

**Carbon Footprint Assessment Report of Toner Cartridges by
Print-Rite Unicorn Image Products Co., Ltd. of Zhuhai**
(English Translated Version)

Name of Assessment Agency:

Institute of Remanufacturing Industry Technology, Jing-Jin-Ji¹

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¹ The institute is an independent legal entity located in the national remanufacturing industry demonstration base of the Hejian economic development zone. It is a high-level research team built on the professional team of the Remanufacturing Engineering Department of the original Armored Force Engineering Institute. Leveraging the intelligence, technology, and military resource advantages of the two national platforms, it will provide technical and intellectual services for the healthy development of the Beijing-Tianjin-Hebei region and China's remanufacturing industry.

This report is originally written in Chinese. In case of discrepancy between the text of this translated version and that of the Chinese version, the Chinese text shall prevail.

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1 Overview

With climate change already an important part of the global sustainable development agenda for industry and commerce, countries have been actively taking action. At the United Nations Climate Change Conference in Copenhagen, countries committed that they would “take action to meet this objective consistent with science and based on equity”. China has also put in place active measures to push forward energy conservation and emission reduction, formulated relevant policies, and undertaken to aim to have CO₂ emissions peak before 2030 and achieve carbon neutrality before 2060.

Carbon footprint, in the global arena, remains a relatively unknown concept. It is not yet common for domestic companies to report their carbon emissions, and the companies being assessed for their carbon footprint are all leaders in environmental protection and social responsibility. After putting forward the “dual carbon goals”, China launched the “1+N” policy framework for carbon peak and carbon neutrality in 2021. Realizing the dual carbon goals has become a new driving force for national socioeconomic transformation, under which all sectors will see significant changes. In this connection, the Carbon Neutral Initiative for Enterprises appeals: To carry out a carbon footprint verification to have a full picture of carbon emission conditions. We should carry out total factor verification of all aspects throughout the production and operation of enterprises, so as to go deep into the carbon footprint of every process, product and position. China will embrace a constantly strengthened and improved ability to reduce greenhouse gas emissions with the increasing number of companies beginning to undergo carbon footprint assessments, which is the first step towards conscious corporate action against global warming.

The term “**product carbon footprint**” generally refers to the greenhouse gas (GHG) emissions of a product throughout its life cycle, i.e., the GHG emissions at all stages from raw materials to production (or provision of services), distribution, use and disposal/recycling. Its scope includes carbon dioxide (CO₂), methane (CH₄), nitrogen oxide (N₂O), etc. Product carbon footprint is a means for surveying, analyzing and commenting on the greenhouse gas emissions associated with the product from the life cycle perspective, including stages of raw materials, transportation, production, use, and disposal. Besides meeting the needs of customers, we implement in-depth product carbon footprint management based on the results of the survey and study-specific measures to reduce carbon footprint, such as more low-carbon raw materials, lightweight packages, and reasonable transportation planning to achieve the purpose of energy saving and emission reduction in factories.

Commissioned by Print-Rite Unicorn Image Products Co., Ltd. of Zhuhai, this report involves a carbon footprint analysis of the compatible toner cartridge for W1110 versus the OEM and other aftermarket products of the same model, with the aim of comparing the carbon emissions of each product, providing basic data for the life cycle

assessment of imaging supplies industry and the products therein, and serving as a reference for the macro decision-making of enterprises.

2 Objective and Scope Definition

2.1 Introduction to the Company and Its Products

In 1988, Print-Rite set up China's first imaging supplies factory in Zhuhai, China, which laid the foundation for the development of the imaging supplies industry in China. On December 25, 1995, Print-Rite Unicorn Image Products Co., Ltd. of Zhuhai was registered and established in Zhuhai Administration for Industry and Commerce. It is one of the world's largest manufacturers of imaging supplies, the vice-chairman unit of China Computer Industry Association (CCIA) and the first chairman unit of CCIA Consumables Professional Committee. As a specialized, comprehensive and highly integrated consumables production base, the company is a leading manufacturer of remanufactured/compatible consumables in Asia, with its business scope encompassing the production and sales of in-house printing equipment and accessories, imaging products (including remanufactured laser toner cartridges and inkjet cartridges) and accessories. It supplies more than 1,000 categories of products, which are exported to over 100 countries and regions worldwide. Print-Rite has now vertically integrated the whole industrial chain of raw materials, parts and finished products, with its production base centered in Zhuhai and extending globally. It has established more than ten factories in Shanghai, Hangzhou, etc. with an area of 330,000 square meters, forming a highly integrated large consumables production base integrating R&D and production of 3D printing, ribbon, inkjet, laser consumables and parts. Specializing in more than 10,000 models in 9 categories in the field of imaging supplies, its own brands "Print-Rite", etc. are internationally well known, with products sold to more than 150 countries and regions worldwide.



Fig. 2.1 Print-Rite R&D Centre and Production Base

Following three decades of development, Print-Rite has advanced from wholesale trade to self-built brands, and from simple processing to independent innovation. Its products have been diversified from ribbon products to ink cartridges, toner cartridges, chips and accessories, and to innovative products with high added value and broad

market prospects, such as inkjet printing solutions which are applied in textile, electronics, ceramics and other fields, as well as professional systematic print service solutions and customized solutions, and 3D printers, filaments and parts. Print-Rite has achieved the vertical integration of the whole industrial chain from raw materials to parts and finished products, and transformed and upgraded from a production enterprise to an innovative and service-oriented enterprise. The past 30 years have witnessed Print-Rite's consistent efforts to explore the sustainable development of the industry in a healthy and orderly manner, leading and promoting the development of the industry in terms of management, innovation and environmental protection. With its faithful belief in quality and unremitting insistence, Print-Rite has succeeded in shattering the long-term industry monopoly of multinational enterprises by realizing the industrial breakthrough and upgrading in manufacturing, thereby spurring the development of Zhuhai into the world's largest production base for imaging supplies and parts, and driving the rapid development of China's printing consumables industry cluster and office information industry chain.

2.2 Purpose of the Research

This research aims to analyze the carbon footprint of compatible toner cartridges (Fig. 2.2) produced by Print-Rite Unicorn Image Products Co., Ltd. of Zhuhai for the HP W1110A series, along with a comparative analysis of the carbon footprint of two toner cartridge products of the same model of an aftermarket brand and OEM brand in the market. The findings contribute to the enterprises' grasp of the greenhouse gas emission pathways and emissions of their products, enabling them to tap the potential for emission reduction, effectively communicate with consumers, advance the brand, and significantly reduce greenhouse gas emissions. The findings can also serve as a good database for the cooperation and communication between raw material purchasers and product suppliers.



Fig. 2.2 Print-Rite Compatible Toner Cartridge for W1110A²

² The model number of W1110A is suitable for China printer model. For overseas markets, the consumable models are W1105A, W1106A, W1107A and W1112A, and the applicable printer models are HP Laser 108a/108w, HP Laser MFP 136a/136w/136nw/138p/138pn/138pnw /138fnw.

2.3 Description of Carbon Footprint Scope

The carbon footprint is calculated using the life cycle assessment method. **Life Cycle Assessment (LCA)** is a process of assessing the environmental impacts associated with a product, process, or activity through its life cycle encompassing extraction and processing of the raw materials, the product’s manufacturing, transportation, sale, use, maintenance, recycling and final disposal.

Where data are available at all stages of the life cycle, a full life cycle assessment method is employed for calculating the carbon footprint. Where the data of raw materials or waste disposal are difficult to obtain, the carbon footprint is calculated by one of the following three forms: “carbon emissions of raw materials + carbon emissions from production”, “carbon emissions from production”, “carbon emissions from production + carbon emissions from waste disposal”.

Based on research and confirmation with the manufacturer, the carbon footprint inventory is accounted for with “carbon emissions of raw materials + carbon emissions from production” as the boundary, while other emissions are not considered due to the difficulty of quantifying the process data. The accounting system boundary is shown in Table 2.1. GHG emissions from human-related activities are not accounted for in this report.

Table 2.1 Production Processes in System Boundary

Process included	Process not included
<ul style="list-style-type: none"> ◇ Production of raw materials for parts of various types of toner cartridges ◇ Production of various types of toner cartridges 	<ul style="list-style-type: none"> ◇ Raw material transportation ◇ Maintenance of production equipment ◇ Product sales and use ◇ Product recycling, disposal and discard

To facilitate quantification, the product functional unit defined in this report is to produce a number of Product A (Aftermarket), Product B (OEM), and Print-Rite Compatible Toner Cartridges for W1110A (9K and 1.8K version) to meet the demand of the user’s printing equipment with a nominal life of 30,000 standard pages. As a result, the production demand for the four products to meet the demand of printing 30,000 standard pages as defined is shown in the table below.

Table 2.2 Production Demand by Functional Unit

Product	Page Yield	Production Demand (Unit)
Print-Rite Compatible Toner Cartridge for W1110A 9K	9000	4
Print-Rite Compatible Toner Cartridge for W1110A 1.8K	1800	17
Product A (Aftermarket)	2000	15
Product B (OEM)	1500	20

3 Data Collection

The verification team set up a carbon footprint inspection working group as required by PAS2050:2011 to inspect the carbon footprint of toner cartridge products of Print-Rite Unicorn Image Products Co., Ltd. of Zhuhai. The working group began the carbon footprint inspection with preparatory work, followed by a determination of the work plan and scope. The inspection was completed through document review and telephone communication. The preparatory work mainly includes: understanding the basic information of the product, production process, etc., and researching and collecting part of the original data to ensure the integrity and accuracy of the data.

3.1 Primary Activity Level Data

Primary activity level data is applied to all processes and materials owned, operated, or controlled by the organization that produces the carbon footprint, as required by PAS205:2011. The primary activity level data herein include resource consumption of raw materials and energy consumption of production processes, which are obtained from enterprises and can truly reflect the input of materials and output of products throughout the production.

(1) Acquisition of Raw Materials

The raw material type and weight data of Print-Rite Compatible Toner Cartridges for W1110, Product A (Aftermarket) and B (OEM) of the same model in the market are collected through the material breakdown for the unit product (as shown in Table 3.1).

Table 3.1 Material Breakdown by Product (Unit: g)

Product Name Material	Print-Rite Compatible Toner Cartridge for W1110A 9K	Print-Rite Compatible Toner Cartridge for W1110A 1.8K	Product A	Product B
Steel	260.6	300.7	318.7	283
Aluminum (organic photoconductor drum, magnetic roller)	31.1	34	34.1	32.5
Plastic (ABS, shell, etc.)	343.6	221.1	254.6	261.1
Plastic (POM, gear)	8.9	8.9	10.3	13.4
Rubber (rubber roller)	40	42.5	48.5	53.8
Toner	200	55	75	70

(2) Processing and Production

The production energy consumption per unit product in the processing and production stage is obtained based on the enterprise statistics, while those of products A (Aftermarket brand) and B (OEM) of the same model in the market are presented by analogy and hypothesis, as shown in Table 3.2.

Table 3.2 Production Energy Consumption by Product (Unit: kW·h/PC)

Product Name Material	Print-Rite Compatible Toner Cartridge for W1110A 9K	Print-Rite Compatible Toner Cartridge for W1110A 1.8K	Product A	Product B
Magnetic roller	0.02	0.02	0.02	0.02
Doctor blade	0.04	0.04	0.04	0.04
Toner hopper	0.04	0.04	0.04	0.04
Toner	0.8	0.22	0.3	0.28
Organic photoconductor drum	0.2	0.2	0.2	0.2
Primary charge roller	0.2	0.2	0.2	0.2
Wiper blade	0.05	0.05	0.05	0.05
Waste bin	0.04	0.04	0.04	0.04
Production energy consumption per unit product	1.39	0.81	0.89	0.87

3.2 Secondary Activity Level Data

Where primary activity level data are not available or the quality thereof is questionable, it is necessary to use secondary data from sources other than direct measurements, as required by PAS2050:2011. The secondary activity level data herein are mainly derived from those in the standard materials, which are authentic and reliable, highly scientific and reasonable.

4 Product Carbon Footprint Calculation

The formula of product carbon footprint indicates the sum of all materials, energy and wastes generated in all activities in the whole product life cycle multiplied by their respective emission factors. The formula is as follows:

$$CF_{i=1, j=1} = P_i \times Q_{ij} \times GWP_j$$

Where,

CF = carbon footprint

P = activity data

Q = emission factor

GWP = global warming potential

The emission factors are based on the Technical Specification for Eco-design Product Assessment - Office Equipment (GB/T 40774-2021).

Based on the activity data and relevant emission factors, the carbon footprint by functional unit can be obtained using the formula, as shown in Table 4.1.

Table 4.1 Carbon Footprint by Functional Unit (Unit: gCO₂eq)

	Print-Rite Compatible Toner Cartridge for W1110A 9K	Print-Rite Compatible Toner Cartridge for W1110A 1.8K	Product A	Product B
Carbon emissions of raw materials				
Steel	648.89	748.74	793.56	704.67
Aluminum (organic photoconductor drum, magnetic roller)	386.57	422.62	423.86	403.98
Plastic (ABS, shell, etc.)	1109.83	714.15	822.36	843.35
Plastic (POM, gear)	33.2	33.2	38.42	49.98
Rubber (rubber roller)	255.6	271.58	309.92	343.78
Toner	646	177.65	242.25	226.1
Carbon footprint per unit product	3080.09	2367.94	2630.37	2571.86
Carbon emissions from production				
Carbon footprint per functional unit	945.2	550.8	605.2	591.6
Carbon footprint by functional unit	16101.16	49618.58	48533.55	63269.2

5 Conclusions and Recommendations

The carbon footprint metrics of the above products show that in meeting the user's demand of printing 30,000 standard pages, (1) the carbon footprint of using the Print-Rite Compatible Toner Cartridge for W1110A 9K is 16.1kgCO₂eq, achieving a carbon emission reduction of 33.5kgCO₂eq; (2) the carbon footprint of products A and B of the same model in the market is 48.5kgCO₂eq and 63.3kgCO₂eq, respectively, 3-4 times of that of the Print-Rite Compatible Toner Cartridge for W1110A 9K. It is evident that the Print-Rite Compatible Toner Cartridge for W1110A 9K emits significantly less carbon than the pre-improved one and products A and B of the same model in the market, which has good environmental benefits.

In response to the basic situation of emissions during the production of raw materials and products, we hereby recommend enterprises to:

1. Further monitor and collect energy consumption during production, so as to continuously improve resource utilization and reduce carbon emission level in the production stage;
2. Effectively manage the green supply chain based on the full assessment of production efficiency and low carbon development, collect and make statistics on the data of raw materials and waste disposal, and select suppliers with small carbon footprints of raw materials.

6 Conclusion

To peak carbon dioxide emissions and achieve carbon neutrality is a major strategic decision taken by China in light of both domestic and international imperatives. The decision bears on the sustainable development of the Chinese nation and the building of a community with a shared future for mankind. It sets a grand vision for China's participation in tackling global climate change and boosting green and low-carbon development. Low-carbon development is the natural choice for the future survival and development of enterprises. For them, the first step to manage greenhouse gases and develop low carbon development strategies is to account for the carbon footprint of their products. Accounting for the carbon footprint of the product life cycle enables enterprises to identify emission sources and grasp the emissions of the production process, based on which enterprises can improve their industrial layout to reduce material and energy consumption, thereby paving the way for the formulation of reasonable emission reduction targets and development strategies. Meanwhile, certification and application of carbon footprint is a way to explore to establish the product life cycle carbon footprint tracking system, with a view to responding to the general trend of accelerating green and low-carbon transformation in international trade and guiding market players to better adapt to changes in international carbon rules. By leveraging the advantages of clean energy to develop green and low-carbon products, enterprises can empower their products to compete in the global market and expand the international market. As revealed by the findings of the carbon footprint analysis of Print-Rite's improved products, enterprises' stepped-up technological innovation plays an important role in reducing product carbon emissions.