ReSoCart-ED

Recycling Solution for Non-Reusable Printer Cartridges in Emerging and Developing Countries

67EXI5040

RAPID ASSESSMENT REPORT

GHANA

November 2022

Supported by:

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

based on a decision of the German Bundestag

Purpose / Goal / Approach

Developing and emerging countries, like Ghana, are currently fast-growing markets for office printing products. This fact reflects in the very high consumption of toner cartridges for laser printers and copiers. Despite the fact, Ghana is a way weaker economy than for example Germany, it has not only a good third of the population but as well a good third of the consumption in printer cartridges as well, as will be shown in this report.

OEM cartridges can usually be refilled up to three times, even though this is usually not desired by the manufacturers at present. After this reuse, they reach the end of their service life. So-called "newbuild", "compatible", or "generic" toner cartridges from third-party manufacturers usually reach the end of their service life after a single use due to their simpler product design after the first usage cycle in developed markets. As seen in examples in Ghana even these are being – preferably used for refilling – for at least a second round before they do reach the end of life.

But even at the end-of-life stage of their life-cycle, these cartridges still contain valuable raw materials, but also various pollutants. Conventional disposal methods, if available in the affected community, such as incineration or landfilling therefore merely ensure that these material fractions are treated in an environmentally sound manner at best, if not sent for regular domestic waste or uncontrolled dumping. Both "regular" methods cause avoidable energy and resource consumption and, if not handled properly, significant pollution of soil, air, and water. From a sustainable point of view, it is therefore necessary to handle non-reusable toner cartridges appropriately to recycle valuable resources at the end of their life. However, recycling the plastics and metals contained in the cartridges is made difficult by the remaining toner dust in the cartridges. This can contaminate reusable materials, lead to health hazards when inhaled, and cause dust explosions during processing.

For these reasons, appropriate recycling techniques require expert knowledge which is hardly available or not yet established in developing and emerging countries such as Ghana. On the other hand, available recycling techniques can be transferred and exported, to make them compatible with the existing conditions. Hence, this could solve the problem by contributing a valuable solution by improving the environmental situation in the target countries.

This project will study the feasibility of an economically viable solution for the disposal of toner cartridges in the target country Ghana as a model for the West African region. The main objective is to gain initial insights into feasibility that could lead to further steps, such as pilot plants in the target countries.

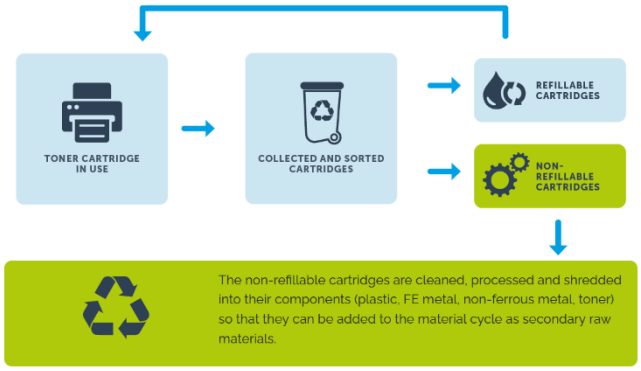

Figure 1: Optimal Material Flow for Empty Toner Cartridges

Market Data

Ghana, officially the Republic of Ghana, is a country in West Africa. It is located on the Atlantic Ocean and is laying along the Gulf of Guinea to the south, sharing borders with Ivory Coast in the west, Burkina Faso in the north, and Togo in the east[i]. Ghana covers an area of 238.535 km^2, spread over two major biomes, the tropical high forest in the south-west and the savannahs in the north, south, and southeast.[ii] [iii] The climate of Ghana is tropical, with a warm and humid wet season and a very hot dry season.[iv] Ghana sits at the intersection of three hydro-climatic zones. The southeast is warm and comparatively dry, the southwest is hot and humid and the north is dry with hot temperatures. The annual rainfall decreases continuously from the southwest to the northeast which leads to arid vegetation in the north.[v]

With over 30.8 million people, Ghana is the second-most populated country in West Africa.[vi] The population growth rate of 2.2 % lies under the regional mean in the sub-Saharan countries.[vii] [viii] In the south, on the 540 km long Atlantic coast, lies the capital of Accra with about 5 million inhabitants (greater Accra region), which is the biggest city in Ghana.[ix] Other major cities are Kumasi, Tamale, and Sekondi-Takoradi.[x] Ghana has a very young demographic structure with 37 % of the population between 0-14 years and 60 % between 15-64 % years. Only 3 % of the population are older than 65 years.[xi] Life expectancy has increased during the last few years and is above the average in west Africa.[xii] The urban population is also increasing continuously during the past years and is at a rate of 56.7 % in 2021.[xiii] Population density decreases from south to north since the metropolitan cities are in the south.[xiv] Ghana is a multi-ethnic country with a diverse population, with many different linguistic and religious groups. The largest ethnic group named Akan has a population share of 47.5 %, followed by Mole-Dagbon (16.6 %) and Ewe (13. 9 %). Other ethnical groups are Ga-Dangme, Gurma, Guan, Grusi, Mande, and others. The ethnical groups are mostly located in different regions of the country. Religion is very important in Ghana, most Ghanaians are Christian (71.3 %). 17.6 % of popularity are Muslims and around 5 % are followers of indigenous religions.[xv] The official teaching language is English (60 %) due to the colonial domination of the United Kingdom up to 1957.[xvi] Besides English, many other languages and dialects are spoken. Most important is Asante (16 %), spoken by Akan people, Ewe (14 %), Fante (11.6 %), and Boron (4.9 %). English is more widely used in the south and rural areas than in the rural areas in the north of Ghana.[xvii] [xviii]

There is a compulsory education system for all Ghanaian children aged between 4 and 14.[xix] In 2018 literacy rate is at a level of 92.5% in the group of 15-24 years old.[xx]

Economic development in Ghana has been generally positive in recent years. The preliminary and estimated GDP figures for 2021 are 442.9 billion GHc, 2022 532.0 billion GHc, and for 2023 616.9 billion GHc. However, the effects of the COVID-19 pandemic and the war in Ukraine make it difficult to reliably estimate the economic situation. For instance, the inflation rate in 2022 increased from 10 % in 2021 to 16.3 % in 2022 due to these crises. It is expected to decrease somewhat in 2023 and to be around 13 %.[xxi]

The economic structure of the country shows many typical characteristics of a developing market economy. In 2020, agriculture/forestry/fisheries accounted for 20.5 % of the gross value added, mining and industry for 25.3 %, trade/restaurants/hotels for 18.0 %, transport/logistics/communications for 10.8 %, Construction 6.3 %, and miscellaneous for 19.1 %. The country's economic performance is therefore predominantly dependent on mining, industry, and Construction. The entire tertiary sector, however, now seems to have comparable economic importance with a total of 28.8 %.

In addition, parts of the tertiary sector seem to be growing in 2020 despite the pandemic. Transport/logistics/communication increased by 10.6 % compared to the previous year. While agriculture/forestry/mining and industry fell by 5.2 %. Trade/restaurants/hotels also declined by 10.1 %, which is likely to be a direct result of the COVID-19 pandemic.[xxii]

The overall high and presumably growing importance of the service sector plays a role in the project insofar as it probably generates a large part of the demand for printing and copying services, from which the majority of the consumption of toner cartridges is derived.

Legal Framework

Among others, Ghana has acceded to the following international environmental agreements (year of ratification in brackets):[xxiii]

- African Convention on the Conservation of Nature and Natural Resources (1968)
- The United Nations Framework Convention on Climate Change (1995)
- The United Nations Convention to Combat Desertification (1996)
- The Kyoto Protocol to the United Nations Framework Convention on Climate Change, in short, the Kyoto Protocol
- Climate Change, Kyoto Protocol for short (2003)
- Stockholm Convention on Persistent Organic Pollutants (2003)
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (2005)
- Paris Convention (2016)
- Minamata Convention (2017)

The Ghana Environment Protection Agency, established in 1994, is responsible for policies concerning the environment in Ghana. It is attached to the Ministry for Environment, Science, Technology, and Innovation (MESTI), which was established in 1993. Internationally, Ghana is particularly known for its environmental problems in the area of waste management of electronic waste (e-waste). In 2016, the Ghanaian Government passed the Hazardous and Electronic Waste Control and Disposal Act. Hazardous and Electronic Waste Control and Management Act, No. 917 as well as the legal instrument LI 2250 to reduce the negative environmental impact of improper processing of e-waste and other hazardous wastes from improper processing. Particularly noteworthy here are the high

levels of pollutants for air, soil, and humans caused by the incineration of waste (e.g. tires, electrical waste, electronic equipment, etc.). There are also environmental problems connected to the mining of raw materials, especially in the gold mines. Environmental laws and guidelines that are supposed to limit the environmental impact of the mines have not yet been implemented adequately. In recent times, environmental awareness has increased due to the damage caused by mining. The adoption of new laws and directives in the last years to curb the environmental problems caused by the lack of wastewater and waste management, as well as the establishment by the Ministry of Sanitation and Water Resources.

Market Situation for Toner Cartridges

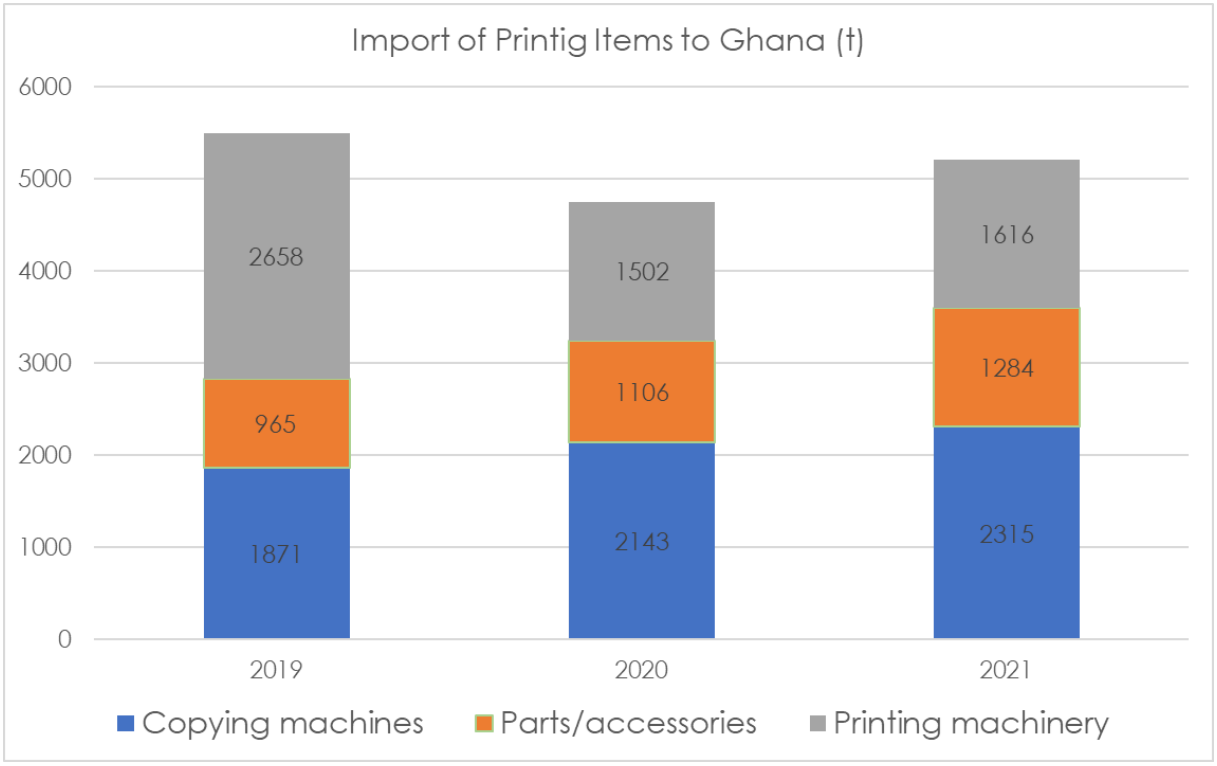

Figure 2: Import of Printing Items to Ghana.
Source: Data provided by GIZ Ghana , Visualisation: Umweltcluster Bayern

Based on findings, observations, reports, and inquiries made before, during, and after the trip to Ghana, the following initial insights could be gained:

- The amount of toner cartridges-related items imported annually lies at approximately 5.000 – 6.000 tonnes - with an upward trend for copying machines and parts (Cf. Figure 2). This data, which is based on the import data of the Ghanaian customs and was provided by GIZ Ghana, will be used in a further step to estimate the number of imported toner cartridges. In comparison, the calculated volumes for the German market are in the range of 16.000 – 17.000 tonnes.

- Take-back systems or organized buy-back programs for empty and used cartridges do not seem to exist in Ghana. The OEMs (Original Equipment Manufacturers) are also not active nor visible with corresponding manufacturer solutions or take-back programs. The existence of a professional printer cartridge collection industry with the aim of reusing – mainly via exporting to other countries with industrialized refilling capacities has not been identified and neglected by all consulted local stakeholders.
- Due to the unclear structures, there is no mapping of the toner market yet, available for the Ghana market
- For refilling toner cartridges, on the other hand, there is an active refilling in Ghana that mainly refills used cartridges from all manufacturers by hand in small, local shops. Industrial-scale refilling does not seem to exist at present. The preferred raw material for refilling is a so-called "newbuild", "compatible", or "generic" toner cartridges from third-party manufacturers. This has been explained by the good availability of empty cores for this quality of cartridges which enables an easy standardized refilling procedure.
- The market share of OEM seems to be small in comparison to "newbuild", "compatible", or "generic" toner cartridges from third-party manufacturers. Both types/qualities of cartridges are being imported. No import of refilled/reused cartridges has been identified.
- According to our findings, used cartridges that can no longer be refilled are either collected but not further processed, end up in official or unofficial landfills, or are not properly dismantled for lack of better knowledge to recycle the metals they contain, which leads to environmental and health hazards. Official approaches for dealing with cartridges, such as those currently being developed for selected electrical appliances in Ghana, are completely lacking for toner cartridges. The explosion of dust is classified as a major problem, as well by the spokesmen of the so-called informal sector who "would welcome a clear strategy and solution approach" since "they do not know how to handle the dust well" when mostly manually crashing the cartridges in their open-air facilities.
- Furthermore, awareness of the market value of an empty cartridge in a global marketplace – if the right quality is provided - but also the problems of the materials contained in the cartridges is only weakly developed. This is where the ReSoCart-ED project steps in. No significant aggregation of volume is happening at this time, anyways cartridges have been found and identified with multiple stakeholders from formal/informal users, formal/informal collectors, and formal as well as informal treatment operators.
- Official institutions such as the MESTI (Ministry of Environment, Science, Technology & Innovation) as well as the Ghana EPA are welcoming and supporting the project strongly and, based on the results of face-to-face meetings in Accra and online after the trip, do support the idea of Ghana becoming a regional hub in Western Africa to offer solutions for neighboring countries that are facing similar issues as well.

- The Ghana E-Waste Fund is operating a co-project with the GIZ E-Waste program funded by KFW in Ghana to actively buy back problematic materials such as batteries, encased wires, brominated plastics, and CRT Monitors. The aim is to take these problematic and hazardous fractions of the market to foster an environmental and health-sound treatment a controlled procedure. First talks with the main driving decision-makers on the ground in Ghana do prospect a possible inclusion of cartridges to this program in the future as especially toner cartridges are being seen as a similar threat to health and the environment if recycled uncontrolled. The outcomes and results of ReSoCart-ED will be vital for further decision-making in this circumstance.
- Local formal recycling or collection providers, such as Caritas Ghana who is strongly involved in the collection of e-waste as well, for example, the private company City Waste Recycling, Accra, has not only expressed their strong interest in providing infrastructure for the implementation of solutions but as well already started to put a stronger focus on the aggregation of cartridges – countrywide via 16 collection points which are connected with the official MESTI / EPA e-waste collection program, to prepare for further steps.
- To gain detailed insights into the market structures in Ghana, subcontracts will be tendered this year, with the help of which a detailed market analysis will be carried out to achieve the next milestones in several areas such as legal and operational.
- A possible spin of the project or addition to ReSoCart-ED is being discussed to run an incentivized take-back trial with the informal sector in Ghana to identify possible take-back volumes. This could be aligned with the E-waste Fund / GIZ / KFW-buyback project for problematic fractions.

Figure 3: Impressions of Waste Treatment and Recycling in Ghana.
Photos: Umweltcluster Bayern

Evaluation / Further Procedure

Ghana is one of the most politically and economically stable countries in West Africa. For this reason, many international and German development cooperation organizations are well represented in Ghana, such as the GIZ. The fundamental problem in waste from electrical and electronic equipment (WEEE) has been well recognized and has resulted in many well-established projects and a strong focus in this area. ReSOCart-ED can benefit greatly from these existing and established structures and good contacts have already been established with GIZ in particular.

The awareness of the issue with toner cartridges was also notable throughout all sector talks with different stakeholders. In particular, the authorities such as the Ministry for the Environment (MESTI) show a high level of interest in possible solutions and offer further support. Contacts with the informal sector have also not revealed any rejectionist attitude – vice versa – first individual activities have been launched after the visit by certain stakeholders. ReSoCart is raising a high awareness, fostering already existing activities in the market, and is as well seen and identified as a good business opportunity by local actors. Despite the awareness of the problem, there is still a lack and a need for useful data, figures, and organized structures in Ghana to systematically tackle the problem. This problem has been recognized by the government (MESTI, EPA), which has led to harmonious and solution-oriented cooperation between local organizations, KFW, GIZ, and other organizations. All organizations involved are very supportive of the ReSoCart-ED project. To keep all stakeholders up-to-date, a newsletter on an irregular basis with information about the progress of the project will be sent out. In addition, the website (www.resocart-ed.de) will be launched in December 2022, which will foster communication and continue to raise awareness.

To get a better overview of the market structures in Ghana and to be able to better collect missing data, subcontracts will be tendered this year (in 2022), the implementation of which is to be started on-site at the beginning of 2023. Specifically, the following data needs to be gained and collected: Legal framework in Ghana, cartridge volume, market situation, etc. With the help of this data, specific and detailed market analysis will be compiled.

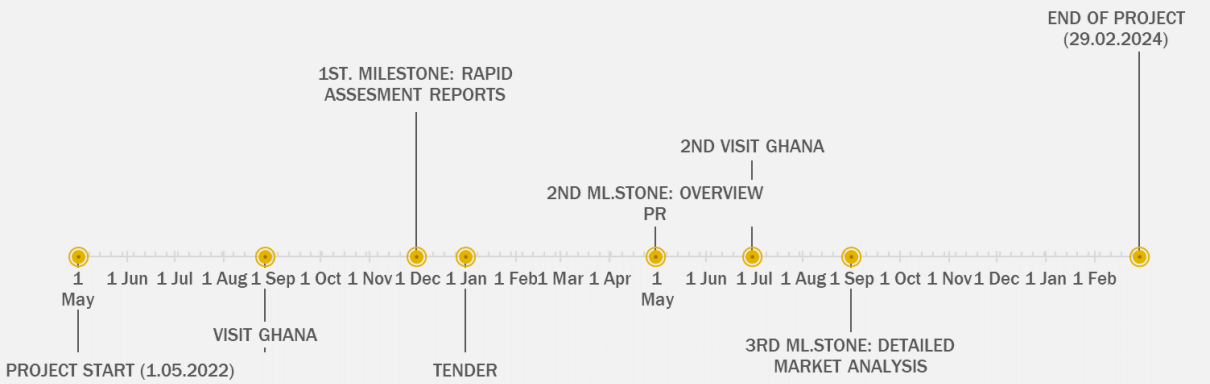

Figure 4: Project Timeline Ghana

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