PLASTIC WASTE, REFUSE DERIVED FUELS (RDF) AND CEMENT KILNS REPORT IN UGANDA

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REPORT BY NETWORK ON SOUND MANAGEMENT OF CHEMICALS (NESMAC) - KITARA

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LIST OF ABBREVIATIONS

AF	Alternative Fuels
CER	Certified Emission Reductions
CDM	Clean Development Mechanism
COD	Chemical Oxygen Demand
CPA	Component Project Activities
EIA	Environmental Impact Assessment
FDI	Foreign Direct Investment
GEF	Global Environment Facility
GHS	Greenhouse Gas
HDP	High-density Polyethylene
HHV	Higher Heating Value
HFO	Heavy Fuel Oil.
IPEN	International Pollutants Elimination Network
KCCA	Kampala Capital City Authority
LFG	Landfill Gas

LDP	Low-density Polyethylene
LHV	Lower Heating Value
MBT	Mechanical Biological Treatment
MFA	Material Flow Analysis
MSW	Municipal Solid Waste
NAAS	National Agricultural Advisory Services
NEMA	National Environment Management Authority
NESMAC	Network of Sound Management of Chemicals
NGO	Non-governmental Organization
PT	Polyethylene terephthalate
PPP	Polypropylene
PVC	Polyvinyl Chloride
PA	Program of Activities
RDF	Refuse-derived Fuel
SSA	Sub-Saharan Africa
UGX	Uganda Shillings
COMTRADE	UN International Trade Statistics Database
UNFCCC	United Nations Framework Convention on Climate Change
UPMRA	Uganda Plastic Manufacturers and Recyclers Association

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1. PROJECT BACKGROUND

Overall, the widespread recycling of plastic has been a failure. Globally, only about 9% of all plastic produced is recycled with the rest incinerated, dumped in landfills or burned in open air (OECD, 2022). Many governments are now turning to burning plastics to claim they are either recycling plastic waste through energy recovery or diverting it from landfills. The main reasons recycling has failed is due to most plastics containing a range of toxic additives that make them difficult to recycle or not being designed to be recycled. The more difficult it is to recycle a plastic, the more it costs. The cost of recycled plastic is often a lot higher than virgin plastic, discouraging further recycling investment as the business model is rarely viable when competing against new plastic. Recent stricter regulation of plastic waste exports has exacerbated this situation and countries are seeking ways to continue to export their waste, generally from wealthy countries to less developed countries. Plastics contributed 3.4% of the global greenhouse emissions in 2019, 90% of it from "production and conversion from fossil fuels" (OECD, 2022).

One approach that has been taken by a number of countries, including Australia, is to manufacture, use and export Refuse Derived Fuel (RDF)[1] which is a mix of plastic waste (about 25-35%), timber waste, textiles, paper and other combustible materials. The materials are shredded and turned into either compressed bales or pellets, and are burned in cement kilns, incinerators and industrial boilers as 'alternative fuel' to fossil fuels (even though plastic is made from fossil fuels). Sometimes it is not baled or pelletized but simply shredded. This is called 'loose RDF', or in some countries, 'fluff'. It has been reported that cement kilns across the world now use up to 50% RDF as part of their fuel needs and have been claiming carbon credits and similar benefits from what they claim is 'low carbon 'fuel. Exporting plastic waste as RDF means it is categorized as 'fuel product' and not waste, thereby, not falling under the Basel Convention. This project is designed to help reveal the scale and extent of RDF use in Uganda, its origins and fate.

[1] IPEN (March 2022) - Australian refuse-derived fuel product or plastic waste export in disguise?

RDF is one name for a group of waste derived fuels that are similar and research should investigate similar fuels known by other names such as Process Engineered Fuels (PEF), Solid Recovered Fuels (SRF), and Waste Derived Fuel (WDR). Where the term RDF is used in this guidance, it refers to other similar waste fuel names.

In Australia, the government has announced it will end the export of waste (in particular plastics). While many congratulated that position, the Australian government has instead put its support behind the widespread domestic establishment of waste incinerators (waste to energy) and processing of RDF[2] and other plastic based fuels for burning. The RDF/SRF/PEF contains high quantities of plastic due to its high calorific value (as it is made from petrochemicals) that is used as fuel in cement kilns in Australia and in South East Asia. It is also used in some incinerators. The exact composition and toxicity of these *'alternative fuels*' are unknown.

Burning RDF in cement kilns leads to increased emissions of heavy metals and also potentially dioxins, PAHs and PFAS. During the first phase of the project, the NESMAC made an inventory of known cement kilns in Uganda and investigated how much RDF is used. The research revealed that incinerators and other industrial facilities (pulp mills, boilers) are also burning RDF. Most importantly, it showed how much RDF in total is imported into the country and identified the plastics imported in the country.

Current information suggests that most RDF is traded in South East Asia and Egypt, but it may be more widespread as some major cement companies have indicated it is used across their global cement kiln chain. Waste '*co-processing'* is

[2] *Refuse derived fuel (RDF), Process Engineered Fuel (PEF) and Solid Recovered Fuel (SRF) are variations of 'alternative fuels' made by compressing into bales or pelletising waste with a high calorific value to be burned in cement kilns or incinerators (and sometimes industrial boilers). Because they need to have a high calorific value, plastics are included in large amounts alongside paper, wood, textiles (which are often polymers) and other combustible wastes.*

another term used by industry and government for burning mixed waste, municipal waste and mixed plastic waste in cement kilns. NESMAC documented the type of burned waste. Documentation of facilities burning RDF will assist in targeted sampling (e.g. bio-monitoring or soil sampling) for pollutants that may be carried out at a later point in phase 2 of the project.

The entire life cycle of plastics from fossil fuel extraction through petrochemical manufacture, to use and disposal involves toxic emissions, releases and other forms of pollution. This project created a space to examine these issues with a focus on RDF and with reference to the development of Toxic Free Sustainable Development Goals.

2. ABSTRACT

NESMAC-Kitara has conducted research on plastic waste, Refuse Derived Fuels (RDF) and cement kilns in Uganda. The research intended to raise awareness of the imports of RDF and the facilities where they are burned, for example, cement kilns and any domestic RDF production in Uganda.

The research is based on data from COMTRADE, customs, waste industry news etc. to assess the scale of RDF imports and their country of origin accessing Government data on RDF use and HS codes they use to identify RDF imports, field visits to facilities burning RDFs.

NESMAC-Kitara carried out interviews of kiln operators/industry associations among others, documented both manufactured and/or imported RDF and mapped out RDF burning facilities/production sites in Uganda.

RDF is one of the derivatives of the municipal solid wastes (MSWs) that are used as an energy source, especially in the cement industry. In Uganda, in Sub-Saharan Africa, a World Bank-funded development project was implemented under the

Clean Development Mechanism (CDM) of the Kyoto Protocol for the purpose of improving waste management and reducing emissions from untreated household waste.

3. PLASTIC WASTE MANAGEMENT IN UGANDA

Plastic waste generation has progressively increased over the past 30 years (OECD, 2022). Due to the immense trade, there has been mass production and use of plastics. Globally 6.3 billion MT plastic wastes are produced each day (Lee, R. D. (2019)). The management of such a large amount of plastic waste is very difficult in highly populated and better economically developed countries. Due to a wide variety of use, plastic recycling can be challenging and material properties of plastic can limit the number of times plastic can be recycled. The recycling techniques of waste plastics presently used include land filling, incineration, chemical or mechanical recycling, and conversion to fuel. The conversion of plastic waste into fuel is claimed to resolve two important problems: one is avoiding the negative impacts of plastic pollution on the environment and the second is producing an alternative fuel for diesel engines, thus reducing the demand in fossil fuels. While this seems to reduce the plastic waste load from the environment, the process of making the alternative fuel, as well as the byproducts from the diesel engines that use the fuel are major pollutants of the environment with a wider spread than the original plastic waste.

Kavera is the most commonly used plastic shopping bag in Uganda, but in 2009, it was banned. In the revised National Environment Act of 2019, the government of Uganda, through NEMA, banned the import, manufacture and use of polythene bags with a gauge of 30 microns and below, popularly known as “kavera.” The issues cited as reasons for the ban included clogging water channels and impeding smooth water filtration and percolation into the soil. However, NEMA has since failed to enforce the ban due to strong lobbying by recyclers and manufacturers of kavera. The lobby group, Uganda Plastic Manufacturers and Recyclers Association

(UPMRA) consists of 45 members and claims to have the support of Uganda's Ministry of Trade as well as KCCA. UPMRA claims that there are currently 30+ kavera recycling plants in Uganda, which invested over $45 mil. in machinery and provide direct employment to 3,000 people and indirectly employ 10,000+ others. The machinery used to make kavera cannot easily be switched from manufacturing kavera to manufacturing other products. The recyclers buy the raw material from street pickers and landfill waste brokers, and as per UPMRA, produce a total of 2,500+ tons of recycled material per year.

Collection company employees or loaders are usually the first point of segregation. They extract plastics and other recyclable materials from each bag of waste and pack them in separate bags, which are then tied atop the collection truck. The process is very hurried and thus inefficient, because the activity of segregation is for their own private benefit and not for the collection company that employs them. Then, they sell the bags of recyclable waste to landfill brokers along the road to Kiteezi. Landfill brokers then clean and do a more thorough segregation of the waste and sell the final product (clean plastic material) to recyclers. Street pickers, who are either independent or contracted by large waste brokers walk around neighborhoods in search of discarded plastics, which they pack and sell to specialized brokers who usually have storage facilities where they aggregate waste provided by street pickers, and after they aggregate large volumes, then pay for a truck to transport the material to their client, usually to the plastic recycling plants.

Currently, it is estimated that at least 600 tons of plastics are used every day in Uganda and most of them are disposed of irresponsibly[3]. Uganda recognizes the threat and dangers posed by plastic litter and associated pollution. Plastic has become the most dominant waste in the country both on land and in water. Whereas Uganda is a land locked country, it has a large number of inland fresh water bodies, which are suffocated by plastic litter. This is in addition to the

[3] Ugandabiodiversityfund.org/why-uganda-should-ban-plastic-bags

pollution caused on land, in the drainage systems, in towns, dump sites and parks. The problem increases each passing day and it is not difficult to see how bad the situation is, especially on rainy days, when the flowing water dredges up waste, including plastic water bottles, polythene bags and other kinds of plastic containers.

The chemical structure of plastics makes them resistant to many natural processes of degradation and as a result, plastics soak up other toxic chemicals and pollutants present in the environment and water bodies. Eventually, when plastics break down, these chemical and other harmful substances are released into the environment along with additives such as colorants, which are highly toxic. This eventually gets into the water we drink, the food we grow, and the fish we eat.

Some of the plastic manufacturing companies in Uganda include Winworld Impex Limited, Luban Pack manufacturers, Nile Plastic Industries Limited, Luuka Plastics, Samco Plastics, Metro Plastics, Nabukka Industries Limited, Jaydeep industries Limited, Balteck Construction and Trading Company Limited.

In light of all that, Uganda reviewed its environment protection law (the National Environment Act No. 5/2019) and banned all plastic bags under 30 microns. In February 2023, NEMA issued a press release in which among other environment protection provisions, importing, exporting, manufacturing, using and reusing plastic bags or plastic products made of polymers of ethane (polyethene) and propylene that are below 30 microns will attract a fine of up to Ugx 100,000,000 effective April, 1, 2023. In addition, it also imposed producer extended responsibility as part of the Polluter Pays Principle, which will ensure that producers of all materials with potential to pollute will have the duty to follow the management of their product through its life cycle. The law has brought on board a cross section of other actors including the office of the Prime Minister, the National Bureau of Standards (UNBS), and the Uganda Revenue Authority (URA) in addition to the National Environment Management Authority (NEMA) to implement the provisions of the law on plastic pollution. Government has also imposed a mandatory condition to all plastic manufacturers to establish recycling plants and ensure that they trace their plastic materials and bring

them back for recycling. This is a precondition for licensing any new plastic manufacturing enterprises.

Although Uganda had previously banned single-use plastics, enforcement of the ban has not been effected. It is believed that the Government embarked on the enforcement of the ban in 2015 under the Finance Act 2009. The campaign included: A massive public campaign on education and increasing awareness on dangers and impacts associated with plastics and plastic carrier bags across the country through community meetings, print and electronic media; Consensus meetings with key stakeholders including manufacturers, traders, line ministries, agencies and civil society organizations; Mobilization and sensitization of local governments to implement the ban; Awareness increasing meetings with supermarkets and department stores within Kampala to stop distributing and selling plastic carrier bags; and carried out enforcement targeting distributers and retail outlets in Central, Eastern and Western regions where 180,000 kg of plastic carrier bags was seized and destroyed.

The efforts, however, drew both support and opposition from the public. While the broader public supported the ban, a strong business lobby comprising of manufacturers and traders continued to oppose the ban, engaging both legal and political methods. The opposition resulted in a temporary court injunction which prevented government from further enforcement and as such reduced the momentum of anti-plastic pollution drive.

There are also over 30 companies registered as plastic recycling companies. Most of these are engaged in the recycling of PET, polyethylene (both HDPE and LDPE) and polypropylene (PP). Some of these manufacture PET flakes mostly for export to China and India and to a lesser extent recycle HDPE to feed local manufacturing of plastic products such as jerry cans, basins, and bottle caps. However, it is believed that China closed the doors to waste plastic imports, after which Uganda's main market became India. Similarly, business with India is also in limbo after the Indian Ministry of Environment, Forests and Climate Change passed a notice on October 3, 2019 prohibiting the import of all types of plastic scrap. The implication of the ban is therefore that prices for plastic waste will drastically decrease. Hence, many people in

the informal plastic waste collection sector will run out of business and therefore the accumulation of waste plastic in landfills and water bodies in Uganda will exponentially increase.

On the 27 February 2020, the State Minister for Environment, Beatrice Atim Anywar, ordered that Section 2 of the 2009 Finance Act that prohibits the import, local manufacture, sale or use of plastic bags or bags of polymers of ethene and polyethene be effected and the ban taking immediate effect. She directed implementing agencies like the National Environment Management Authority (NEMA) among others to take responsibility. The directives targeted plastic bags, cups, straws, coffee stirrers, soda and water bottles, and most food packaging materials that pose a threat to the environment. However, these plastic materials continue to be seen on the market to date.

After their use, products made from plastic can be disposed, recycled or incinerated. Until 1980, almost all of plastic waste was discarded as recycling and incineration were negligible. Incineration as a method for plastic waste management started growing since 1980 and in 1990, recycling started to be appreciated as well.

In 2015, approximately 6300 million tonnes of cumulative plastic waste was generated globally and about 9% was recycled, 12% was incinerated, and 79% was accumulated in landfills or in the natural environment. From these three routes of plastic waste disposal, incineration was the only permanent route of eliminating waste and this thermal treatment means combustion. Most synthetic plastics that are disposed in nature have a very slow degradation process spanning hundreds to thousands of years. When plastics are thrown away by consumers, some are blown off by wind and spread over a larger area and some are washed away by rains to find their way into water bodies.

3.1 Landfilling

Landfills are low technology sites for open dumping of wastes. Landfills give rise to air and water pollution, which severely affects the environment and can prove fatal to the lives of humans and animals. Residents living close to dumpsites are therefore exposed to environmental and disease risks. The disposal sites are, in most cases, located in environmentally sensitive, low-laying areas such as wetlands, forest or water bodies adjacent, which can lead to environmental problems. (Troschinetz and Mihelcic, 2009). There is only one landfill in Uganda. However, quite a number of compost plants exist in different districts of Uganda. KCCA disposes garbage using the land filling method at Kiteezi. Garbage disposal at Kiteezi landfill is contracted out to private companies by KCCA. The companies are paid on a monthly basis depending on the tonnage of garbage delivered and disposed. All the garbage is collected and transported to the landfill and weighed at the entrance. Each vehicle is weighed on arrival and both the gross and net tonnage recorded using a computer system that generates waste management reports. The weighed garbage is then spread, compacted and covered with soil to prevent environmental degradation in the form of pollution and the spread of disease. After the garbage is covered with soil, on decomposition, the leachate is directed downstream where a plant was constructed to treat the leachate before it is allowed into the surrounding vegetation.

Figure 1: Kitezi Landfill

3.2 Waste Incineration in Uganda

Open burning of waste is common in Uganda especially around dumpsites**.** In Uganda, there is a limited number of waste incinerators; there are 3 registered incinerators. The rest of the incinerators located in healthcare institutions do not meet standards of incinerators, they are simply burning chambers, they burn mixed waste, and the chimneys simply emit waste to the environment. The registered incinerators also burn hazardous wastes, which is also mixed with plastics.

4. PLASTIC AND RDF USE IN UGANDA

At present, Uganda imports approximately 8,768,103 tons of plastic which includes new plastic packaging materials and containers and raw materials for production of different plastic products (URA, 2019). These imports represent a large increase in comparison to the 1.9 Mt of plastic in different forms between 1994 and 2017 and a small percentage of the 86.14Mt imported in Africa (Babayemmi et al., 2019). In 2020, according to the United Nations COMTRADE database on international trade, Uganda imports of Plastics and articles was worth US$384.84 million. Ugandan industrial sector consumes up to 600 metric tons of plastic waste a day and only about 6% of that waste is collected from the environment (Planet Buyback, 2021). This means that the 94% is either left to litter the environment or kept for re-use.

There are several initiatives to produce fuel from plastics and other refuse in Uganda. According to the data from the United Nations COMTRADE database on international trade, Uganda imported plastics and articles worth US$384.84 million during 2020. Most of these plastics included: polyethers, epoxides and polyesters, primary forms, polymers of vinyl chloride or of other halogenated olefins and other articles of plastics such as plates, sheets, film foil, strips of

plastics (non-cellular), floor coverings, wall or ceiling coverings, tubes, pipes, hoses, fittings.

A study carried out by Lee, R. D. (2019) titled Evaluating Uganda's Waste Management System for the Production of Refuse-derived Fuel (RDF) and its Potential Implementation in the Country's Growing Cement Industry indicates that Uganda was funded by the World Bank to implement a project under the Clean Development Mechanism (CDM) of the Kyoto Protocol for the purpose of improving waste management and reducing emissions from untreated household waste. The project set up twelve active composting facilities in twelve municipalities in Uganda. They are two different forms of refuse-derived fuel—one primarily composed of paper and one primarily composed of plastics.

Also, a report compiled by the Standard News Paper (*Wambi Michael,* Tuesday, 30 November 2010) showed Fred Kyagulanyi and James Sendikwanawa, who come from a town about 17 km outside the Ugandan capital - are two men who turned refuse such as plastic bottles, polythene bags and organic waste into "non-fossil fuel". They have been using all types of waste from plants, plastic bottles, shoe soles and all types of organic waste to produce 100 litres of fuel per day.

According to Cement News (23 April 2012), Hima Cement started growing coffee in the Rwenzori region from which it can get husks to heat its kilns. The factory resorted to bio-fuels to heat the kilns after realising it is 10 times cheaper than imported fuel and electricity, which is often unreliable.

The increased use of RDF globally is of great concern. Particularly, IPEN is concerned that RDF and similar products are simply a way to burn plastic waste as fuel. Most RDFs contain between 33% (EU) and 66% (Indonesia) plastic waste. By classifying RDF as a 'fuel product' parties can avoid the Basel Convention restrictions that apply to plastic waste as the Convention addresses only wastes not products.

Plastic waste can contain persistent organic pollutants (POPs), heavy metals, phthalates and other endocrine disrupting chemicals (EDCs) and can generate

unintentional POPs (UPOPs) such as chlorinated and brominated dioxins when burned. This can lead to localised air pollution and food chain contamination in the areas where these materials are burned.

5. UGANDAN GOVERNMENT TRACK ON RDF IMPORTS AND HS CODES USED

According to the Uganda Revenue Authority (URA), Uganda does not have data on either locally produced or imported RDFs. However, there are plastic wastes used as fuel, especially in cement kilns and some industries.

There are some people who are trying to produce RDF for home and commercial consumption but at a limited scale and as a way to reduce the impact of plastic in the environment but it is not yet common and it's not widely adopted There is also one industry that is producing fuel from tires. Plastic waste and other polythene materials are used in cement kilns and also in incinerators to accelerate burning of wastes.

To reduce pollution of plastics, the government is trying to protect the environment by making plastic products very expressive by taxing it with 15% excise duty, 6% withholding tax, 18% VAT as well as an environment level of 1.5% for all plastic imports. Also, in trying to save the environment, the government doesn't tax any raw materials derived from recycled plastic because it is used plastic which litters the environment. Despite all these taxes however, imports of plastic are still rising in both quantities and monetary value.

RDF is not cost effective compared to the local organic products that Uganda has in abundance. Hence, the manufacturers prefer organic waste like coffee husks. The East African Custom Law does not prohibit the import of RDF, only the

taxation and transport costs, and 15% excise tax prohibit or stop the import of RDF in the country.

One of the recycling centers visited, ACACIA FOUNDATION, is making plastic products from recycled product waste such as basins, buckets, bottles etc. They can crush about three metric tons of plastic in a day.

Another facility, ECO PLASTIC LTD, produces up to 100% recycled products from plastic waste like buckets, chairs etc. The process involves crushing waste collected, washing, drying, separation according to colours, then pellets are produced and from pellets they produce plastic products like chairs, containers, etc.

The government of Uganda has tasked all plastic producers to have recycling plans. There is a challenge with supplying plastic waste due to the competitive market for the waste. As of September 2022, there were many recycling centers around the city. The price of plastic made from recycled pellets is cheaper than imported pellets, but there are some product colours such as transparent colours, white, and red that cannot be manufactured from recycled pellets.

6. REFUSE DERIVED FUELS IMPORTED TO UGANDA

Table 1: Refuse Derived Fuels Imported by Country of Origin and Year from Uganda Revenue Authority Data

Country	Net weight (kg)			Value in Shillings (UGX)		
	2020	2021	2022	2020	2021	2022
Tanzania	683,000	136,867	522,500	703,706,651	134,707,295	1,057,151,663
Kenya	2,558,677	1,494,060	483,130	1,630,039,693	1,939,107,094	407,711
Rwanda	675,4000	478,060	135,840	422,775,443	22,441,337	212,834862
United States	85,721	21,729	46,732	201,835,472	19,482,371	67,813,191
China	673,461	94,115	27,279	1,344,298121	176,921,893	59,850,043
South Sudan	2500	11,205	49,000	27,374,100	47703756	48
Burundi	363,108	109,750	7,000	35,645,629	28,928,497	9,245,394
United Arab Emirates	39,545	26,696	7,894	984,981,254	60,960,227	2,861,084
Saudi Arabia		13,600	10,045		3,880,881	2,867,084
India	8,725	300	500	85,644,535	856,321	1,43,129
Taiwan Province of China	100		300	295,808		86,957
Democratic Republic of Congo			100			8,2102
Switzerland		1440			427,257	
Poland	2			154,642		
Canada		12,347				
Russian Federation	1,573			7,972,026		
South Africa	531			3,976,491		
Mexico	180,076			38,127,896		
Oman	24920			62,144,851		

Table 2: **HS Codes of Refuse derived fuel imported and the year from Uganda Revenue Authority Data**

		Net weight			Value in shillings (UGX)		
HS code		**2020**	**2021**	**2022**	**2020**	**2021**	**2022**
3915.10.00.000	Waste parings and scrap of polymers of ethylene	20,119	165,777	2109	5,767,836	175,671,033	4,176,899
3915.20.00.000	Waste parings and scrap of polymers of ethylene	3,904	12,275		12,741,954	31,687,937	
3915.30.00.000	Waste parings and scrap of polymers of chloride	531	96,371	32,000	34,970,481	30,867,192	10,171,200
3915.90.00.000	Waste parings and scrap of other plastics	5,306,154	3,298,206	12,551,211	498,354,395	3,430,867,192	185,462,154
		5,330,708	3,572,629	12,289,320	50,337,024,221	2,882,308,689	1,869,761,253

7. GOVERNMENT POLICY ON RDF USE

Although the laws and policies in Uganda do not expressly mention RDF, there are laws that regulate the use and disposal of RDF and plastics, and they include the following:

7.1 The National Environment Act

Section 70 of the National Environment Act provides for the prohibition or restriction on import, export, manufacture, formulation, distribution and use of hazardous chemicals. Part (3) states that a person shall not import, export, manufacture, formulate, distribute or use hazardous chemicals or products containing hazardous chemicals prohibited under subsection (1) and (2), (4). A prohibition or restriction shall apply to any hazardous chemical on its own, in a mixture or in a chemical product, including those chemicals that do not require registration.

Furthermore, Section 76 of the National Environment Act provides for the management of plastics and plastic products (1). The import, export, local manufacture, use or re-use of categories of plastic carrier bags or plastic products made of polymers of ethane (polythene) and propylene (polypropylene) is prohibited, except for plastic carrier bags or plastic products made of polymers of ethane (polythene) and propylene (polypropylene) of above 30 (thirty) microns and those listed under Schedule 9.

7.2 National Environment (Waste Management) Regulations

Section 92 of the National Environment (Waste Management) Regulations, 2020 guides the export and import of waste, where Part (1) provides that a person who intends to export waste from Uganda or to import waste into Uganda shall apply in writing to the Authority for a license. In 2022, for the total licenses issued, 1,290,320 kg of waste were imported valued at UGX 1,413,200,139. (2) An application under sub-regulation (1) shall be accompanied with a movement

document in Form I set out in Schedule 12 to these Regulations and the fees prescribed in Schedule 6 to these Regulations.
The regulations also provide that the importer is licensed to manage the type of waste to be imported and has the facilities and capacity to safely manage the waste.

Also, Section 95 the National Environment (Waste Management) Regulations, 2020 contains provisions on control of emissions, discharges and contamination of the environment. (1) A person who generates hazardous waste and a waste handler shall take measures to ensure that the waste management methods do not cause adverse effects to human health or the environment through emissions, discharges or other contamination.

Section 39 of the National Environment (Waste Management) Regulations, 2020 provides the criteria for managing waste from plastics and plastic products (1). In accordance with section 76(2) and (3) of the Act, a person who imports or manufactures plastics or plastic products shall: (a) maintain a record of raw materials and their chemical constituents used to manufacture plastics and plastic products, including plastic carrier bags; (b) document the quantity of plastics and plastic products; (c) batch and label the plastics and plastic products with use, recycling and disposal instructions; (d) ensure that the plastics and plastic products are stored and recycled by persons with appropriate facilities, making use of cyclical resources.

7.3 The Waste Management Policy

The Waste Management Policy and Guidelines provides for sector-specific norms, standards, and procedures; compliance and enforcement (compulsory recycling); environmental liability by self-responsiveness; green public procurement; taxes and levies (differentiated VAT); fees and user charges.

8. CEMENT KILNS IN UGANDA THAT BURN OR PLAN TO BURN RDF

Uganda has four main cement producers that make up almost all of the cement production of the country: Tororo Cement Limited, Hima Cement Limited, Kampala Cement Company Limited, and Simba Cement Uganda Limited. Hima Cement is a subsidiary of France's Lafarge and Simba Cement Uganda is a subsidiary of Kenya's National Cement Company Limited (Lafarge, 2019). There are many limestone deposits throughout the country (see Figure 2 below), but the two largest are in Hima and Tororo, hence the location and naming of two of the cement producers and their corresponding mining activities (Uganda Investment Authority, 2016).

In 2018, it was estimated that the total production capacity of Uganda's cement producers was around 6.8 million tons of cement (Global Cement, 2018), with Tororo, Hima, Kampala, and Simba having 44%, 28%, 15%, and 13% of the market respectively (Khisa, 2018). Although domestic demand does not meet the current supply capacity of the producers, demand and sales in neighboring countries such as Rwanda, Eastern Democratic Republic of Congo, Western Kenya, and South Sudan have relieved worries of excess supply (Global Cement, 2018). The global cement sector contributes about 7% of the global anthropogenic carbon dioxide (CO_2) emissions, and about 60% of the greenhouse gas (GHG) emissions are attributed to 'process emission' that happens during clinker manufacturing[4]. The cement sector in Uganda is the leading taxpayer in the extractives sector.

Four Ugandan cement producers are included in the scope of this project. They are the largest in operation and include: Tororo Cement Ltd, Hima Cement Ltd, Kampala Cement Company Ltd, and Simba Cement Uganda Ltd (also sometimes referred to as the "National Cement Company Uganda (Khisa, 2018). Hima Cement uses biofuels such as coffee husks, as well as plastics and fossil fuels, Tororo Cement uses fossil fuel only.

[4] IEA (2021), Cement, IEA, Paris, France. https://www.iea.org/reports/cement

8.1 Hima Cement

Hima Cement Limited is a cement manufacturer from Uganda. It is a subsidiary of the Holcim Group, a building materials manufacturer headquartered in Switzerland, with subsidiaries in over 80 countries. At Hima Cement, 51% of thermal energy is generated from biomass (groundnut husks, coffee husks, rice husks, baggase, sawdust), and the company uses over 80,000 tons of biomass annually.

Hima Cement uses (10%) used oil, carbon black, dolochar, which are wastes from other industries, including steel industry and tire pyrolysis. Others fuels used are traditional, including HFO, Petcoke and coal.

Hima Cement as a company is making a great effort to reduce its carbon footprint by reducing the use of RDF through using as much renewable energy as possible. Currently, over 51% of Hima's energy is generated from biomass, which has a significant impact on CO_2 emissions. Hima substitutes clinker in their final cement products to reduce the carbon footprint of the cement. Over 70% of Hima sales are from green cements, their fundi cement, which was launched in 2021, produces 54% less CO2 than ordinary portland cement.

Figure 2: A truck full of husks to be used to burn in the cement kilns

Measures in place by Hima to protect the environment

Hima Cement claims it is managing pollution to the environment by complying with environmental laws, regulations and standards applicable to their products and operations. They also claim to have developed and therefore use effective controls to monitor, minimize or prevent the release of pollutants to the environment (air, water, and soil) in their operations. On air emissions, Hima installed a Technical Information System (TIS) and a Continuous Emissions Monitoring System (CEMS) to enable them to monitor in real time air emissions including NOx, SOx and dust in their main kiln stacks. Hima Cement is also ISO 14001:2015 certified. While it has rehabilitation plans for all its quarries and expects the same of all their suppliers, the operationalization of such plans is not fully guaranteed.

Carbon dioxide emissions from cement production account for around 9.5% of the world's total CO_2 emissions (Olivier, et al., 2014). As would be expected, this is due to two specific aspects of cement production:

1) the sheer volumes of cement that are being produced annually worldwide; and
2) the actual process whereby cement is produced.

In 2016, 807 million tons of cement were produced globally to meet the ever-increasing demands for construction and infrastructure projects of countries around the world, most notably, China and India (WBCSD, 2016). Within the actual production process, there are two primary places where CO_2 is emitted as a byproduct: 1) the chemical conversion of calcium carbonate ($CaCO_3$) to lime (CaO) (responsible for roughly 60-70% of the emissions); and 2) the fuel burned to heat the raw materials to the temperature necessary to catalyze the chemical reaction (30 - 40% of emissions) (Olivier, et al., 2014).

First, limestone and clay are quarried from natural reserves, which are generally abundant in most regions of the world. Then, the raw materials are grinded to a

suitable consistency and level of homogenization and heated to 1,500 degrees Centigrade (Lafarge, 2019).

There heating process consists of two phases: first, in a secondary firing system to preheat the raw materials, and then, in a primary firing system to bring the limestone mixture up to the optimal temperature and keep it there long enough (residence time) for the chemical conversion to take place (Rotter, 2011). This primary heating process takes place in a long rotating kiln with a single flame at the lower end. Once this calcination has occurred, where calcium carbonate in the limestone mixture is converted to lime, it is then known as clinker. The clinker is then mixed with a number of additional additives (e.g. gypsum) to fine-tune the setting and resultant physical properties of the cement, and ground into a fine powder to form the finished product - cement (Lafarge, 2019).

Depending on the production process and availability of other suitable raw materials, a variable percentage of clinker in the cement can be substituted to reduce the CO2 emissions per ton of produced cement (Worrell, et al., 2001). This is common place in many European countries, but to what extent Ugandan cement producers carry out this practice was not determined (based on the resources available to the author of this study), leading to the necessary assumption that Ugandan cement contains more than 90% clinker, an often times unnecessarily high percentage for the most common applications of cement.

Figure 3: Coffee husks used in the cement kilns

8.2 Tororo Cement Limited

Tororo Cement Limited (TCL) is the largest manufacturer of cement in Uganda, producing an estimated 3.0 million metric tonnes annually[5]. In July 2015, TCL successfully completed and commissioned an 86 billion UGX expansion to increase annual production to 3.0 million metric tonnes[6]. The newly completed production line became operational in 2018. Tororo Cement is an ISO Certified Company for the quality management system (9001:2015) and environment protection system (14001:2015). Tororo Cement Limited uses fossil fuel in the cement kilns.

[5] *David Mugabe (10 September 2014). "CMA to discuss funding options at oil and minerals meet". New Vision. Kampala, Uganda. Retrieved 1 August 2015.*

[6] IEA (2021), Cement, IEA, Paris, France. https://www.iea.org/reports/cement

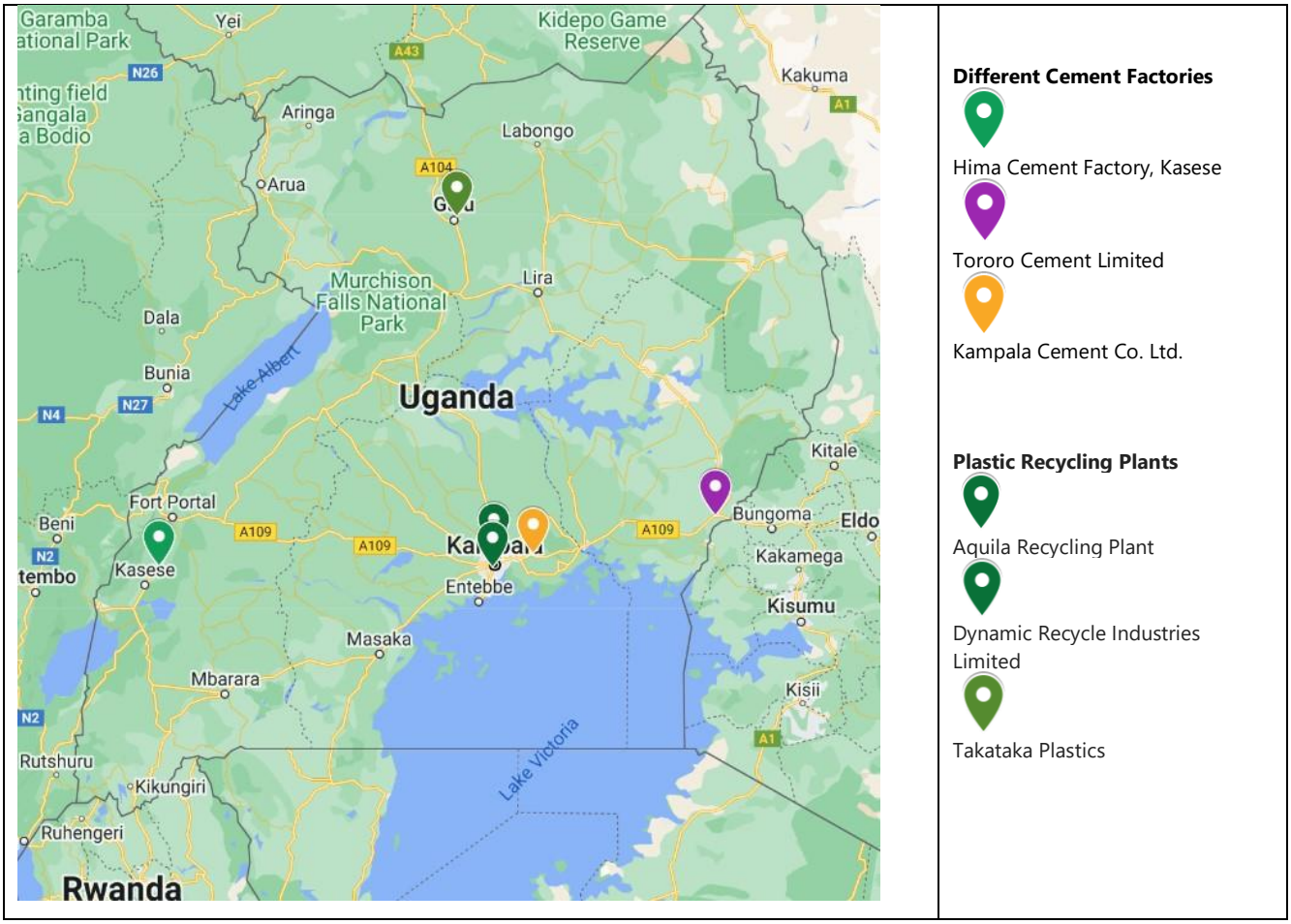

Figure 4: Map showing cement factories and plastic recycling plants in Uganda

9. OUTREACH TO STAKEHOLDERS

During the study, NECMAC-Kitara engaged the following stakeholders:

URA: During its research, NESMAC conducted meetings with Uganda Revenue Authority (URA) and it provided data on the quantity of plastics imported in the country.

NEMA: NESMAC also conducted meetings with the National Environment Authority (NEMA). The role of NEMA is to coordinate and supervise all matters on environment in Uganda. NEMA enforces the act, regulations, standards and guidelines on

environment. NEMA provided information on management of plastics and plastic products. NEMA provided a list of companies registered to carry out incineration in Uganda.

Private Sector: NESMAC also engaged with the private sector and the Uganda Manufacturers Association and especially, association members that are mostly involved in the business of making plastic products, including recycling and production of cement.

Civil Society: NESMAC consulted civil society organizations, especially CSOs involved in waste and chemical management in Uganda. The CSOs were consulted through stakeholder consultation meetings. Their capacity on RDF was strengthened.

UCPC: NESMAC also visited the Uganda Cleaner Production Centre (UCPC), which is a project operated under UNIDO. Uganda Cleaner Production Centre gave its view on the operation of industry and especially industries using plastics.

Uganda Bureau of Standards (UNBS): NESMAC visited the Uganda National Bureau of Standards, which is a statutory body under the Ministry of Trade, Industry and Co-operatives established by the UNBS Act Chapter 327. It provided a list of industry plastics recycling entities.

Academia and Media: The academia and the media were consulted during meetings and they made their inputs to the report.

10. COMMUNICATION AND DISSEMINATION OF PROJECT OUTPUTS

The project produced high resolution photos (attached to the report) and flyers, photos, posters.

Overall outcome

- The report has brought up the status of plastic waste, refuse derived fuels and cement kilns in Uganda. The study has shown that plastic and fossil fuels are still used in cement kilns.
- The study has also shown that the disposal of plastics, including through burning, is still rampant.
- NESMAC produced a policy paper, conducted a stakeholders meeting to validate the research report. The stakeholders meeting was attended by representatives of the National Environment Management Authority, Ministry of Finance, Ministry of Gender and Labour and Social Development, Uganda Industrial Research Institute, industries, Uganda Investment Authority, importers, policy makers, Uganda Revenue Authority, trade associations, recycling plants, UNIDO, UNDP and CSOs.
- A policy paper was produced and shared with policy makers, the media, CSOs and the general public.
- The information from the research is also shared through social media platforms.

11. CONCLUSIONS AND RECOMMENDATIONS

The project allowed NESMAC to examine issues related to RDFs and the development of Toxic Free Sustainable Development Goals in Uganda. The burning of plastics is still rampant in open spaces and in incinerators, especially in hospital establishments. The use of plastics and fossil fuels in cement kilns is also widespread in Uganda. As

already noted, the use of plastic refuse derived fuel possess a dangerous risk to the health of the population and the environment and therefore, there is a need to:

(i) Minimize and ultimately stop open burning of plastics to reduce pollution;

(ii) Minimize and ultimately stop use of plastics and fossil fuels in cement kilns;

(iii) Prohibit the burning of plastic including burning of RDF in cement kilns and other industrial facilities.