and Mineral Development (MMMD) based on specific activities (i.e. prospecting, exploration, or mining). Additionally, secure environmental permits through the Zambia Environmental Management Agency (ZEMA), including preparing an Environmental Impact Assessment (EIA) or Environmental Project Brief (EPB) if required. Finally, engage with the Zambia Development Agency (ZDA) for further guidance on compliance, business incentives, and investment opportunities.*

Sulphuric Acid Production

Conduct Market Analysis

Perform a detailed market analysis to assess the full demand for sulphuric acid within Zambia, especially from the mining industry, and identify potential export markets (such as neighbouring countries with demand).

Form Partnerships or Joint Ventures (JVs) - *follow the same formalisation steps above*

- Partner with established mining companies; those that use sulphuric acid in their operations and those that produce sulphur dioxide. This could provide guaranteed buyers/ suppliers, potential technical support and shared infrastructure.
- Expand into new markets, explore opportunities to sell sulphuric acid beyond mining, such as the production of fertiliser to reduce Zambia's reliance on imported fertilisers.
- Develop new products or venture into new markets, especially in sectors like agriculture (fertiliser production) or other chemical industries that require sulphuric acid as a raw material.

Value Addition and E-Waste Management

Feasibility Study

The value addition sector presents enormous potential in Zambia, particularly when it comes to reprocessing electronic waste (e-waste) for metal recovery. However, scale is critical due to regional competition and therefore a market feasibility study is required.

Public Private Partnership

PPP's are key to actualizing the opportunities in E-waste recycling and value addition. Through PPPs, businesses can benefit from:

- Government support.
- Access to public resources like land or infrastructure.
- Easier navigation of legal and regulatory frameworks (ZDA).

Due to regional competition, it is crucial to think beyond local markets. Research export opportunities for value-added mining products or import/ export of recovered metals from E-waste. Collaborations with neighbouring countries to access their markets and resources.

Compliance & Key Considerations

- Invest in large-scale processing facilities.
- Leverage advanced technologies for efficient metal recovery from e-waste.
- Compliance and Environmental Considerations
- Ensure that operations comply with environmental regulations, particularly in managing hazardous materials found in e-waste.

For the Textile Value Chain

General Steps

A first step towards leveraging opportunities in the textile value chain is to conduct in-depth market research and a feasibility study assessing the demand, potential partners, required scale, and sourcing of raw materials.

Securing Textile Waste for Mechanical Recycling

The realisation of this opportunity hinges on proper waste separation practices being in place. Such a systematic change necessitates large investments into waste management, but also behavioural change among the citizens. A key factor for mechanical recycling to be a viable business is a stable supply of quality feedstock in large volumes. This step also involves finding the right suppliers and setting up a textile waste separation operation.

Accessing an Export Market for High-End Artisanal Textile Products

A business looking to start a small-scale textile business needs to secure access to an export market in Europe, Australia, USA or the likes. Since the local market is underdeveloped and demand is limited, access to a high-end market becomes vital.

Certification Process for Organic Cotton

Securing certification is key when looking to enter the global organic cotton market. Cotton farmers and ginneries looking to convert to organic cotton can expect a lengthy process that can take up to two years. Get guidance from the Ministry of Agriculture on the requirements and process details.

Government Support

There is minimal Government support but the newly announced tax holiday for the textile industry is a first step towards the long-promised revitalisation of the once blooming textile industry in Zambia. However, for the time being there is little support, and the local demand is limited.

The textile value chain falls under the Ministry of Agriculture and the Ministry of Commerce Trade and Industry. Businesses looking to tap into opportunities in the textile value chain can find the following entities useful:

Cotton Board of Zambia (CBZ): Regulates the production, ginning and marketing of seed cotton. CBZ is also responsible for setting standards for cotton (cotton crop, seed cotton, cotton seed and lint).

The Cotton Association of Zambia (CAZ): Provides a platform for smallholder cotton farmers to participate more effectively in the operations and development of the industry in Zambia.

The Zambia Cotton Ginners Association (ZCGA): An association of ginning companies in Zambia with the aim of providing a framework for Zambian cotton companies.

Zambia Association of Manufacturers (ZAM): ZAM's major objective is to promote the manufacturing sector through policy advocacy, dialogue, lobbying and technology upgrading of the production process as a way of improving productivity and competitiveness in the industry.

Handloom Textiles Association (HATTAZ): Seeks to promote the local production and use of locally woven fabric in Zambia.

For Finnish (and other International) Stakeholders Interested in Zambia

While many challenges exist, opportunities can be developed into strong businesses with patience, resilience, flexibility, humility and willingness to adapt frequently to suit local market conditions and context.

In many African markets, there is a prevalent expectation that money, technology, and know-how should be provided for free. This perception complicates the navigation for foreign businesses, which are often viewed primarily as investors or financiers. Additionally, the Zambian market presents challenges due to its underdeveloped nature, low demand, and an unstable operating environment, including issues like corruption. These factors make it challenging to build a compelling business case. However, certain critical sectors, such as the energy sector, tend to have a better success rate.

Another significant challenge is the mismatch in business sizes and expectations; what is considered a small business in Finland may be equivalent to a medium or large business in Zambia, leading to operational mismatches. Furthermore, access to funding is often contingent on having a viable business outlook. There is a notable lack of medium-sized funding opportunities for exploring business prospects.

To navigate these challenges effectively, international businesses can consider the following recommendations:

- **Conduct Thorough Research:** Proper groundwork is essential before entering the Zambian market.
- **Local Partnerships:** Finding reliable, skilled and committed local partners is crucial. Finnish companies often prefer commission-based contracts, which can lead to a lack of persistence and interest from local partners if progress is slow.
- **External Support:** Seek external support, including legal and expert services, when needed.
- **On-the-Ground Presence:** Companies must establish a strong physical presence or have a strong and trustworthy local partner in Zambia to ensure control and transparency, as remote operations move slowly and have increased risks.
- **Tangible Incentives:** What has been successful in other developing markets is to build projects around private sector incentives such as feed-in energy tariffs or EPR schemes.
- **Technology Solutions:** Finnish firms excel in innovative technology; however, solutions must address the broader complexities of the market rather than just specific issues. Past challenges, especially in developing markets, have shown that some technology, developed to solve one specific issue, often becomes less useful when the issues are much more complex than the single issue the technology is solving. Companies should adopt a cross-industrial approach, offering tailored solutions that address specific local contexts and problems. Technology should always be adjusted to local context, and include skills to operate, maintain, troubleshoot and repair.

The Embassy of Finland in Lusaka offers advisory services for companies looking to enter the Zambian market. They can help your company succeed in Zambia by providing information about Zambian market opportunities, helping to find suitable partners and contacts, helping in case of encountering possible trade obstacles, and arranging meetings and visits with local public and private stakeholders. Companies can contact the Embassy of Finland in Lusaka by email on sanomat.LUS@gov.fi.

Finnpartnership Business Partnership Support (Liikekumppanuustuki) can be granted to Finnish operators for projects that are targeted to developing markets and have one of the following objectives:

- Long-term business partnership (the most common project type)
- Piloting with an international organisation eligible for Official Development Assistance (ODA)
- Feasibility study for an investment project (PIF)
- Support function project

For Zambia, the grant funding covers 75% of project costs for Finnish SMEs, and 50% for Large Finnish companies. Maximum support is EUR 400,000. Project long-term goal must be internationalisation in the sense of e.g. establishing a subsidiary or JV, or forming a licensing agreement with a local partner.

Additional details can be found here.

Finnpartnership hosts monthly application workshops for Finnish companies (i.e. eligible applicants) providing all necessary details for applying. Additional information can be found here .

Projects whose objective is to e.g. establish long-term business partnership or pilot a solution with an international ODA-eligible organisation are eligible for Business Partnership Support. The majority of projects supported by Finnpartnership aim to establish a long-term business partnership. In this context, business partnership means cooperation between a Finnish operator and a local company or organisation in the target country. In order to receive the financial grant, a project must have one of the following goals:

- Establish a joint venture
- Establish a subsidiary
- Import products to Finland or the EU
- Initiate subcontracting, or form a long-term service agreement, or long-term franchising or licensing agreement (excl. sales and user licences)
- Develop existing business operations in the target country

Business Finland supports Finnish companies looking to enter new markets by offering funding, advice as well as information and contacts in the target market. Business Finland offers funding for SMEs to, for instance, conduct market analysis, for R&D, for acquiring expert services, and for target market group visits. Business Finland also offers programs that focus on a specific theme or sector and offer companies information and contacts in the sector. There are active programs in cleantech, bioeconomy, circular economy, digitalisation, the consumer sector, as well as health and wellbeing. In addition, the Developing Markets Platform, a joint endeavour of Business Finland and the Ministry for Foreign Affairs of Finland, helps Finnish companies and their partners develop sustainable business and access market opportunities in growing developing markets.

Finland serves as a strong testbed for projects, characterised by its well-established networks and strong ecosystems in the circular economy. It is these ecosystems and the effective collaboration between the private and public sectors that creates a unique enabling environment for circular innovations and a systematic change towards a circular economy. The Finnish Innovation Fund Sitra's newest list of most interesting companies in the circular economy 2.1 shows you what operating a business in Finland's circular economy means in practice. The list showcases innovative solutions across industries.

Appendix

Stakeholder Map

Key

1. Waste Raw Materials
2. Value Chains
3. Government Ministries
4. Agencies, Associations and Regulators
5. Some market players active in the value chains

List of Stakeholders

MCTI	Ministry of Commerce, trade and Industry
MLGRD	Ministry of Local Government and Rural Development
MGEE	Ministry of Green Economy and Environment
MoA	Ministry of Agriculture
MMMD	Ministry of Mines and Mineral Development
LCC	Lusaka City Council
LISWMC	Lusaka Integrated Waste Management Company
ZAM	Zambia Asscociation of Manufacturers
ZIEM	Zambia Institute of Environmental Management
ZDA	Zambia Development Agency
ZEMA	Zambia Environmental Management Agency
ERB	Energy Regulation Board
ZARENA	Zambia Renewable Energy Association
ZABS	Zambia Bureau of Standards
AES	Agriculture Extension Services
ZCCM-IH	Zambia Consolidated Copper Mines - Investment Holdings
CEEC	Citizens Economic Empowerment Commision
CFs	Commercial Farmers
SHFs	Small Holder Farmers
ZAMEFA	Metal Fabricators
CAZ	Cotton Association of Zambia
ZNFU	Zambia National Farmers Union
ZCCI	Zambia Chamber of Commerce and Industry
CBE's	Community Based Enterprises
L2 Aggregators	Individuals/Companies: collect, store & sale to waste traders
Recycling Companies	Local - Solid waste value addition companies
Contracted Collectors	Solid waste collectors contracted by the LCC
ZARI	Zambia Agriculture Research Institute
UNZA	University of Zambia
E4A	Energy for Agriculture Project
SNV	Stichting Nederlandse Vrilwilligers
ZCM	Zambia Chamber of Mines

Companies that participated in the study and are interested in circular economy opportunities

Value Chain	Company Name	Line of Business
MSW	Separation at Source	Innovative waste as a service model- waste is separated at the point of generation
MSW	EarthCheck	Aggregator and trader of post-consumer PET for recycling
MSW	City Waste Solutions	Franchise waste service provider- collection of waste and disposal
MSW	Newtech Recycling	Recycling of plastic waste into high-value products
MSW	TCHE-waste	E-waste repair and recycling service provider
Biofertiliser	Twala Farms	Production of compost from agricultural waste
Biofertiliser	Albida Agricluture	Production of biofertiliser from agricultural residues
Biogas	Green Belt Energy	Production and distribution of Biogas from biowaste
Mining	Neelkanth Cables	Value addition- manufacturing of cables for the local & regional market.
Mining	ZAMEFA	Value addition- manufacturers and distributors of electric cables from copper cathodes.
Mining	Jubilee Metals	Metals recovery from overlooked resources such as tailings.
Mining	Chambishi Copper Smelter	Ore processing and production and distribution of Sulphuric acid from the processing of Copper.
Mining	Metso	Mining and refining technologies and machinery. Also focuses on extending the life cycle of critical minerals through efficient recycling.
Textiles	Alliance Ginneries	Production of organic cotton, interested to explore textile recycling

Project and Equipment Costs for certain opportunities

This section highlights the cost of project equipment discussed in certain value chains.

Biofertiliser from Animal Manure (Chickens)

For businesses looking to enter the biofertiliser value chain, establishing a small-scale biofertiliser facility requires investment in machinery. Estimated costs for medium-scale centralised machines start around **USD 70,000**[103] or more, depending on capacity, while small-scale and decentralised machines are expected to be less expensive. A small bio-fertiliser business in Zambia aiming to produce **100 tonnes** of biofertiliser annually would need approximately **200 - 300 tonnes** of chicken manure each year.

Decentralised Composting from Agricultural Residue

Businesses looking to invest in the space face an initial investment cost for setting up the compost operation. The costs for equipment can vary widely depending on the type and capacity. A small system will cost between **USD 550** and **2,200**, a medium sized system between **USD 3,500** and **15,000**, and a large scale system will cost between **USD 60,000** and **250,000**. The cost of decentralised composting equipment varies depending on the scale of the operation[104]. Please see below for more detailed price estimates. Note: These estimates provide a broad overview of the potential costs, but exact prices are dependent on the equipment's capacity, brand, and specific features[105].

Biogas from Animal Manure (Cattle)

For companies looking to enter space, the capital cost for large On-Farm Anaerobic Digester systems of sizes 100 m^3 to 1,000 m^3 typically ranges from **USD 400,000 - USD 5,000,000**, with an average cost of around **USD 1.2 million** for a typical system. More specifically, costs are estimated at **USD 800 - USD 1,200 per cow** for dairy farms, which can significantly impact total costs based on herd size[106].

Biogas from Municipal Food Waste

For companies looking to enter the biogas space, the cost of low-tech anaerobic digesters and biogas engines are as follows:

- **Small-Scale Biogas Plants**: The cost of installing a small-scale biogas plant can range from USD 30,000 to USD 250,000, depending on the design and capacity.
- **Biogas engines**: The 45 kW Cummins 6 BT engine is often a substantial part of the overall investment in a biogas business model. While specific costs for this engine vary, it is common for engine-generator systems to account for up to 50% of the total project cost. For example, if a biogas digester system is estimated at **USD 1.2 million**, the engine could cost about **USD 600,000** or more, depending on the specific configuration and requirements[107].

Tailings Reprocessing

The estimated minimum viable size for a tailings reprocessing plant is between 5,000 to 7,500 metric tonnes (Mt) of copper (Cu) per year[108], with capital investment between USD 25 million and US$75 million[56]. Factors such as; the technology adopted for reprocessing, geographic considerations such as location and infrastructure, energy costs, and regulatory requirements, particularly regarding environmental compliance. Additionally, market conditions for copper and other potential byproducts could affect the project's overall financial viability.

Sulphuric Acid Production

The cost of a sulphuric acid production plant using sulphur dioxide (SO_2) as feedstock would typically range from **USD 500** to **USD 2,000** per tonne of annual production capacity, depending on factors such as technology (e.g., double-contact, double-absorption process), location, and regional costs. As with other industrial plants, the overall investment will be influenced by technology choices, energy consumption, regulatory requirements, and market conditions for sulphuric acid.

Materials Recovery Facility

A manual MRF, will have an initial capital investment

---

103 https://agriinfra.dac.gov.in/Documents/ModelDPR/Bio%20Stimulant%20Plant/E5338A7CB77C420D85EB2817678957D9.PDF
104 Source for price estimates: https://www.agriculture-xprt.com/products/available-in-zambia/page-5/
105 UNIDO (2019). Waste Management Study - Chongwe, Zambia. https://stopopenburning.unitar.org/site/assets/files/1097/zambi_chongwe_municipality_final_report_baseline_study-_march2019.pdf
106 https://energypedia.info/images/8/88/Costs_of_Anaerobic_Digestion.pdf
107 https://rutherfordrenewables.co.uk/costs-of-anaerobic-digestion-and-the-functions-of-a-biogas-business/
108 Africa Rise, Zambia Copper Wire and Cable Market Assessment, 2024.

from **USD 25,000** to **USD 500,000**, while semi-automated or fully automated facilities can cost between **USD 500,000** and **USD 3 million** or more[109]. The main operational costs will include; labour, maintenance, utilities, and waste processing fees.

Space requirements for a typical MRF can range from 1,500 to 3,000 square metres, depending on the scale of operations. The specific technology adopted, such as clean vs. dirty MRF, will also significantly impact both capital and operational cost.

Local Organic Cotton Production and Spinning

Prices for small scale modern cotton yarn spinning machines start at around **USD 10,000** and can go up to **USD 100,000**, depending on capacity. A smaller textile business in Zambia would use around 5,000 to 10,000 metric tonnes of cotton in a year.

Mechanical Textile Recycling

A small-scale garnett machine capacity starts at **50 kg** and goes up to industrial scale machinery that can handle **600-700 kg** of material in one shift. Textile shredding machines start at a similar scale and can go up to industrial machines processing **3000 kg**.

[109] Asian Development Bank, Materials Recovery Facility Tool Kit, 2013, https://www.adb.org/sites/default/files/publication/30220/materials-recovery-facility-tool-kit.pdf

Embassy of Finland, Lusaka

https://finlandabroad.fi/web/zmb/mission

+260 211 251 234

Sanomat.LUS@gov.fi

Tandem Circular Consulting Limited

1277 Lubuto Road , Rodes Park

Lusaka, Zambia

admin@tandemcircular.com

+260 956 855 475

Registration no: 120180006022

Tax no: 1016755312