LIFE CYCLE ASSESSMENT (LCA) 2023

AND CARBON FOOTPRINT ASSESSMENT REPORT: CIRCULAR ECONOMY PERSPECTIVE

HYPERTECHNOLOGIE CIARA INC.

Trade/Brand:	Ciara | Ciara Tech | Hypertechnologie Ciara Inc.
Document:	HypertecGroup_Doc_LCAReport_2023
Version:	01
Report Date:	06.01.2025
OpenLCA:	Version 2.2.0 – ecoinvent_38
Target Market:	North America

TABLE OF CONTENTS

PART I: LIFE CYCLE ASSESSMENT

1. GENERAL ASPECTS

This study is divided into three main parts, as outlined in Part I – Life Cycle Assessment, Part II – Corporate Greenhouse Gas Emissions, and Part III – Corporate Greenhouse Gas Emissions from Product Transport. The study was conducted in accordance with the requirements of ISO 14040, ISO 14044, and the GHG Protocol. Additionally, Hypertec Ciara referenced ISO 14025, ISO 14065, and ISO 14067 to support related reports and work towards best practices and compliance.

Hypertechnologie Ciara Inc. has allocated internal resources to conduct the LCA of twelve devices (micro-PC, desktops small-form, desktops mini-tower, and high-performance workstations) that were commercialized in 2023. The report has been validated by a qualified third party. More details regarding the personnel involved can be found in Section 8 and eventual annexes.

The decision to embrace a circular economy approach and language has been key to promoting cultural change at Hypertec Ciara. This strategy focuses on using resources more efficiently, reducing waste, and extending product lifecycles, demonstrating our strong commitment to environmental responsibility. Current contracts with recycling partners ensure proper end-of-life management for our devices, while our supply chain follows strict sustainability guidelines to minimize environmental impact.

Additionally, the upcoming state-of-the-art building, announced in 2024, is designed to prioritize innovation and sustainability, further reinforcing our dedication to eco-friendly practices. These initiatives position Hypertec Ciara as a leader in creating a greener, more responsible technology sector.

2. GOAL OF THE STUDY

Hypertechnologie Ciara Inc. is committed to enhancing its environmental performance and positively contributing to the planet. By focusing on reducing resource consumption and minimizing ecological impact, the company is actively shaping a more sustainable future. A key component of this initiative is the pursuit of EPEAT certification for its general-purpose devices, underscoring its dedication to meeting global environmental standards.

In alignment with ISO 14040 and 14044 requirements, the goal of this LCA study is to meet customer requirements related to EPEAT 4.8. The intended audience includes stakeholders, customers, and anyone seeking transparency regarding our environmental impact.

The results of this study serve multiple purposes: supporting internal decision-making, providing transparency to governments, agencies, and stakeholders, and informing the development of additional sustainability reports and carbon footprint-related content. These standards enable us to support our stakeholders as we strive to reduce emissions, design eco-friendly products, and empower consumers to make more sustainable choices.

2.1 Context and Objectives

This report adheres to EPEAT criteria (IEEE 1680.1:2018, Section 4.8) and ISO 14040, ISO 14044 guidelines, ensuring that Hypertechnologie Ciara Inc provides transparent and reliable information on the environmental impact and carbon footprint of its products. Our teams conduct a comprehensive Life Cycle Assessment (LCA) to highlight the environmental benefits of its devices and maintain our EPEAT certifications. This reinforces Hypertechnologie Ciara Inc's dedication to eco-friendly innovation and sustainability, meeting customer expectations and the global market's demand for responsible technology.

2.2 Intended application

The LCA of these twelve devices is a critical step for Hypertechnologie Ciara Inc to fulfill EPEAT standard requirements, offering transparent environmental impact data. These findings will also address inquiries from customers and third parties. The LCA report includes six key environmental impact indicators, such as the global warming potential (carbon footprint), and one inventory indicator. The six selected impact indicators are globally recognized, well-established in the market, and supported by consistent, reliable data. They ensure comprehensive environmental analysis, credible reporting, and alignment with industry standards.

2.3 Target Audience

This report is intended for stakeholders involved in the EPEAT certification process. The findings will also be shared with clients and business partners to underscore Hypertechnologie Ciara Inc commitment to sustainability.

2.4 Disclaimer of Uncertainty

Although the results are based on the ecoinvent 3.8 database and openLCA software, alongside several expert assumptions, variations may arise from the use of different LCA tools, datasets, or assumptions, potentially impacting the carbon footprint and other indicators.

2.5 Comparability

This LCA study is not intended for direct comparison with other studies, as differences in system boundaries, functional units, data sources, and assumptions can significantly influence the results. While this study adheres to established LCA standards, any comparisons should account for these factors to ensure an accurate interpretation.

3. SCOPE OF THE STUDY

The scope of this study outlines the boundaries, processes, and key parameters considered in this Life Cycle Assessment, ensuring a comprehensive evaluation of the environmental impacts associated with the production, use, and disposal of Hypertechnologie Ciara Inc devices, consisting in the products manufactured and sold in the year 2023. The device types cover the micro-PCs, desktop small-Form, desktop mini-Tower, high-performance workstations, presented in detail per device model and quantity in section 3.3, table 01.

3.1 Function

The devices in this study support a wide range of IT functionalities for administrative and office use, for private corporations and government institutions. While they serve various purposes, examples of their functions include word processing, data research, database management, and spreadsheet calculations as well any other applicable high-performance software and systems if applicable.

Micro-PCs: Compact and energy-efficient, micro-PCs are ideal for office environments requiring space-saving solutions for everyday computing tasks such as document management, web browsing, and email communication.
Desktop Small-Form: Balancing performance and size, small-form desktops are tailored for users needing reliable devices for multitasking, data analysis, and moderate computing workloads.
Desktop Mini-Tower: Mini-tower desktops provide scalable computing power, making them suitable for intensive applications like graphic design, video editing, and light gaming in professional or creative settings.
High-Performance Workstations: Designed for demanding workloads, high-performance workstations excel in tasks like 3D rendering, simulation modeling, and advanced computational research.

3.2 Functional Unit

The functional unit for this LCA is: "use of a Hypertechnologie Ciara Inc. device in an office setting over five years." This reflects the typical lifespan of a computer device and aligns with industry standards and this LCA's range of the scope (see Table 01).

The period of 5 years considered in this study reflects the market practices and Hypertec's policies for extended warranty, as stated at https://hypertec.com/ciara/mini-pcs/.

3.3 Sales for 2023

This LCA covers the following devices sold by Hypertechnologie Ciara Inc:

Table 01: Hypertechnologie Ciara Inc's Devices Sold In 2023 for LCA Analysis

Range of the Scope | Device Type	Device Model	Sales for 2023
2 | micro-PC	Astro PB62 Astro PN64	64 132
3 | desktop small-Form	Horizon D11750 Horizon D12170 Horizon D12750	125 919 696
5 | desktop mini-Tower	Horizon T11170 Horizon T11750 Horizon T12170 Horizon T12560 Horizon T12750	50 237 747 10 3,562
2 | high-performance workstations	Kronos 540 – G2 Kronos 545	15 6

3.4 Technical Information

This chapter presents the technical specifications and relevant details for the Hypertechnologie Ciara Inc devices included in this Life Cycle Assessment, providing a comprehensive understanding of their functionalities and performance characteristics.

Table 02 : Technical Information for Hypertechnologie Ciara Inc's Devices

Device Type	Device Model	Max RAM	Weight	Lifespan
micro-PC	Astro PB62	64 GB	1.47kg	5 years
	Astro PN64	64 GB	1.16kg	
desktop small-Form	Horizon D11750	64 GB	5.77kg	5 years
	Horizon D12170	64 GB	5.77kg	
	Horizon D12750	64 GB	5.77kg	
desktop mini-Tower	Horizon T11170	64 GB	6.48kg	5 years
	Horizon T11750	64 GB	6.48kg	
	Horizon T12170	64 GB	6.48kg	
	Horizon T12560	64 GB	6.48kg	
	Horizon T12750	64 GB	6.48kg	
high-performance workstations	Kronos 540 – G2	128 GB	12.25kg	5 years
	Kronos 545	2 TB	12.25kg	

3.5 Product Composition

Herein, we provide an overview of the material composition of Hypertechnologie Ciara Inc devices, detailing the components and resources utilized in their manufacture to assess their environmental impact throughout the life cycle.

Table 03: Product Composition of Hypertechnologie Ciara Inc's Devices Component Mass (Kg)							
Device Model	Chassis	Memory	Power Supply	Mounted Mainboard	SSD Drive	Cable	Total
Astro PB62	0.78	0.02	0.44	0.20	0.01	0.03	1.47
Astro PN64	0.47	0.02	0.44	0.20	0.01	0.03	1.16
Horizon D11750	3.20	0.03	1.93	0.51	0.01	0.09	5.77
Horizon D12170	3.20	0.03	1.93	0.51	0.01	0.09	5.77
Horizon D12750	3.20	0.03	1.93	0.51	0.01	0.09	5.77
Horizon T11170	3.60	0.04	2.22	0.51	0.01	0.11	6.48
Horizon T11750	3.60	0.04	2.22	0.51	0.01	0.11	6.48
Horizon T12170	3.60	0.04	2.22	0.51	0.01	0.11	6.48
Horizon T12560	3.60	0.04	2.22	0.51	0.01	0.11	6.48
Horizon T12750	3.60	0.04	2.22	0.51	0.01	0.11	6.48
Kronos 540 – G2	7.13	0.08	3.60	1.27	0.01	0.16	12.25
Kronos 545	7.13	0.08	3.60	1.27	0.01	0.16	12.25

3.6 Packaging Composition

The following chapter presents the packaging composition of Hypertechnologie Ciara Inc devices, detailing the mass of each component to provide insights into the materials used and their implications for sustainability and waste management.

Table 04: Packaging Composition of Hypertechnologie Ciara Inc's Devices Component Mass (Kg)					
Device Type	**Cardboard**	**Wood Pallet**	**BEPF[1]**	**WEPF[2]**	**Total**
micro-PC	1.33	0.20	0.10	0.15	1.78
desktop small-Form	1.43	0.21	0.11	0.16	1.91
desktop mini-Tower	1.62	0.21	0.12	0.18	2.13
high-performance workstations	1.73	0.60	0.13	0.20	2.66

3.7 System Boundaries

In this section of the report, we outline the system boundaries defined for this Life Cycle Assessment, detailing the life cycle stages included in the study as well as those deemed not applicable.

For this Life Cycle Assessment, the system boundaries were set to cover the life cycle stages from raw material (A1) through Disposal (C2) (see Table 05).

Our Life Cycle Assessment (LCA) provides a comprehensive 'cradle-to-grave' analysis of our products' environmental footprint throughout their life cycle, covering pre-manufacturing (A1 and A2), manufacturing and packaging (A3), shipping (A4), product use (B), and end-of-life management (A5, C1 and C2). By examining these stages, we identify opportunities to reduce our carbon footprint, make better strategic decisions and enhance our sustainable practices.

It is relevant to highlight:

- The C3 and C4 (End-of-life treatment) and D (Recycling) stages were intentionally not applied due to the nature of the stages, as the final disposal lays exclusively on our customer we lack data for the analysis.
- For Energy use, stage B, we did not consider the extended life of our devices, as well as maintenance and services, as it represents less than 2%.

Furthermore, Hypertechnologie Ciara Inc. is committed to defining a sustainable strategy for its supply chain, supported by existing agreements with recycling centers. This commitment ensures that the LCA report accurately reflects our ongoing efforts to align with industry standards and practices.

[1] Black Expanded Polyethylene Foam
[2] White Expanded Polyethylene Foam

3.7.1 Life Cycle Stages

Our LCA evaluates the life cycle stages of Hypertechnologie Ciara Inc.'s devices, covering raw material extraction (A1), transportation (A2), manufacturing (A3), and distribution (A4). Components are sourced from East Asia (China, Taiwan, Vietnam, and Malaysia) and transported via ocean freight, rail, truck to our assembly facility in St-Laurent, QC.

During assembly, we emphasize resource efficiency, utilizing electricity, natural gas, and minimal freshwater exclusively for building operations and human consumption. Finished devices are shipped across Canada and the USA exclusively via truck and designed for a five-year usage period (as explained in section 3.2).

While no maintenance or operational impacts are anticipated during the energy use (Stage B), we exclude it from the system boundaries as it is covered in the warranty and the maintenance may vary from a fix in software to a full replacement of a barebone, due to the lack of consistent data it was not considered, as well as it represents less than 2% of the devices.

At Hypertec, the end-of-life phase (C) is limited to stages C1 (deinstallation or dismantling at the point of use) and C2 (transport to a treatment facility). During stage C1, we ensure the segregation of waste based on its nature while guaranteeing the secure destruction of components that may contain data. In stage C2, the waste is transported to qualified recyclers with whom we have contractual agreements, as we do not have the necessary infrastructure to process it internally. To adopt a conservative approach, we have included these two stages in our analysis by considering the worst-case scenario, as well as all potential energy consumption associated with this process.

Additionally, Stages C3 (waste processing), C4 (disposal) and D (Environmental benefits related component recycling) are not applied, as the final disposal lays exclusively on our customer we lack data for the analysis. Packaging materials, typically landfilled, are included in the calculation (stage A5).

Our system boundaries align with our functional unit, reinforcing our commitment to transparency and accountability in sustainability. The following table summarizes the life cycle stages included in this analysis.

Table 05: Life Cycle Stages of Hypertechnologie Ciara Inc's Devices in the LCA[3]									
Raw materials and components manufacturing	Transport of components to assembly site	Device assembly and packaging Energy Usage for manufacturing	Transport to client	Waste management of device packaging	Energy consumption for device use	Dismantling at treatment	Transport to treatment facility	Waste Processing Disposal	Environmental benefits related component recycling
A1	A2	A3	A4	A5	B	C1	C2	C3_C4	D
Applicable								Not Applicable	

3.7.2 Included processes

Considering the system boundaries and life cycle stages presented for this study, in this section we can understand the internal and external processes that are included in each life cycle stage.

Table 06: Inputs and Outputs Included in the System Boundary		
Life Cycle Stage		Process Description
A1	Raw materials and components manufacturing	Chassi manufacturing
		Memory manufacturing
		Power supply manufacturing
		Mounted mainboard manufacturing
		SSD drive manufacturing
		Cable manufacturing
		Component and raw materials Packaging
A2	Transport of components to assembly site	Transport of components and materials by truck
		Transport of components and materials by boat
		Transport of components and materials by train

A3	Device assembly and packaging Energy Usage for manufacturing	Electricity consumption
		Natural gas consumption
		Freshwater consumption
		Gasoline consumed by CIARA's fleet
		Diesel consumed by the generator at CIARA's plant
		Transport of packaging to CIARA's assembly site
		Packaging manufacturing
A4	Transport to client	Transport to the final user by truck
A5	Waste management of device packaging	Transport of waste packaging to waste management site
		Landfill of waste packaging
B	Energy consumption for device use	Electricity consumption for device use
C1	Dismantling at treatment facility	Disassembly for disposal
C2	Transport to treatment facility	Transport of the device to its end-of-life treatment site by truck

3.7.3 Excluded processes

To define the system boundaries, rules for the inclusion and exclusion of processes were established, please see Section 3.8 for cut-off criteria. Certain elements that contribute only marginally to the results were excluded, as explicitly on Table 06.

Table 07: Processes Excluded from the System Boundary

Life Cycle Stage		**Process Description**
A3	Device assembly and packaging Energy Usage for manufacturing	Garbage (coffee cups, newspapers, and other items) destined for landfill. This waste is estimated to represent 5% of the total waste destined for recycling, which is considered negligible.
B	Energy consumption for device use	No significant maintenance or operational impacts are expected during the device's five-year usage period. As per internal data.

C3 C4	Waste Processing Disposal	Waste processing and final disposal are not applied in this LCA as the responsibility for these lies exclusively with our customers. Additionally, due to the lack of data, we are unable to perform a comprehensive analysis.
D	Environmental benefits related component recycling	Potential environmental benefits from recycling and reuse were not applied in this LCA due to the complexity and variability in recycling processes. The environmental impacts of recycling and reuse depend on numerous factors beyond the control of Hypertechnologie Ciara Inc., and the necessary data for a consistent analysis is not available currently.

3.7.4 Assumptions

Conducting an LCA often involves making assumptions to reproduce common scenarios of complementing incomplete data. The following assumptions were made for this study:

Energy Mix for Electricity Production:

- Since Hypertechnologie Ciara Inc's assembly site is in Quebec, the flow "market for electricity, low voltage | electricity, low voltage | Cutoff, S - CA QC" was used to model electricity consumption during the assembly of the devices.
- The use of electric forklifts is considered part of the electricity consumption during device assembly.
- The devices covered in this study are sold in majority in Quebec and Ontario. To calculate the impact of electricity consumption during the use phase, the energy mix was based on Hypertechnologie Ciara Inc's sales distribution across Canadian provinces, as well as some parts of USA. For instance, if a device's sales distribution is 45% in Ontario and 30% in Quebec, the energy mix was modeled accordingly to represent the percentage, for each province in Canada. For the confederations of USA, when applicable, the representation is around 13%, we used the "market group for low voltage cutoff, U-US".

Other Assumptions:

- For devices not sold in 2023, which fall outside the scope of this study, resource consumption (freshwater, natural gas, and electricity) was allocated, but this data is not presented in the report. Additionally, the provincial sales distribution, used to calculate the average transport distance to the client and determine the applicable energy mix, was unavailable, as these devices were not shipped to customers.

- Energy consumption was assumed to be the same as other devices in the same category (see Table 11). Based on lead time, we used worked hours to estimate consumption for the units sold.
- The use of electric forklifts is considered part of the electricity consumption during device assembly.
- The samples shipped were excluded from the calculations as they represent less than 1%.
- In the absence of primary data concerning the packaging of components and raw materials, it was assumed to be equivalent to the packaging of the final product and modeled accordingly.
- It is estimated that less than 2% of devices are returned by clients for replacement. The components from these returned devices are reused, disposed or destinated as determined by the team at Hypertechnologie Ciara Inc's assembly facility. All waste destined for recycling (e-waste, paper, cardboard, metal) is considered to have monetary value on-site. As such, it is assumed that this waste does not contribute to the environmental burdens of the device's lifecycle, as it belongs to a separate lifecycle.
- All assumptions have been verified with relevant stakeholders, and sensitive data has been handled in accordance with confidentiality agreements.
- For the chassis calculation, the percentage for the acrylonitrile-butadiene-styrene copolymer was adjusted to match the total chassis weight per device type (see Table 03).
- For freshwater calculation the formula follows:
    - Volume (m3) = [Mass (kg)/Molar Mass (kg/mol)] × Molar Volume (m3/mol)
- The analysis of the end-of-life phase is limited to stages C1 (deinstallation/dismantling) and C2 (transport to a treatment facility), as Hypertec does not handle waste processing internally. It is assumed that all components containing data are fully destroyed before transportation. Furthermore, to ensure a conservative approach, the selected scenario for this phase represents the worst-case scenario in terms of environmental impact, including all potential energy consumption associated with these stages.

3.7.5 Cut-off Criteria

The cut-off criteria and the 95% inclusion rule are essential for creating an efficient, accurate, and transparent LCA. They ensure that the study focuses on the most impactful elements while maintaining a level of detail that is practical and aligned with international standards. The reference to exclusions ensures clarity about the scope and limitations of the assessment, enhancing its credibility and utility for decision-making were defined by Hypertec as the parameters for this study.

Efficiency in Analysis

- Simplifies the LCA process: By excluding processes or flows that contribute less than 1% of the total mass or energy, the study avoids the excessive complexity and effort required to account for inconsequential details.
- Focuses on critical elements: This allows the analysis to concentrate on processes that significantly affect the results, ensuring that the key drivers of environmental impacts are thoroughly evaluated.

Accuracy and Completeness

- 95% inclusion ensures robustness: Including at least 95% of the mass and energy flows ensures that the analysis captures the overwhelming majority of the product's environmental footprint. This high threshold provides confidence that the results are representative and comprehensive, even with minor exclusions.
- Balancing practicality and detail: While LCA aims for a detailed assessment, there is always a trade-off between detail and feasibility. By setting clear criteria, the study remains both accurate and manageable.

The exclusions of life cycle stages and processes are explained in sections 3.7.1 and 3.7.3 (see Table 06).

3.8 Third party Verification & Compliance

All background data, processes, and results presented in this report [including the Life Cycle Assessment (LCA), Corporate Greenhouse Gas (GHG) Emissions, and GHG Emissions from Product Transport] have been independently verified by a third-party organization to ensure accuracy, reliability, and compliance with relevant standards.

The verification was conducted by **Marie Bellemare Consulting**, a certified organization specializing in LCA validation, ensuring alignment with ISO 14040/14044 requirements and methodologies.

The official verification statement and full credentials of the verifier are available in Appendix [XX].

4. LIFE CYCLE INVENTORY ANALYSIS

This chapter provides a detailed account of the inputs and outputs associated with each phase of the product's life cycle, laying the foundation for assessing the environmental impacts of Hypertechnologie Ciara Inc 's devices.

Transportation Mode

- Please note that the transportation mode may vary depending on the parts and device types. For example, the chassis for desktop small-form, desktop mini-tower, and high-performance workstations may be transported by train from the west coast to Montreal, and then by truck to our assembly facility, while other parts may use different transportation modes.

4.1 Packaging Composition

The data collection process was conducted by Hypertechnologie Ciara Inc in the first quarter of 2024. It involved listing the quantities of materials, freshwater, and energy consumed within the system boundaries, using an Excel Model spreadsheet. Given that the quality of this LCA heavily relies on the quality of the data used, special attention was given to collecting the most representative and reliable data available. Data quality was assessed for its reliability and representativeness in terms of time, geography, and technology, see Section 4.3 and 4.5.

4.2 Description of Unit Processes

The following table details the unit processes used to model the life cycle of the micro-PC, Astro PB62, which serves as a representative example of the devices under study, as it follows the same processes as the other devices. The remaining devices in the assessment were modeled using the same approach, with only the quantities differing.

Table 08: Description of Unit Processes for the LCA of Astro PB62		
A1 - Raw materials and components manufacturing		
Amount	Unit	Process
0.0904	kg	acrylonitrile-butadiene-styrene copolymer production | acrylonitrile-butadiene-styrene copolymer | Cutoff, U - RoW
0.0904	kg	injection moulding | injection moulding | Cutoff, U - RoW
0.1080	kg	aluminium production, primary, cast alloy slab from continuous casting | aluminium, primary, cast alloy slab from continuous casting | Cutoff, U - RoW
0.1350	kg	metal working, average for aluminium product manufacturing | metal working, average for aluminium product manufacturing | Cutoff, U - RoW
0.1285	kg	market for copper, cathode | copper, cathode | Cutoff, U - GLO
0.0031	kg	polyethylene production, high density, granulate | polyethylene, high density, granulate | Cutoff, U - RoW
0.0072	kg	polymer foaming | polymer foaming | Cutoff, U - RoW

0.0041	kg	polypropylene production, granulate | polypropylene, granulate | Cutoff, U - RoW
0.4488	kg	market for steel, unalloyed | steel, unalloyed | Cutoff, U - GLO
0.4488	kg	hot rolling, steel | hot rolling, steel | Cutoff, U - RoW
0.0122	item	hard disk drive production, for desktop computer | hard disk drive, for desktop computer | Cutoff, U - GLO
0.0200	kg	integrated circuit production, memory type | integrated circuit, memory type | Cutoff, U - GLO
0.1831	item	power supply unit production, for desktop computer | power supply unit, for desktop computer | Cutoff, U - RoW
0.0226	kg	acrylonitrile-butadiene-styrene copolymer production | acrylonitrile-butadiene-styrene copolymer | Cutoff, U - RoW
0.0226	kg	injection moulding | injection moulding | Cutoff, U - RoW
0.0270	kg	aluminium production, primary, cast alloy slab from continuous casting | aluminium, primary, cast alloy slab from continuous casting | Cutoff, U - RoW
0.1122	kg	steel production, converter, unalloyed | steel, unalloyed | Cutoff, U - RoW
0.1122	kg	hot rolling, steel | hot rolling, steel | Cutoff, U - RoW
0.2000	kg	printed wiring board production, mounted mainboard, desktop computer, Pb containing | printed wiring board, mounted mainboard, desktop computer, Pb containing | Cutoff, U - GLO
0.3692	m	cable production, connector for computer, without plugs | cable, connector for computer, without plugs | Cutoff, U - GLO
0.0436	Item(s)	plug production, inlet and outlet, for computer cable | plug, inlet and outlet, for computer cable | Cutoff, U - GLO
1.3261	kg	market for corrugated board box | corrugated board box | Cutoff, U
0.2000	item	market for EUR-flat pallet | EUR-flat pallet | Cutoff, U RoW
0.1000	kg	market for polyethylene, linear low density, granulate | polyethylene, linear low density, granulate | Cutoff, U GLO
0.1500	kg	polymer foaming | polymer foaming | Cutoff, U RoW
A2 - Transport of components to assembly site		
Amount	Unit	Process
67.0613	Kg*km	transport, freight, lorry 16-32 metric ton, EURO4 - RoW
32,195.0287	kg*km	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - GLO
A3 - Device assembly and packaging - Energy Usage for manufacturing		
Amount	Unit	Process
85.7101	kWh	market for electricity, low voltage | electricity, low voltage | Cutoff, S - CA QC
0.2743	MJ	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | Cutoff, S - CA-QC

0.1439	kg	market for tap water | tap water | Cutoff, S - CA-QC
0.0375	km	transport, passenger car, large size, petrol, EURO 4 | transport, passenger car, large size, petrol, EURO 4 | Cutoff, U
0.0695	h	machine operation, diesel, >= 74.57 kW, generators | machine operation, diesel, >= 74.57 kW, generators | Cutoff, U
35.5220	kg.km	transport, freight, lorry 16-32 metric ton, EURO4 - RoW
1.3261	kg	market for corrugated board box | corrugated board box | Cutoff, U
0.2000	item	market for EUR-flat pallet | EUR-flat pallet | Cutoff, U RoW
0.1000	kg	market for polyethylene, linear low density, granulate | polyethylene, linear low density, granulate | Cutoff, U GLO
0.1500	kg	polymer foaming | polymer foaming | Cutoff, U RoW
A4 - Transport to client		
Amount	Unit	Process
265.4934	kg.km	transport, freight, lorry 16-32 metric ton, EURO4 - RoW
A5 - Waste management of device packaging		
Amount	Unit	Process
177.6100	kg.km	transport, freight, lorry 16-32 metric ton, EURO4 - RoW
1.3261	kg	treatment of waste paperboard, sanitary landfill | waste paperboard | Cutoff, U
2.4000	kg	treatment of waste wood, untreated, sanitary landfill | waste wood, untreated | Cutoff, U - RoW
0.1000	kg	treatment of waste plastic, mixture, sanitary landfill | waste plastic, mixture | Cutoff, U - RoW
0.1500	kg	treatment of waste plastic, mixture, sanitary landfill | waste plastic, mixture | Cutoff, U - RoW
B - Energy consumption for device use		
Amount	Unit	Process
1095.0000	kWh	market for electricity, low voltage | electricity, low voltage | Cutoff, S - CA ON
C1 - Dismantling at treatment facility		
Amount	Unit	Process
1.4732	kg	treatment of used desktop computer, mechanical treatment | used desktop computer | Cutoff, U
C2 - Transport to treatment facility		
Amount	Unit	Process
147.3187	kg.km	transport, freight, lorry 16-32 metric ton, EURO4 - RoW

4.3 Sources

This table outlines the various sources of data utilized in the assessment, providing a comprehensive overview of the information that supports the Life Cycle Assessment of Hypertechnologie Ciara Inc's devices.

Table 09: Data Sources for The LCA Of Hypertechnologie Ciara Inc's Devices	
Data Type	**Source**
Primary Data	Primary data was provided by CIARA for the period spanning from January to December 2023 and included: • Supply chain data, considering the main suppliers per component and per device type. Mainly in China, shipped via boat in most part of the way to the facility. Data compiled in Tab "distances • " in the "LCAData&Model_2023" • Factory consumption for direct and indirect emissions (Diesel, Gasoline, Freshwater, Natural Gas, Electricity). in Tab "Factory" in the "LCAData&Model_2023", based on invoicing and internal consumption tracker. • Annual Report of Sales Data, that determines the distances to transport to client, energy consumption and data modeling for electricity and waste, this report is available at the ERP "Pilot", as well transferred to "LCAData&Model_2023", in tab "Nb Products".
Secondary Data	Secondary data from the ecoinvent version 3.7 "cut-off" database was used to provide reliable, standardized, and comprehensive environmental impact data for processes where primary data was unavailable.

4.4 Calculation Procedures

4.4.1 Energy Consumption for Device Use

The amount of electricity required for device use was estimated by Hypertechnologie Ciara Inc, considering a power consumption of 100 watts and a usage time of 6 hours per day. As for the question related to electricity consumption, here is the reference we based ourselves: Energy consumption calculator | kWh calculator (rapidtables.com) [4]

The following formula was used:

$$E_{(kWh/day)} = P_{(W)} \times t_{(h/day)} / 1000_{(W/kW)}$$

Thus, the estimated electricity consumption of the device during its entire considered lifetime (5 years as described previously) is 1,095 kWh. This electricity consumption is assumed to be the same for all twelve devices under study.

Due to equipment efficiency, the reference is the certification Energy Star Rev8[5], the device use is also considered in the sensitivity analysis, where the device proves its efficiency.

4.4.2 Transport to Client

The transport distance to the end-user was estimated based on Hypertechnologie Ciara Inc.'s sales distribution across Canada and the USA.

This was calculated as a weighted average of sales per region, the transport distance from the company's plant in St-Laurent to clients, with deliveries primarily to government locations in each provincial capital, same applied to the USA data.

The transportation distances in this assessment were calculated using GPS tracking and logistics data to ensure accuracy. These distances reflect real transport routes based on supplier locations, distribution hubs, and customer destinations. The methodology ensures consistency and reliability by using weighted averages based on sales distribution and transport modes, improving the precision of impact calculations.

Detailed information is available in tab "Distances" Detailed information is available in tab "Distances'' in the "LCAData&Model_2023", upon request.

Transportation Mode

- The mode of transportation used for delivery is 100% by truck (road, lorry).

[4] https://www.rapidtables.com/calc/electric/energy-consumption-calculator.html

[5] https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Computers%20Version%208.0%20Final%20Specification%20Rev.%20July%202022.pdf

4.5 Data Quality Assessment

This chapter evaluates the quality of data used in the Life Cycle Assessment (LCA) to ensure the reliability and accuracy of the findings. The evaluation is based on the Data Quality Pedigree Matrix outlined by A. Edelen and W. Ingwersen in their Guidance on Data Quality Assessment for Life Cycle Inventory Data (EPA, 2016), with the addition of indicators for Flow Reliability (in Table 10 represented by **Q1**) and Flow Representativeness (in Table 10 represented by **Q2**). These indicators are assessed on a scale from 1 to 5, where 1 represents the lowest quality and 5 represents the highest.

Table 10: Data Quality for The LCA Of Hypertechnologie Ciara Inc's Devices

Representativeness	Evaluation	Q1 (1-5)	Q2 (1-5)
Geographical	The primary data represents the life cycle stages of the device in East Asia and Canada. Secondary data was selected to ensure geographical context was as representative as possible. For processes related to resource consumption during device assembly in Quebec (Canada), data reflective of the Quebec context was used. Regarding electricity consumption, data representing each Canadian province was applied. For packaging processes, data from Quebec (Canada) and global sources were used. Overall, the data is considered to have good geographical representativeness.	4	5
Temporal	The primary data is representative of 2023. Life cycle inventory data is sourced from the ecoinvent version 3.8 (2021) database, which is based on version 3.0, released annually since 2013. Some secondary data from version 3.0 dates back to earlier versions (1991-2012), with data on device components from 2002. Therefore, this data is considered average in terms of temporal representativeness.	3	4
Technological	The primary data accurately reflects the technologies used throughout the device's life cycle. Secondary data was selected to represent these technologies as accurately as possible, including energy mix, components, and transport. However, secondary data for components is based on the "computer production, desktop" process, which dates back to 2002. As such, this data is considered to have average technological representativeness.	3	4
Data Collection Method	Data collection methods include the use of the ecoinvent v3.8 database (2021), which compiles data from a variety of sources and includes both primary and secondary data. These data were selected based on the most reliable methods available, but some older secondary data (pre-2013) introduces some uncertainty. The collection methods are considered generally reliable.	4	4
Completeness	All processes with mass and energy flows exceeding the cut-off threshold of 1% were included in the LCA. The study ensures that the data covers all relevant life cycle stages, from resource extraction to end-of-life disposal.	5	5

Legend for Flow Reliability and Flow Representativeness:

Flow Reliability (Q1): This indicator evaluates how reliable the data is based on the consistency and precision of the flows used in the LCA. A score of 5 indicates highly reliable data with minimal uncertainty, while a score of 1 indicates poor reliability.

Flow Representativeness (Q2): This indicator assesses how well the data represents the real-world flows across different regions, technologies, and temporal contexts. A score of 5 indicates that the data is highly representative, while a score of 1 indicates that the data is not very representative of the real-world flows.

Conclusion:

In this assessment, the data shows a good balance of representativeness and reliability. However, there are some limitations related to the age of the secondary data, particularly in terms of its temporal and technological relevance, which may affect the accuracy of the results. For future assessments, incorporating more up-to-date and specific data would enhance the robustness of the LCA.

4.6 Sensitivity Assessment

To analyze the influence of certain processes and life cycle stages on the overall impacts and refine the system boundary, sensitivity assessments were performed. The influence of specific parameters in the modeling was evaluated by determining the differences between the impact assessment results for each parameter.

Two parameters were considered in this sensitivity assessment:

- **Total mass of the components and materials**: To analyze the influence of this parameter, the total life cycle impact results were compared with those considering a 30% increase in the mass of the components and materials used in the device. This increase represents the observed average in the worst-case scenario, accounting for factors such as rework, human errors, potential supply chain disruptions, market fluctuations, currency exchange rate changes, or any other factors that could stress the supply chain and lead to a need for additional raw materials.
- **Electricity used during device operation**: To assess the influence of increased energy usage, the impact of consuming twice as much electricity per device was analyzed. This scenario models a situation where the device is used for extended periods, such as in a two-shift operation or with working hours increased from 6 to 12 hours per day. The results were compared to those based on the electricity consumption assumed in this assessment, effectively doubling the energy usage per unit. This analysis helps to understand the potential environmental impact in cases of prolonged device usage, reflecting more intense operational demands.

The results of the sensitivity assessment are presented in Section 5.5.

4.7 Allocation

To calculate the impact of freshwater, electricity, and natural gas consumption during the assembly of devices at Hypertechnologie Ciara Inc's plant, an allocation was performed. Resources were allocated per device type: desktops small-form or mini-tower, micro-PC, and high-performance workstations.

The allocation method used was based on the number of hours required to assemble each device in a given product range (product lead time), compared to the total hours spent assembling all devices across product ranges in 2023. The total resource consumption (freshwater, natural gas, and electricity) for each product range was then divided by the number of devices produced in that range during 2023 to calculate the resource consumption per device.

The following table illustrates the assembly time-based allocation used in the assessment.

Table 11: Assembly Time Allocation for Resource Consumption by Device Type

Process Description	Device Type	Manufacturing Leadtime (hours)	% of Device Manufacture time / Total Manufacture time (hours/hours)
2,931 Hours	micro-PC	1.6	0.000546
	desktop small-Form	3.6	0.001228
	desktop mini-Tower	3.9	0.001331
	high-performance workstations	3.9	0.001331

5. LIFE CYCLE IMPACT ASSESSMENT (LCIA)

5.1 LCIA Procedure

The life cycle impact assessment (LCIA) was conducted using the ecoinvent 3.8 database and inventory data provided by Hypertechnologie Ciara Inc., with OpenLCA v10.1 as the software tool. The TRACI 2.1 impact assessment method, widely used in North America, was applied to evaluate environmental impact. The six selected impact categories are globally recognized and well-established in the market, supported by consistent and reliable data. These categories ensure thorough environmental analysis, credible reporting, and alignment with industry standards, making them essential for this study.

- Fossil Fuel Depletion Potential (FFDP)
- Ozone Depletion Potential (ODP)
- Global Warming Potential (GWP)
- Eutrophication Potential (EP)
- Acidification Potential (AP)
- Smog Potential (SP)

The life cycle assessment results regarding freshwater consumption (FWC) are also presented in this report. For this category, the inventory flows were based on a reference guide, considering freshwater consumption during the A3 stage (manufacturing) of the life cycle. The freshwater used in the process is sourced from tap water supplied by the municipal system in Quebec, which is used for human consumption and building operations.

For the environmental impact of freshwater consumption, the AWARE (Available Water Remaining) impact assessment method was used in our study, as it is recognized for its precision and accuracy in quantifying water scarcity impacts. This method provides a reliable assessment of water use, ensuring that the impact on freshwater resources is accurately represented.

- Water, lake | Water, river | Water, unspecified natural origin | Water, well | Water, well, in ground

5.2 LCIA Results

The total LCIA results according to the functional unit can be found in the following table for each model of Hypertechnologie Ciara Inc device studied. The LCIA results are relative expressions and do not predict impacts on category endpoints, exceeding thresholds, safety margins, or risks.

Table 12: LCIA Results per Hypertechnologie Ciara Inc's Devices Type
TRACI 2.1

Device Model	FFPD		ODP		GWP		EP		AP		SP		FWC	
Astro PB62	251.6165	MJ Surplus	2.22E-05	kgCFC-11eq	197.06	kg CO2 eq	1.1718	kg N eq	1.0639	kg SO2 eq	12.6968	kg O3 eq	1.43E-05	m3 freshwater
Astro PN64	380.7989	MJ Surplus	3.05E-05	kgCFC-11eq	378.74	kg CO2 eq	2.4517	kg N eq	1.4633	kg SO2 eq	16.6039	kg O3 eq	1.43E-05	m3 freshwater
Horizon D11750	374.2036	MJ Surplus	3.65E-05	kgCFC-11eq	345.37	kg CO2 eq	2.4689	kg N eq	1.9668	kg SO2 eq	23.8787	kg O3 eq	3.63E-06	m3 freshwater
Horizon D12170	300.5674	MJ Surplus	3.18E-05	kgCFC-11eq	329.25	kg CO2 eq	2.5746	kg N eq	1.7650	kg SO2 eq	22.0601	kg O3 eq	3.63E-06	m3 freshwater
Horizon D12750	359.7188	MJ Surplus	3.56E-05	kgCFC-11eq	330.92	kg CO2 eq	2.4568	kg N eq	1.8735	kg SO2 eq	23.1557	kg O3 eq	3.63E-06	m3 freshwater
Horizon T11170	300.9688	MJ Surplus	3.24E-05	kgCFC-11eq	331.70	kg CO2 eq	2.5896	kg N eq	1.8155	kg SO2 eq	22.6491	kg O3 eq	1.48E-06	m3 freshwater
Horizon T11750	302.2965	MJ Surplus	3.24E-05	kgCFC-11eq	309.87	kg CO2 eq	2.3912	kg N eq	1.7872	kg SO2 eq	22.4121	kg O3 eq	1.48E-06	m3 freshwater
Horizon T12170	805.803	MJ Surplus	6.41E-05	kgCFC-11eq	795.77	kg CO2 eq	5.4351	kg N eq	3.1567	kg SO2 eq	35.5335	kg O3 eq	1.48E-06	m3 freshwater
Horizon T12560	254.8369	MJ Surplus	2.94E-05	kgCFC-11eq	289.49	kg CO2 eq	2.3318	kg N eq	1.6932	kg SO2 eq	21.4603	kg O3 eq	1.48E-06	m3 freshwater
Horizon T12750	334.4842	MJ Surplus	3.46E-05	kgCFC-11eq	339.59	kg CO2 eq	2.4956	kg N eq	1.9159	kg SO2 eq	23.4994	kg O3 eq	1.48E-06	m3 freshwater
Kronos 540 – G2	18453.04	MJ Surplus	1.93E-04	kgCFC-11eq	6656.24	kg CO2 eq	10.4155	kg N eq	21.5844	kg SO2 eq	265.8089	kg O3 eq	3.26E-04	m3 freshwater
Kronos 545	18453.04	MJ Surplus	1.93E-04	kgCFC-11eq	6656.24	kg CO2 eq	10.4155	kg N eq	21.5844	kg SO2 eq	265.8089	kg O3 eq	3.26E-04	m3 freshwater

5.3 GWP (Carbon Footprint) Results per Life Cycle Stage

The Global Warming Potential (GWP), expressed as the carbon footprint per life cycle, can be found in the following table for each model of Hypertechnologie Ciara Inc device studied.

Table 13: LCIA Results per Hypertechnologie Ciara Inc's Devices Type TRACI 2.1

Device Model	Total lifecycle	A1	A2	A3	A4	A5	B	C1	C2	Unit
Astro PB62	197.06	100.50	0.41	10.44	0.05	1.82	83.20	0.62	0.03	kg CO2 eq
Astro PN64	378.74	99.12	0.25	10.44	0.45	1.82	266.16	0.49	0.02	kg CO2 eq
Horizon D11750	345.37	235.47	2.28	5.36	0.20	1.96.	97.55	2.45	0.10	kg CO2 eq
Horizon D12170	329.25	235.47	2.28	5.36	0.43	1.96	81.20	2.45	0.10	kg CO2 eq
Horizon D12750	330.92	235.47	2.28	5.36	0.20	1.96	83.10	2.45	0.10	kg CO2 eq
Horizon T11170	331.70	248.80	2.57	4.54	0.64	2.20	70.11	2.74	0.11	kg CO2 eq
Horizon T11750	309.87	248.80	2.57	4.54	0.26	2.20	48.64	2.74	0.11	kg CO2 eq
Horizon T12170	795.77	248.80	2.57	4.54	2.07	2.20	532.75	2.74	0.11	kg CO2 eq
Horizon T12560	289.49	248.80	2.57	4.54	0.30	2.20	28.23	2.74	0.11	kg CO2 eq
Horizon T12750	339.59	248.80	2.57	4.54	1.22	2.20	77.40	2.74	0.11	kg CO2 eq
Kronos 540 – G2	6656.24	6399.66	4.41	168.10	1.21	2.64	74.82	5.19	0.003	kg CO2 eq
Kronos 545	6656.24	6399.66	4.41	168.10	1.21	2.64	74.82	5.19	0.003	kg CO2 eq

Chart Legend: A1 -Raw materials and components manufacturing; A2 - Transport of components to assembly site; A3 - Device assembly and packaging -Energy Usage for manufacturing; A4 - Transport to client; A5 - Waste management of device packaging; B - Energy consumption for device use; A5 + C1 + C2 – End of Life Management

5.4 LCIA Results per Life Cycle Stage and Main Contributors

The LCIA results for each life cycle stage of one of each device type are presented in this section, with a focus on the Global Warming Potential (GWP) impact category. These four devices were selected as representative examples from the four different ranges of device types under study to demonstrate distinct result profiles.

For the high-performance workstation, the GWP impact is primarily driven by the raw materials and components manufacturing stage. In contrast, the desktop small-form and the desktop mini-tower, the product use stage has made a more significant contribution to the GWP results. For the micro-PC it is noticeable that the balanced results between pre-manufacturing and energy consumption; this difference is largely due to sales distribution, as the electricity use impact varies by province, and in some cases, it can exceed the impacts of raw materials and component manufacturing.

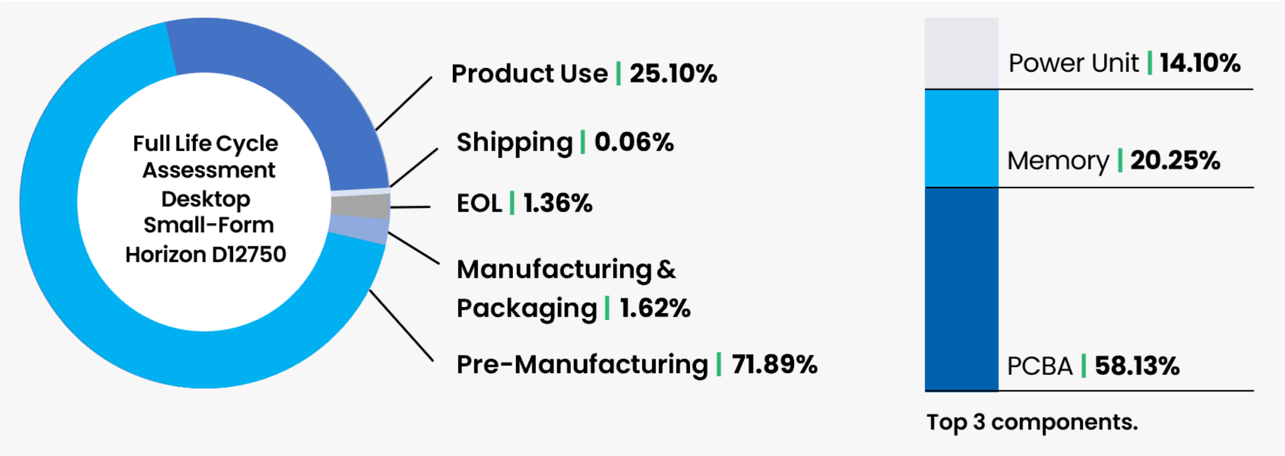
The following figures show the contribution of each life cycle stage to the overall impacts, with GWP chosen as the representative impact category.

Table 14: LCIA Results for GWP Impact Sampling
Section 5.4.1 To 5.4.4

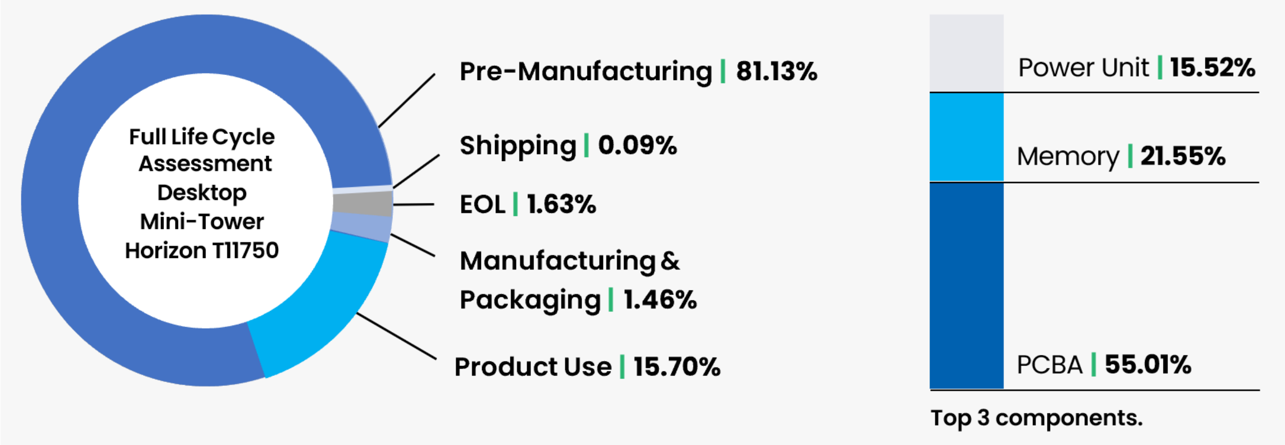
Device Type	Sample Device Model	Total GWP
micro-PC	Astro PB62	197.06 kg CO2 eq
desktop small-Form	Horizon D12750	330.92 kg CO2 eq
desktop mini-Tower	Horizon T11750	309.86 kg CO2 eq
high-performance workstations	Kronos 540 – G2	6656.23 kg CO2 eq

5.4.1 Micro-PC GWP Impacts

5.4.2 Desktop Small-Form GWP Impacts



5.4.3 Desktop Mini-Tower GWP Impacts



5.4.4 High-Performance Workstation GWP Impacts

5.4.5 Contribution of Each Life Cycle Stage to GPW Impacts

This section examines how different life cycle stages contribute to the Global Warming Potential (GWP) impacts for various device types assessed in this study. The devices include desktop small-form systems, desktop mini-towers, high-performance workstations, and laptops. These categories differ in physical size, motherboard configuration, and chassis, each affecting environmental impacts uniquely.

Larger devices, such as desktop mini-towers and high-performance workstations, typically have higher power consumption due to their size and more complex components. Their larger motherboards and robust chassis are designed for enhanced performance, which translates into greater energy demand during usage. Conversely, smaller devices, including desktop small-form systems and laptops, are more energy-efficient. Their compact design and lower power requirements result in a reduced environmental footprint during the usage phase.

The analysis uses a functional unit representing a device's operation over five years. This functional unit highlights variations in energy consumption and related GWP impacts depending on device type. While smaller devices generally have a lower environmental impact due to their efficiency, larger devices, designed for high performance, contribute disproportionately to GWP during the usage phase because of their elevated energy needs.

This trade-off between performance, device size, and eco-efficiency is a crucial consideration when assessing environmental impacts. Larger devices provide higher computational power and capabilities, but this comes with a higher environmental cost. In contrast, smaller devices achieve better eco-efficiency but are limited in power and functionality. Balancing these trade-offs is essential for designing devices with minimized environmental impacts.

Table 15: Impact of Each Life Cycle Stage and Process on The Global Warming Potential (GWP) of a Micro-PC – Astro PB62

Process	Contribution (%)	Amount (kg CO2 eq)
Full LCA – Micro-PC – Astro PB62	**100.00**	**197.06**
A1 - Raw materials and components manufacturing	**51.00**	**100.50**
printed wiring board, mounted mainboard, desktop computer, Pb containing	27.4000	53.9955
integrated circuit, memory type	14.3000	28.2213
power supply unit, for desktop computer	4.0300	7.9502
aluminium, primary, cast alloy slab from continuous casting	1.7500	3.4563
corrugated board box	1.0100	1.9920
copper, cathode	0.5500	1.0812
steel, unalloyed	0.5100	1.0100
polyethylene, linear low density, granulate	0.3600	0.7107
acrylonitrile-butadiene-styrene copolymer	0.3300	0.6469
polymer foaming	0.1500	0.2907
steel, unalloyed	0.1300	0.2475

without plugs | cable, connector for computer, without plugs	0.1200	0.2400
hard disk drive, for desktop computer	0.1200	0.2350
EUR-flat pallet	0.1100	0.2142
injection moulding	0.0835	0.1645
plug, inlet and outlet, for computer cable	0.0107	0.0211
polypropylene, granulate	0.0060	0.0118
polyethylene, high density, granulate	0.0045	0.0089
A2 - Transport of components to assembly site	**0.21**	**0.41**
transport, freight, sea, container ship	0.2000	0.3912
transport, freight, lorry 16-32 metric ton, EURO4	0.0075	0.0148
A3 - Device assembly and packaging Energy Usage for manufacturing	**5.30**	**10.44**
machine operation, diesel, >= 74.57 kW, generators	2.4500	4.8223
electricity, low voltage	1.1200	2.2098
EUR-flat pallet	0.8400	1.6481
corrugated board box	0.6900	1.3638
polyethylene, linear low density, granulate	0.1100	0.2187
polymer foaming	0.0681	0.1342
furnace >100kW | heat, district or industrial, other than natural gas	0.0120	0.0237
transport, passenger car, large size, petrol, EURO 4	0.0080	0.0158
transport, freight, lorry 16-32 metric ton, EURO4	0.0031	0.0060
tap water	0.00001	0.00003
A4 – Transport to client	**0.02**	**0.05**
transport, freight, lorry 16-32 metric ton, EURO4	0.0229	0.0452
A5 – Waste management of device packaging	**0.93**	**1.82**
waste paperboard	0.8200	1.6220
waste wood, untreated	0.0755	0.1487
transport, freight, lorry 16-32 metric ton, EURO4	0.0153	0.0302
waste plastic, mixture	0.0112	0.0221
B – Energy consumption for device use	**42.20**	**83.20**
electricity, low voltage - CA-QC	42.2000	83.2006
C1 - Dismantling at treatment facility	**0.01**	**0.03**
used desktop computer	0.0127	0.0251
C2 - Transport to treatment facility	**0.32**	**0.62**
transport, freight, lorry 16-32 metric ton, EURO4	0.3200	0.6243

Table 16: Impact of Each Life Cycle Stage and Process on The Global Warming Potential (GWP) of a Desktop Small-Form – Horizon D12750		
Process	**Contribution (%)**	**Amount (kg CO2 eq)**
Full LCA – Desktop Small-Form – Horizon D12750	**100.00**	**330.92**
A1 - Raw materials and components manufacturing	**71.20**	**235.47**
printed wiring board, mounted mainboard, desktop computer, Pb containing	41.4000	136.8763
integrated circuit, memory type	14.4000	47.6941
power supply unit, for desktop computer	10.0000	33.1902
steel, unalloyed	1.9400	6.4206
EUR-flat pallet	0.6700	2.2164
acrylonitrile-butadiene-styrene copolymer	0.5800	1.9057
steel, unalloyed	0.4800	1.5732
hot rolling, steel	0.3700	1.2338
corrugated board box	0.3000	0.9960
cable, connector for computer, without plugs	0.2700	0.9000
injection moulding	0.1800	0.6057
aluminium, primary, cast alloy slab from continuous casting	0.1600	0.5250
copper, cathode	0.1200	0.3971
polyethylene, linear low density, granulate	0.0945	0.3127
hard disk drive, for desktop computer	0.0712	0.2356
polymer foaming	0.0640	0.2117
metal working, average for aluminium product manufacturing	0.0331	0.1095
polyethylene, high density, granulate	0.0092	0.0303
plug, inlet and outlet, for computer cable	0.0064	0.0211
polypropylene, granulate	0.0058	0.0192
A2 - Transport of components to assembly site	**0.69**	**2.28**
transport, freight train	0.4400	1.4454
transport, freight, sea, container ship	0.2500	0.8232
transport, freight, lorry 16-32 metric ton, EURO4	0.0041	0.0135
A3 - Device assembly and packaging Energy Usage for manufacturing	**1.62**	**5.36**
EUR-flat pallet	0.5200	1.7049
corrugated board box	0.4400	1.4710
machine operation, diesel, >= 74.57 kW, generators	0.3700	1.2212
electricity, low voltage	0.1700	0.5601
polyethylene, linear low density, granulate	0.0727	0.2405
polymer foaming	0.0446	0.1476
transport, freight, lorry 16-32 metric ton, EURO4	0.0020	0.0065
heat, district or industrial, other than natural gas	0.0018	0.0060

transport, passenger car, large size, petrol, EURO 4	0.0012	0.0040
tap water	0.000002	0.00001
A4 – Transport to client	**0.06**	**0.20**
transport, freight, lorry 16-32 metric ton, EURO4	0.0598	0.1980
A5 – Waste management of device packaging	**0.59**	**1.96**
waste paperboard	0.5300	1.7495
waste wood, untreated	0.0465	0.1539
transport, freight, lorry 16-32 metric ton, EURO4	0.0098	0.0325
waste plastic, mixture	0.0073	0.0243
B – Energy consumption for device use	**25.10**	**83.10**
electricity, low voltage | CA-ON	22.3000	73.7568
electricity, low voltage | CA-NB	2.0200	6.6690
electricity, low voltage | CA-QC	0.8100	2.6771
C1 - Dismantling at treatment facility	**0.74**	**2.44**
used desktop computer	0.7400	2.4460
C2 - Transport to treatment facility	**0.03**	**0.10**
transport, freight, lorry 16-32 metric ton, EURO4	0.0297	0.0982

Table 17: Impact of Each Life Cycle Stage and Process on The Global Warming Potential (GWP) of a Desktop Mini-Tower – Horizon T11750

Process	Contribution (%)	Amount (kg CO2 eq)
Full LCA – Desktop Mini-Tower – Horizon T11750	**100.00**	**309.86**
A1 - Raw materials and components manufacturing	**80.30**	**248.80**
printed wiring board, mounted mainboard, desktop computer, Pb containing	44.2000	136.8763
integrated circuit, memory type	17.3000	53.6206
power supply unit, for desktop computer	12.5000	38.6220
steel, unalloyed	2.3300	7.2141
EUR-flat pallet	0.7200	2.2164
acrylonitrile-butadiene-styrene copolymer	0.6900	2.1409
steel, unalloyed	0.5700	1.7678
hot rolling, steel	0.4500	1.3863
corrugated board box	0.3600	1.1279
cable, connector for computer, without plugs	0.3600	1.1000
injection moulding	0.2200	0.6805
aluminium, primary, cast alloy slab from continuous casting	0.1900	0.5890
copper, cathode	0.1400	0.4459

polyethylene, linear low density, granulate	0.1100	0.3440
hard disk drive, for desktop computer	0.0760	0.2356
polymer foaming	0.0753	0.2334
metal working, average for aluminium product manufacturing	0.0397	0.1229
polyethylene, high density, granulate	0.0110	0.0341
plug, inlet and outlet, for computer cable	0.0068	0.0211
A2 - Transport of components to assembly site	**0.83**	**2.57**
transport, freight train	0.5300	1.6371
transport, freight, sea, container ship	0.3000	0.9163
transport, freight, lorry 16-32 metric ton, EURO4	0.0048	0.0149
A3 - Device assembly and packaging Energy Usage for manufacturing	**1.46**	**4.54**
EUR-flat pallet	0.5500	1.7049
corrugated board box	0.5400	1.6658
machine operation, diesel, >= 74.57 kW, generators	0.1600	0.4996
polyethylene, linear low density, granulate	0.0854	0.2646
electricity, low voltage	0.0740	0.2292
polymer foaming	0.0524	0.1623
transport, freight, lorry 16-32 metric ton, EURO4	0.0023	0.0072
heat, district or industrial, other than natural gas	0.0008	0.0025
transport, passenger car, large size, petrol, EURO 4	0.0005	0.0016
tap water	0.000001	0.000003
A4 – Transport to client	**0.09**	**0.26**
transport, freight, lorry 16-32 metric ton, EURO4	0.0852	0.2641
A5 – Waste management of device packaging	**0.71**	**2.20**
waste paperboard	0.6400	1.9812
waste wood, untreated	0.0497	0.1539
transport, freight, lorry 16-32 metric ton, EURO4	0.0117	0.0362
waste plastic, mixture	0.0086	0.0267
B – Energy consumption for device use	**15.70**	**48.64**
electricity, low voltage | CA-ON	9.9700	30.8930
electricity, low voltage | CA-QC	5.7300	17.7490
C1 - Dismantling at treatment facility	**0.89**	**2.74**
used desktop computer	0.8900	2.7445
C2 - Transport to treatment facility	**0.04**	**0.11**
transport, freight, lorry 16-32 metric ton, EURO4	0.0355	0.1101

Table 18: Impact of Each Life Cycle Stage and Process on The Global Warming Potential (GWP) of a High-Performance Workstations – Kronos 540 – G2		
Process	**Contribution (%)**	**Amount (kg CO2 eq)**
Full LCA – High-Performance Workstations – Kronos 540 – G2	**100.00**	**6656.24**
A1 - Raw materials and components manufacturing	**96.10**	**6399.66**
acrylonitrile-butadiene-styrene copolymer	87.9000	5852.6756
printed wiring board, mounted mainboard, desktop computer, Pb containing	5.1500	342.8657
integrated circuit, memory type	1.7000	112.8854
power supply unit, for desktop computer	0.8300	55.1042
steel, unalloyed	0.2100	14.2050
EUR-flat pallet	0.0966	6.4274
steel, unalloyed	0.0523	3.4809
hot rolling, steel	0.0410	2.7296
copper, cathode	0.0397	2.6419
cable, connector for computer, without plugs	0.0245	1.6301
aluminium, primary, cast alloy slab from continuous casting	0.0229	1.5212
corrugated board box	0.0181	1.2045
injection moulding	0.0140	0.9298
polyethylene, linear low density, granulate	0.0057	0.3784
metal working, average for aluminium product manufacturing	0.0048	0.3168
polymer foaming	0.0043	0.2828
hard disk drive, for desktop computer	0.0035	0.2356
polyethylene, high density, granulate	0.0011	0.0731
polypropylene, granulate	0.0008	0.0528
plug, inlet and outlet, for computer cable	0.0003	0.0214
A2 - Transport of components to assembly site	**0.07**	**4.41**
transport, freight train	0.0454	3.0205
transport, freight, sea, container ship	0.0204	1.3609
transport, freight, lorry 16-32 metric ton, EURO4	0.0004	0.0289
A3 - Device assembly and packaging Energy Usage for manufacturing	**2.53**	**168.10**
machine operation, diesel, >= 74.57 kW, generators	1.6500	109.7258
electricity, low voltage	0.7600	50.2732
EUR-flat pallet	0.0743	4.9442
corrugated board box	0.0267	1.7789
heat, district or industrial, other than natural gas	0.0081	0.5396
transport, passenger car, large size, petrol, EURO 4	0.0054	0.3586
polyethylene, linear low density, granulate	0.0044	0.2910
polymer foaming	0.0027	0.1786

transport, freight, lorry 16-32 metric ton, EURO4	0.0001	0.0091
tap water	0.00001	0.00064
A4 – Transport to client	**0.02**	**1.21**
transport, freight, lorry 16-32 metric ton, EURO4	0.0181	1.2078
A5 – Waste management of device packaging	**0.04**	**2.64**
waste paperboard	0.0318	2.1157
waste wood, untreated	0.0067	0.4462
transport, freight, lorry 16-32 metric ton, EURO4	0.0007	0.0453
waste plastic, mixture	0.0004	0.0294
B – Energy consumption for device use	**1.12**	**74.82**
electricity, low voltage | CA-ON	0.9200	61.0137
electricity, low voltage | CA-MB	0.1500	10.0465
electricity, low voltage | CA-QC	0.0566	3.7642
C1 - Dismantling at treatment facility	**0.08**	**5.19**
used desktop computer	0.0780	5.1894
C2 - Transport to treatment facility	**0.003**	**0.003**
transport, freight, lorry 16-32 metric ton, EURO4	0.0031	0.0031

5.4.6 Key Findings from Life Cycle Analysis

Detailed analyses for representative devices (Micro-PC Astro PB62, Desktop Small-Form Horizon D12750, and Desktop Mini-Tower Horizon T11750) offer insights into the contribution of life cycle stages to GWP impacts.

Raw Materials and Component Manufacturing (A1):

- This stage is the largest contributor to GWP for all device types, driven by energy-intensive processes like mother board production, integrated circuits, and memory components.
- For instance, raw materials account for **51%** of the Micro-PC Astro PB62's GWP and **80.3%** for the Desktop Mini-Tower Horizon T11750., in contrast with High-Performance Workstations – Kronos 540 – G2, witch this stage represents **96.1%** of the amounted emissions.

Energy Consumption During Use (B):

- Usage phase energy demand is the second most significant contributor to GWP, especially for larger devices. For example, it accounts for **42.2%** of GWP for the Micro-PC Astro PB62 and **25.1%** for the Desktop Small-Form Horizon D12750.

Device Assembly and Packaging (A3):

- While less impactful than raw materials manufacturing and usage, assembly and packaging contribute marginally (approximately **1.5% to 5.3%** across devices). Reflecting the energy efficiency in our operations.

Transportation (A2, A4, C2):

- Transportation impacts are minimal **(<1%),** reflecting efficiencies in freight logistics. Even below the cutoff criteria, this information is kept guaranteeing better comprehension of this study.

Waste Management (A5, C2):

- Waste disposal and recycling have relatively low GWP contributions (e.g., **0.93%** for Micro-PC Astro PB62). The average distance for the waste transport considered in this study is 100km, based on local recycling centers and agreements in place.

Comparative Highlights

- The Micro-PC Astro PB62 demonstrates the lowest total GWP (197.06 kg CO_2 eq), largely due to its compact size and efficient energy use.
- The Desktop Mini-Tower Horizon T11750, with more extensive raw material requirements and higher energy consumption, exhibits a higher GWP (309.86 kg CO_2 eq).
- The Desktop Small-Form Horizon D12750 represents an intermediate case with a GWP of 330.92 kg CO_2 eq, driven by its moderate energy demands and material use.

5.5 Sensitivity Assessment Results

The sensitivity assessment was conducted using two parameters outlined in Section 4.6, with the micro-PC, Astro PB62 as the subject of analysis. The results of this assessment are presented in the table below:

Table 19: Sensitivity Assessment Results for The Micro-PC Sample, Astro PB62

Impact category	Unit	Deviation from the initial scenario	
		Scenario considering + 30% component and materials mass	Scenario considering twice the use electricity consumption
FFPD	MJ surplus	+11%	+56%
ODP	kg CFC-11 eq	+9%	+43%
GWP	kg CO2 eq	+9%	+42%
EP	kg N eq	+3%	+17%
AP	kg SO2 eq	+6%	+32%
SP	kg O3 eq	+6%	+29%

The sensitivity assessment identifies two key parameters with substantial influence on the environmental impact of the micro-PC sample (Astro PB62):

Component and Materials Mass: This highlights the critical role of material choices and efficient component design in minimizing the environmental footprint.

Supplier shipment quantities play a significant role in the life cycle impacts of the device, particularly given the global supply chain used for its components. Transportation emissions, such as GWP and AP, are directly influenced by shipment volumes and distances, underscoring the need for optimized logistics strategies like bulk shipments and efficient routing.

- A **30% increase in mass** resulted in deviations across various impact categories, with the most pronounced being: **FFPD**: +11%; **ODP**: +9%; **GWP**: +9%, considering the mode of transport it reflects the efficiency in the modal transportation for the device components to our assembly facility.
- As the supply chain is mostly in Asia, the increase of raw material has a low impact of BWP 9% due to the arrangement of cargo in the containers and boats. As well as the mass equivalent to the Chassis are also shipped to our facilities via train from the west coast.
- **Material Efficiency**: The high sensitivity to component and materials mass underscores the importance of designing lightweight, efficient products. Using recycled or sustainably sourced materials can mitigate these impacts. The adoption of these practices on top of the continuous improvement of our operational processes will guarantee a minimized impact when ordering materials.

Electricity Consumption During Use: The results emphasize the energy efficiency of the device during its operational phase as a key driver of environmental impact.

- Doubling the electricity consumption resulted in significant increases in all categories, particularly: **FFPD**: +56%; **GWP**: +42%; **ODP**: +43%
- Despite the significant increases, the results emphasize the energy efficiency of the device during its operational phase as a key driver of environmental impact.
- **Energy Efficiency**: The stark impact of electricity consumption on categories like GWP and FFPD demonstrates the need for energy-efficient products. Devices with lower energy use during their operational lifetime can drastically reduce their overall environmental footprint.

The ENERGY STAR certification is essential for reducing environmental impacts and supporting decision-making by ensuring lower operational energy consumption, which minimizes GWP, FFPD, and ODP impacts, enhances market differentiation through eco-friendly branding, meets sustainability and regulatory standards, offers cost savings to end-users, and enables access to incentives that bolster product adoption and brand reputation.

Additionally, the environmental footprint of the components depends on the sustainability practices of suppliers, including the use of lightweight, recyclable packaging and low-impact transport methods. Inventory management is another critical factor; excessive inventory leads to wasted resources, while understocking requires expedited shipments with higher environmental costs. For this LCA, suppliers' practices and shipment distances are key variables, making collaboration with suppliers essential to minimize environmental impacts and enhance overall sustainability**.**

Conclusion

The sensitivity assessment underscores the need for accurate data and robust strategies to minimize environmental impacts across all device types. For Hypertechnologie Ciara Inc., focusing on ENERGY STAR certification, sustainable material sourcing, lightweight product design, and precise energy modeling are critical to achieving sustainability goals and maintaining a competitive edge in the eco-conscious market.

Additionally, collaborating with suppliers to optimize shipping quantities and adopting efficient logistics strategies will further enhance sustainability efforts, ensuring long-term environmental and operational benefits across the product portfolio.

By integrating energy efficiency, sustainable sourcing, and optimized supply chain practices, Hypertechnologie Ciara Inc. can not only reduce its environmental footprint but also lead the market in delivering eco-conscious, high-performance solutions.

5.6 Limitations

The main limitations of this LCA are as follows:

Uncertainty in Secondary Data for Component Modeling: The LCA relies on secondary data from the ecoinvent v3.7 database, with electronic component processes dating back to 2002. This outdated data does not reflect recent advancements in manufacturing technologies, material efficiencies, or production processes, introducing uncertainty in the accuracy of the environmental impact assessment. The rapid evolution of the computer technology sector over the last two decades further highlights this limitation.

Assumptions for Electricity Usage: Electricity consumption throughout the device's lifecycle is based on broad assumptions rather than precise, measured data. Variability in electricity usage patterns, regional differences in electricity sources, and operational modes (e.g., on, off, standby) are not fully accounted for, leading to uncertainty in the results. Incorporating real-world usage scenarios and more detailed data would improve the accuracy of the environmental footprint assessment.

Limitations in Data Availability and Representativeness: In addition to the uncertainty from secondary data, the lack of up-to-date, region-specific, and real-world primary data for certain components introduces further limitations. As technology rapidly evolves, the absence of current and representative data may affect the overall reliability of the results.

5.7 Relationship of the LCIA Results to the Goal and Scope

The LCA was conducted in compliance with ISO 14044, ISO 14040, standards, presenting the environmental impact results for the twelve devices within the scope across their entire life cycle for the year 2023. These results will support compliance with EPEAT, Energy Star, and other applicable requirements. Therefore, it can be concluded that the LCIA results align with and satisfy the defined goal and scope of the assessment.

5.8 Relationship of the LCIA results to the LCI results

The following analysis focuses on the environmental impacts of the Astro PB62 Micro-PC, as derived from the Life Cycle Inventory (LCI). Table 20 highlights the elementary flows that most significantly contribute to each of the six impact categories evaluated in the Life Cycle Assessment (LCA). This table is based on the TRACI 2.1 methodology, ensuring relevance and applicability to the North American context. The contributions reflect the materials and processes involved in the production and life cycle of the device. By identifying the key contributors, this analysis aims to inform strategies for improving the sustainability of the device through targeted interventions in design, manufacturing, and resource use.

Table 20: Highest Contributors for Each Impact Category - Micro-PC Sample, Astro PB62

Impact category	Unit	Elementary flow with the highest contribution to each impact category	
		Flow	Contribution %
FFPD	MJ surplus	Gas, natural, in ground	77%
ODP	kg CFC-11 eq	Methane, bromotrifluoro-, Halon 1301	46%
GWP	kg CO2 eq	Carbon dioxide, fossil	63%
EP	kg N eq	Phosphate	76%
AP	kg SO2 eq	Sulfur dioxide	48%
SP	kg O3 eq	Nitrogen oxides	54%

The analysis of the Astro PB62 Micro-PC reveals key environmental impacts driven by specific elementary flows in its life cycle. Fossil fuel depletion (FFPD), accounting for 77% of the category impact due to natural gas consumption, underscores the significant reliance on non-renewable energy in manufacturing and logistics. Similarly, global warming potential (GWP), with carbon dioxide contributing 63%, highlights the role of fossil fuel combustion across production and transportation processes. Eutrophication potential (EP) is largely influenced by phosphate emissions (76%), likely from material extraction or wastewater discharges, while sulfur dioxide (48%) and nitrogen oxides (54%) drive acidification (AP) and smog potential (SP), respectively, emphasizing the environmental burdens associated with industrial and energy-related emissions. Methane, bromotrifluoro-, contributes significantly to ozone depletion potential (ODP) at 46%, pointing to the need for better refrigerant and chemical management.

Addressing these environmental challenges requires a strategic approach to improving energy efficiency, material selection, and production processes. Substituting harmful chemicals like Halon 1301 with environmentally friendly alternatives will mitigate ODP, while better wastewater treatment. Cleaner combustion technologies and the use of low-sulfur fuels will help lower contributions to AP and SP. By implementing these measures, Hypertechnologie Ciara Inc. can minimize its environmental footprint, enhance the eco-efficiency of its devices, and demonstrate its commitment to sustainable production practices.

6. CONCLUSION

This Life Cycle Assessment (LCA) of Hypertechnologie Ciara Inc.'s devices provide valuable insights into the environmental impacts associated with each phase of the products' life cycle, from raw material extraction to transportation and end-of-life considerations. By examining the resource consumption, energy use, and potential for environmental impact across multiple device types, this study highlights key areas where the company can make substantial improvements in sustainability and resource efficiency.

The analysis reveals that larger devices, such as high-performance workstations and desktop mini towers, contribute more significantly to environmental impacts due to their higher energy consumption. This contrasts with smaller devices like laptops, which have a lower power requirement and, therefore, a reduced environmental footprint. To align with the goal of minimizing the overall environmental impact, the company should focus on improving energy efficiency in larger devices and consider designing products with lower power consumption and enhanced eco-efficiency in mind. Furthermore, adopting eco-design principles that prioritize resource conservation and reducing the use of raw materials will ensure a more sustainable production process.

In addition to enhancing product design, the company should also implement strategies to reduce the occurrence of rework and supply chain disruptions, which were considered as part of the sensitivity analysis. By improving manufacturing processes and reducing mistakes, Hypertechnologie Ciara Inc. can mitigate the potential for unnecessary resource consumption and waste. The data suggests that addressing these inefficiencies could lead to significant reductions in the environmental impact of production.

Based on the findings of this LCA, the company is encouraged to:

Invest in energy-efficient technologies and optimize device designs to reduce power consumption, particularly for high-energy devices.

Adopt eco-design practices that focus on reducing the environmental impact of raw material usage, packaging, and end-of-life treatment.

Enhance production processes to minimize errors and the need for rework, which will reduce unnecessary resource consumption.

Focus on continuous improvements in the supply chain to prevent disruptions that could lead to increased raw material usage.

By focusing on these areas, Hypertechnologie Ciara Inc. can achieve its sustainability goals and further reduce its environmental footprint, aligning with industry standards and making significant strides toward a more sustainable future.

PART II: CORPORATE GREENHOUSE GAS EMISSIONS

In order to comply with EPEAT certification, Hypertechnologie Ciara Inc has assessed its corporate greenhouse gas emissions and chosen to follow the requirements of The Greenhouse Gas Protocol – Revised Edition. Scope 3 emissions were calculated using the device LCA compliant with ISO 14040 and ISO 14044. The object of the assessment is the Saint-Laurent plant, for which Hypertechnologie Ciara Inc has significant responsibility, as the company owns and fully manages the facility. The reference year is 2023, and the number of sold devices is presented in Table 1. This GHG inventory is the first completed by the company. The assessment was carried out using the best available data, and no GHG emissions were deliberately excluded. The chosen boundaries are Scope 1, 2, and 3, which encompass the following:

- **Scope 1:** Direct GHG emissions from sources owned by Hypertechnologie Ciara Inc. This includes on-site combustion of natural gas and emissions from the three vehicles Hypertechnologie Ciara Inc owns and uses for its operations and customer services. GHG emissions from the diesel generator have been included. Hypertechnologie Ciara Inc does not own forklifts powered by fossil fuels and did not register any refrigerant leaks.
- **Scope 2:** Indirect GHG emissions from electricity, which result from the purchase of electricity by Hypertechnologie Ciara Inc. These emissions are sourced from the site where the electricity is produced.
- **Scope 3:** Other indirect emissions are those resulting from Hypertechnologie Ciara Inc's activities but from sources not owned or controlled by the company. Scope 3 includes emissions from the life cycle stages of the eleven devices considered in the life cycle assessment. These stages include raw materials and components manufacturing, transportation of components to Hypertechnologie Ciara Inc's assembly site, Hypertechnologie Ciara Inc's device assembly site (excluding scopes 1 and 2, such as freshwater consumption and packaging), transportation to the final user, waste management of device packaging, energy consumption during device use, transportation to the treatment facility, and dismantling. Transportation of employees to and from work, business travel, the purchase of office furniture and supplies, and garbage generation (e.g., coffee cups, newspapers) were not considered.
- **Scope 1 and 2:** We have established 2019 as our base year for Scope 1 and 2 emissions calculations. This aligns with the best practices in greenhouse gas (GHG) reporting and provides a consistent reference point for tracking our progress over time.
- **Scope 3:** Our calculations for Scope 3 emissions began in 2021, which serves as the baseline year for this category. The latter start date for Scope 3 reflects the complexities involved in collecting and verifying data across our entire value chain.
- **For a detailed overview** of our emissions profile and sustainability initiatives, please refer to our Hypertec Corporate Sustainability Report 2023. This report presents our most extensive scope of work to date, including our progress towards emissions reduction targets and other sustainability metrics: https://ciaratech.com/epeat/ , https://hypertec.com/sustainability/ .

The following table presents the Scope 3 categories included, excluded, or not applicable to the study, in accordance with the Greenhouse Gas Protocol Technical Guidance for Calculating Scope 3 Emissions:

Table 21: Scope 3 Categories for Hypertechnologie Ciara Inc's Corporate Carbon Footprint			
Scope 3 category	**Included**	**Excluded**	**Not Applicable**
1. Purchased goods and services	x		
2. Capital goods		x	
3. Fuel- and energy-related activities (not included in scope 1 or scope 2)	x		
4. Upstream transportation and distribution	x		
5. Waste generated in operations	x		
6. Business travel		x	
7. Employee commuting		x	
8. Upstream leased assets			x
9. Downstream transportation and distribution	x		
10. Processing of sold products			x
11. Use of sold products	x		
12. End-of-life treatment of sold products	x		
13. Downstream leased assets			x
14. Franchises			x
15. Investments			x

The Capital Goods, Business Travel, and Employee Commuting categories have been excluded from the current report due to the lack of sufficient data for accurate emissions calculation. At present, we do not have the necessary metrics or tracking systems in place to effectively measure the emissions associated with these activities.

However, we acknowledge the importance of capturing the full scope of our indirect emissions and are committed to improving our data collection processes. We are actively working to enhance our tracking mechanisms, with the goal of including these categories in future reports. This will enable us to assess our environmental impact more comprehensively and take informed actions to reduce our carbon footprint.

Furthermore, the categories Upstream leased assets, Processing of sold products, Downstream leased assets, Franchises, and Investments are not applicable in our case.

7. GHG EMISSIONS PER SCOPE AND TOTAL

The GHG emissions for each scope were calculated by multiplying the total quantity of resources consumed annually (based on available billing data) by the corresponding GHG emission factors.

For Scope 1 and Scope 2, the GHG emission factors provided by the Quebec government or, where applicable, Canadian sources, were used[6].

For Scope 3, the GHG emissions per unit of each device model (Astro, Horizon, Kronos) were calculated by multiplying the emissions per unit by the number of units sold during the reference year (2023) as shown in Table 01. To avoid double-counting, emissions from Scope 1 and Scope 2 were subtracted from the total Scope 3 emissions.

Regarding our calculation of Scope 3 emissions, emission factors related to materials and component manufacturing, transportation, electricity production and distribution, and waste management were sourced from the ecoinvent database. as it is the most widely used database in the manufacturing sector.

Table 22: Greenhouse Gas Emissions per Scope and Total GHG Emissions

Scope	Element	Quantity (m3)	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	HFC (kg)*	PFC (kg)*	SF_6 (kg)*	eCO_2 (kg)	GHG Emissions (ton CO_2 eq)
1	Natural Gas	436.75	820.21	0.02	0.01	0	0	0	950.84	0.9508
	Diesel	110.7	294.7941	0.0001	0.0443	0	0	0	308.83	0.3088
	Gasoline	59.72	136.6991	0.1612	0.003	0	0	0	141.0109	0.1410
2	Electricity	136, 493.39	272.9868	0	0	0	0	0	278.4465	0.2784
3	See Part I	6563[7]					See Part I			2675.4377
Total										2,677.12

*As part of our Life Cycle Assessment (LCA), we have evaluated potential emissions of all greenhouse gases, including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). After thorough assessment, we have concluded that emissions of these gases are negligible or zero for our company, for the following reasons:

- Electric HVAC System: Our heating, ventilation, and air conditioning (HVAC) system primarily operates on electricity, which significantly reduces the risk of direct emissions of these gases.
- Regular Maintenance: We maintain a rigorous maintenance program for our HVAC system, which minimizes the risk of leaks from refrigerants containing HFCs.
- Absence of PFCs and SF6: Our equipment and processes do not use PFCs or SF6, which are typically associated with specific industrial applications do not present in our company.
- Regulatory Compliance: We strictly adhere to Quebec regulations regarding refrigerant gas management and greenhouse gas emission reporting.

[6] https://transitionenergetique.gouv.qc.ca/fileadmin/medias/pdf/FacteursEmission.pdf

[7] Total quantity in units, according to sale of 2023. Reference Table 01.

While emissions of these gases are considered negligible in our operational context, we continue to monitor and regularly evaluate our systems to ensure optimal environmental performance and ongoing compliance with current standards.

Conclusion:

The greenhouse gas emissions presented in this LCA report focus exclusively on the studied products, as required by EPEAT standards. The total emissions calculated for these products amount to **2,677.12 tons of CO2 equivalent**, covering Scope 1 (direct emissions), Scope 2 (electricity-related emissions), and Scope 3 (indirect emissions). It is important to highlight that this scope is limited to the products analyzed in this report and does not represent the company’s overall emissions. For a complete overview of the organization's total greenhouse gas emissions, including all commercialized products, readers can refer to our **CSR 2023 report**, available on our websites: https://ciaratech.com/epeat/ , https://hypertec.com/sustainability/ .

This specific analysis provides a clear understanding of the environmental impact of the selected products while demonstrating our commitment to meeting EPEAT requirements and promoting transparency in sustainability reporting.

PART III: GREENHOUSE GAS EMISSIONS FROM PRODUCT TRANSPORT

To comply with EPEAT certification, Hypertechnologie Ciara Inc has assessed its greenhouse gas emissions from product transport. The methodology used for calculating and reporting transport emissions follows a well-to-wheel, performance-based assessment utilizing a mode-based approach. This calculation is based on the weight of freight and the transport distance for each transportation mode.

The chosen methodology aligns with the GLEC Framework, the global standard for calculating and reporting logistics and transport emissions. Hypertechnologie Ciara Inc utilized GHG emission factors provided by the GLEC Framework[8] to assess its logistics-related greenhouse gas emissions.

Average transport distances from Hypertechnologie Ciara Inc to end customers were determined based on sales data provided by Hypertechnologie Ciara Inc

These distances were calculated from Hypertechnologie Ciara Inc's assembly facility in Saint-Laurent, QC, Canada, to final users located in the capitals of each Canadian province. Since Hypertechnologie Ciara Inc's clients are provincial governments, the distances were measured between the plant and the clients' postal codes in provincial capitals.

The transportation distances in this assessment were calculated using GPS tracking and logistics data to ensure accuracy. These distances reflect real transport routes based on supplier locations, distribution hubs, and customer destinations. The methodology ensures consistency and reliability by using weighted averages based on sales distribution and transport modes, improving the precision of impact calculations.

All devices are transported exclusively by truck, as confirmed by Hypertechnologie Ciara Inc's sales operations team. Additionally, Hypertechnologie Ciara Inc does not require a distribution center, as deliveries are made directly from the assembly facility to the final user.

[8] Global Logistics Emissions Council (GLEC) Framework for Logistics Emissions Accounting and Reporting, Version 3.1

Table 23: Number of Units Sold and Mass*Distance			
Device Model	**Sales for 2023 (qty)**	**Mass of Unit[9] (kg)**	**Mass*Distance[10] Kg.km**
Astro PB62	64	3.25	265.49
Astro PN64	132	2.95	2,616.74
Horizon D11750	125	7.59	1,146.98
Horizon D12170	919	7.59	2,500.20
Horizon D12750	696	7.59	1,161.47
Horizon T11170	50	7.81	3,746.45
Horizon T11750	237	7.81	1,553.15
Horizon T12170	747	7.81	12,147.90
Horizon T12560	10	7.81	1,781.69
Horizon T12750	3,562	7.81	7,193.95
Kronos 540 – G2	15	14.91	5,740.73
Kronos 545	6	14.91	3,368.49
Total	**6563**	**97.84**	**43,223.24**

The GHG emission factors were sourced from the GLEC Framework for Logistics Emissions Accounting and Reporting, Version 3.1[11] (Table 40). The emission factor used for the calculation is based on a well-to-wheel (WTW) approach and represents transport using an LTL (less-than-truckload) dry van. The WTW emission factor is divided into two sub-categories: well-to-tank (WTT) and tank-to-wheel (TTW). These sub-categories were used to calculate product transport GHG emissions by scope, see Table 25.

[9] Mass of unit including packaging in kg.
[10] Calculation of Mass*Distance for all devices.
[11] Global Logistics Emissions Council (GLEC) Framework for Logistics Emissions Accounting and Reporting, Version 3.1,P.98.

Table 24: GHG Emission Factors for Road Transport		
Transportation Mode	**Amount**	**Unit**
LTL/Dry Van WTW	**0.233**	**(kg CO2 eq/tone-kilometer)**
LTL/Dry Van WTT	0.039	(kg CO2 eq/tone-kilometer)
LTL/Dry Van TTW	0.194	(kg CO2 eq/tone-kilometer)

Note: WTW emissions are the sum of the WTT and TTW emissions. Therefore, the WTW factor used in this section is calculated as the sum of the WTT and TTW factors: 0.039 + 0.194 = 0.233 kg CO_2 eq/tone-kilometer.

Table 25 presents the Well-to-Wheel (WTW) greenhouse gas (GHG) emissions for each device model. These emissions were calculated by applying the WTW emission factor to the product of total mass and distance for the sold units of each model.

Table 25: Product Transportation Emissions Inventory												
Device Model	**TCE**	**TCO**	**Mode Coverage**	**Fuel Type**	**Transport Route**	**Period Covered**	**Distance *Mass*Qty Kg.km**	**Emission Intensity WTW kg CO2e/t-km**	**Total Emissions Kg CO2eq**	**Quality Data**	**Calculation Methodology**	**Data Source**
Astro PB62	TCE3: Road-Truck	Truck-Palletized_ Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Ontario	CY2023	16,991.58	0.233	3.96	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Astro PN64	TCE3: Road-Truck	Truck-Palletized_ Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC To Quebec From Saint-Laurent QC To California	CY2023	34,5410.60	0.233	80.48	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon D11750	TCE3: Road-Truck	Truck-Palletized_ Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Ontario	CY2023	143,372.87	0.233	33.41	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon D12170	TCE3: Road-Truck	Truck-Palletized_ Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Missouri USA	CY2023	2,297,690.23	0.233	535.36	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon D12750	TCE3: Road-Truck	Truck-Palletized_ Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Ontario From Saint-Laurent QC to New-Brunswick	CY2023	808,385.07	0.233	188.35	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon T11170	TCE3: Road-Truck	Truck-Palletized_ Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Arizona USA	CY2023	187,822.71	0.233	43.76	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.

Horizon T11750	TCE3: Road-Truck	Truck-Palletized_Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Ontario	CY2023	368,097.52	0.233	85.77	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon T12170	TCE3: Road-Truck	Truck-Palletized_Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Missouri USA	CY2023	2,806,071.29	0.233	653.81	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon T12560	TCE3: Road-Truck	Truck-Palletized_Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec	CY2023	17,816.92	0.233	4.15	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Horizon T12750	TCE3: Road-Truck	Truck-Palletized_Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Ontario From Saint-Laurent QC to British Columbia	CY2023	25,624,841.71	0.233	5,970.59	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Kronos 540 – G2	TCE3: Road-Truck	Truck-Palletized_Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec From Saint-Laurent QC to Ontario From Saint-Laurent QC to Manitoba	CY2023	86,110.91	0.233	20.06	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Kronos 545	TCE3: Road-Truck	Truck-Palletized_Dry Van LTL	Truck (LTL)	Diesel	From Saint-Laurent QC to Québec	CY2023	20,210.95	0.233	4.71	Good	GLEC Framework v3.1	Sold & Mass unit: internal data Average Distances: the plant and the clients' postal codes in provincial capitals.
Total			**7.62 Ton CO2eq**									

Analysis of Product Transportation Emissions Inventory Results:

Total Emissions: Product transportation generated 7.62 tonnes of CO_2eq in 2023, representing the overall carbon footprint of the company's logistics operations.

Model Variability: Emissions vary significantly across models. The Horizon T12750 accounts for the largest share of emissions (5.97 tonnes CO_2eq), while the Astro PB62 generates only 3.96 kg.

Long-Distance Impact: Models shipped to distant destinations, such as California or Missouri, tend to have higher emissions.

Reduction Opportunities: Models with the highest emissions, such as Horizon T12750 and Horizon T12170, could be prioritized for emission reduction initiatives.

This analysis provides a solid foundation for assessing the environmental impact of logistics operations and identifying opportunities for improvement to reduce the carbon footprint of product transportation.

Emission Reduction Goal:

We are committed to continuously reducing our greenhouse gas (GHG) emissions related to product transport. Our goal is to reduce transport-related emissions by **15% annually**.

The table below presents our transport emissions performance, including the total emissions from product transport, the number of products sold, and the emissions per product (tCO_2eq/product). To achieve our reduction target, we are focusing on optimizing shipment loads to maximize transportation efficiency and minimize emissions.

Table 26: Product Transport Emissions Performance				
Year	**Total Emission Transport**	**Products Sold**	**Ratio (tCO_2eq/product)**	**Target**
2023	7,62	6563	0,0012	0,00099

The results of our product transport emissions and performance, along with additional details on our sustainability initiatives, are publicly available on our website.: https://ciaratech.com/epeat/ .

8. TEAM

The success of this report is a testament to the importance of collaboration and synergy within a dedicated team. By leveraging diverse expertise and working cohesively, the Hypertechnologie Ciara Inc team ensured the delivery of a document that aligns with the company's commitment to quality, sustainability, and innovation. Each team member brought their unique skills and perspective, contributing to a report that not only meets industry standards but also supports Hypertechnologie Ciara Inc's strategic goals.

Anizio Neto, Quality Assurance Project Lead: With extensive experience and a specialization in strategy deployment and sustainable practices across industries such as oil and gas, mining, ports, and transportation, Anizio led the project with a detail-oriented approach and strategic oversight. His expertise in circular economy, sustainability, and product certification ensured that the report met the highest standards of quality and compliance.

Aziza Benabbas, Sustainability Project Specialist: Aziza contributed her in-depth knowledge of sustainability practices, ensuring the integration of eco-friendly principles and compliance with international standards.

Ali Rafati, Quality Assurance Project Manager: Ali managed the quality assurance processes, providing critical support in methodology development and validation to uphold rigorous corporate standards.

Ali Khosroshahi, Senior Manager, Quality Assurance &Sustainability: With extensive expertise in managing quality and sustainability initiatives, Ali offered strategic insights to align the report with Hypertechnologie Ciara Inc's long-term environmental and operational goals.

9. REFERENCES

Bare, J. Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) version 2.1. U.S. Environmental Protection Agency, 2012.

Flanagan, B., & Steckel, D. ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017, 2019.

GreenDelta. openLCA v1.10.3. GreenDelta Berlin, 2020.

ISO. 14025: Environmental labels and declarations – Type III environmental declarations – Principles and procedures. ISO, 2020.

ISO. 14040: Environmental management—Life cycle assessment—Principles and framework. ISO, 2020.

ISO. 14044: Environmental management—Life cycle assessment—Requirements and guidelines. ISO, 2020.

ISO. 14067: Carbon footprint of products. ISO, 2018.

ISO. 9001: Quality management systems—Requirements. ISO, 2015.

ISO. 27001: Information technology—Security techniques—Information security management systems—Requirements. ISO, 2022.

ISO. 45001: Occupational health and safety management systems—Requirements with guidance for use. ISO, 2018.

ISO. 50001: Energy management systems—Requirements with guidance for use. ISO, 2018.

ISO. 14064: Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals. ISO, 2018.

Global Logistics Emissions Council (GLEC) Framework for Logistics Emissions Accounting and Reporting, Version 3.1.

Smart Freight Centre. What is the GLEC framework? https://www.smartfreightcentre.org/en/how-to-implement-items/what-is-glec-framework/58/, 2019.

Swiss Centre for Life Cycle Inventories. ecoinvent 3.8. The Ecoinvent Database, 2020.

World Resource Institute. GHG emissions calculation tool. https://ghgprotocol.org/calculation-tools, 2021.

WRI, WBCSD. Technical Guidance for Calculating Scope 3 Emissions: Supplement to the Corporate Value Chain (Scope 3), 2013.

IEEE. Standard for Environmental and Social Responsibility Assessment of Computers and Displays. IEEE, 2018.

https://ecoinvent.org/database/

https://transitionenergetique.gouv.qc.ca/fileadmin/medias/pdf/FacteursEmission.pdf

https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/calculator/refs.cfm

Third party review according to EPEAT program: several 4.8 criteria and 4.9.2.1 criterion

Trade/Brand: Ciara

Report Produced: First Quarter of 2024

Target Market: North America

March 5, 2025

Practitioner of the Life Cycle Assessment study
Ciara Technologies Inc
9300 Trans-Canada Highway, Saint-Laurent, Quebec, Canada
H4S 1K5

Third-party reviewer
Marie Bellemare Consulting
Consultant in LCA | EPD verifier
5687 5E Avenue, Montreal, Quebec, Canada

Table of Contents

Introduction

Marie Bellemare Consulting is an independent consultancy services with the mission of providing services in Life Cycle Assessment (LCA) verification and LCA for buildings and other infrastructures. For more than 15 years, Marie Bellemare is fully immersed applying ecodesign with LCA throughout different sectors: IT, packaging, furniture, transportation, agri-food, and construction. She has the experience and knowledge on the latest development of methods and approaches in the LCA: ISO standards related and LEED requirements associated to building LCA. Also, she is recognized as an Environmental Product Declaration (EPD) verifier by by CSA Group, as well as for Environdec.

Scope of the Mandate

Marie Bellemare Consulting was engaged to perform a third-party review a life cycle and carbon footprint assessment of eleven CIARA desktops/workstations and for the CIARAs' corporation activities according to the Electronic Product Environmental Assessment Tool (EPEAT) program. The LCA study is not meant to be comparative, but to contain twelve single product LCAs within a single project report (table 1).

Table 1. Products included in the LCA study

Device Model	Device Type
Astro PB62	Micro-PC
Astro PN64	
Horizon D11750	Desktop small-Form
Horizon D12170	
Horizon D12750	
Horizon T11170	Desktop mini-Tower
Horizon T11750	
Horizon T12170	
Horizon T12560	
Horizon T12750	
Kronos 540	High-performance workstations
Kronos 545	

Marie Bellemare reviewed the final version of the *LIFE CYCLE ASSESSMENT (LCA) 2023 AND CARBON FOOTPRINT ASSESSMENT REPORT: CIRCULAR ECONOMY PERSPECTIVE HYPERTECHNOLOGIE CIARA INC.* report dated January 6th, 2025 in accordance with:

a) Electronic Product Environmental Assessment Tool (EPEAT) program;
b) ISO 14040:2006 Environmental Management -- Life cycle assessment -- Principles and framework;

c) ISO 14044:2006 Environmental Management—Life Cycle Assessment—Requirements and Guidelines, Clause 6 Critical review;
d) Greenhouse Gas Protocol for the Corporate carbon footprint (using ISO 14040 & 14044 for the calculations) and The Greenhouse Gas Protocol – _Revised Edition for the reporting methodology.
e) Global Logistics Emissions Council (GLEC) Framework: for Logistic Emissions Accounting and Reporting version 3.1.
f) GHG Protocol Corporate Accounting and Reporting Standard (Revised Edition 2004
g) the quality and accuracy of additional environmental information; and
h) the quality and accuracy of the supporting information.

Marie Bellemare reviewed the final version of the *Critical Review Report for the : Environmental Data Disclosure Hypertec Group - Civil Year 2023 : DOC. #: RP_HYP_QA011_Rev.01* report dated March 5th, 2025 in accordance with:
a) Global Reporting Initiative - GRI 303: Water and Effluents 2018 (Revised Edition 2021).
b) Global Reporting Initiative - GRI 302: Energy 2016 (Revised Edition 2021).
c) Global Reporting Initiative - GRI 305: Emissions 2016 (Revised Edition 2021).
d) Global Reporting Initiative - GRI 3: Material Topics 2021

Within the present document, the following terminology is adopted:
- The term “shall” or “must” is used to indicate what is mandatory.
- The term “should” is used to indicate a recommendation, rather than a requirement.
- The term “may” or “can” is used to indicate an option that is permissible.

General Timeline for the Mandate

Target Dates for the Mandate	
Start date	January 6, 2025
End date	March 5, 2025

Critical Review Statement

According to the initial service offer, the scope of this review includes analyzing the LCA as defined per the EPEAT requirements, by an independent external expert. The life cycle and carbon footprint assessment of eleven CIARA desktops/workstations and for the CIARAs' corporation activities performed by the Quality Assurance & Sustainability CIARA team must be a cradle-to-grave based on ISO14040 /44. CIARA is seeking a letter confirming that the LCA study was performed in accordance with ISO14040 & ISO 14044, including the information below with their application for the ecolabel EPEAT:

- *Credentials of the LCA conductor*
- *Years in field*
- *Number of LCAs reviewed*
- *Number of LCAs conducted*
- *Contact information*
- *Statement that the LCA meets the requirements for the following EPEAT Criteria (4.8.1.1, 4.8.1.2, 4.8.2.1, 4.8.2.2 & 4.9.2.1)*
- *4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)*
- *4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044)*
- *4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 for the calculations) and The Greenhouse Gas Protocol – _Revised Edition for the reporting methodology*
- *4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework version 3.1)*
- *4.9.2.1 – Corporate Reporting and Public Disclosure:*
    - *Water Use: Verification of water withdrawal and consumption data, in accordance with Global Reporting Initiative - GRI 303: Water and Effluents 2018 (Revised Edition 2021).*
    - *Energy Use: Verification of energy consumption across your operations, considering applicable frameworks, including Global Reporting Initiative - GRI 302: Energy 2016 (Revised Edition 2021).*
    - *Greenhouse Gas Emissions: Verification of Scope 1 and Scope 2 emissions, aligned with recognized methodologies such as the GHG Protocol Corporate Accounting and Reporting Standard (Revised Edition 2004) and the Global Reporting Initiative - GRI 305: Emissions 2016 (Revised Edition 2021).*

According to ISO 14044, the critical review process shall ensure that
there are four phases in an LCA study:

> • *the methods used to carry out the LCA are consistent with this International Standard,*
> • *the methods used to carry out the LCA are scientifically and technically valid,*
> • *the data used are appropriate and reasonable in relation to the goal of the study,*
> • *the interpretations reflect the limitations identified and the goal of the study, and*
> • *the study report is transparent and consistent.*
>
> *The scope and type of critical review desired shall be defined in the scope phase of an LCA, and the decision on the type of critical review shall be recorded.*

After a detailed examination, in accordance with the limits of the scope of Marie Bellemare appointment, the third-party reviewer confirms that has come to her attention to suggest any data errors or relevant deviations from the requirements by the above-referenced EPEAT requirements and its supporting project report have been established with respect to:

- The underlying data collected as used for the LCA calculations,
- The way the LCA-based calculations have been carried out to comply with the calculation rules described in the reference EPEAT requirements.

The comments were provided by email, discussed by conference call and implemented after the comments were provided.
This review excludes an assessment of the Life Cycle Inventory (LCI) model and individual data set.

The third-party reviewer confirms that the company-specific data has been examined as regards quality, accuracy and plausibility. Also, that data evaluation includes coverage, precision, completeness, representativeness, consistency, reproducibility, sources and uncertainty.

The third-party reviewer confirms she has sufficient knowledge and experience of information technology (IT) products, the IT industry, relevant standards and the geographical area of the LCA to carry out this third-party reviewer.

The third-party reviewer confirms that she has been independent in her role as third-party reviewer in accordance with the requirements in with the ISO 14040-44 and EPEAT Program, i.e. She has not been involved in the execution of the LCA and have no conflicts of interest regarding this third-party reviewer.

The third-party reviewer confirms that LCA study was found to be in conformance with :

- ISO 14040:2006 Environmental Management -- Life cycle assessment -- Principles and framework;
- ISO 14044:2006 Environmental Management—Life Cycle Assessment—Requirements and Guidelines, Clause 6 Critical review;
- Greenhouse Gas Protocol for the Corporate carbon footprint (using ISO 14040 & 14044 for the calculations) and The Greenhouse Gas Protocol – _Revised Edition for the reporting methodology.
- Global Logistics Emissions Council (GLEC) Framework: for Logistic Emissions Accounting and Reporting version 3.1.
- GRI Standards 2021, the latest version of the Global Reporting Initiative's sustainability reporting framework: for Global Reporting Initiative for Corporate Reporting and Public Disclosure

Title of the study	Critical Review Report for the *: LIFE CYCLE ASSESSMENT (LCA) 2023 AND CARBON FOOTPRINT ASSESSMENT REPORT: CIRCULAR ECONOMY PERSPECTIVE HYPERTECHNOLOGIE CIARA INC*
The commissioner of the LCA study and practitioner of the LCA study	Hypertec (CIARA) 9300 Trans Canada Highway Saint-Laurent, Quebec, Canada H4S 1K5
The version of the LCA report to which the critical review statement belongs	Version 01 report date 06.01.2025

Title of the study	Critical Review Report for the *: Environmental Data Disclosure Hypertec Group - Civil Year 2023 : DOC. #: RP_HYP_QA011_Rev.01*
The commissioner of the GRI reporting and practitioner of the GRI reporting	Hypertec (CIARA) 9300 Trans Canada Highway Saint-Laurent, Quebec, Canada H4S 1K5
The version of the GRI report to which the critical review statement belongs	Version 01 report date 05.03.2025
Name of third-party reviewer	Marie Bellemare
Name of organization and address	Marie Bellemare Consulting 5302 5E Ave, Montreal, Quebec, Canada H1Y 2S5
Date	March 5, 2025
Signature	

Critical Review Report

This review, with the following matrix, assures if the issue is described in the LCA project report and if it is produced according the requirements and guidelines in the applicable reference as ISO 14044 and EPEAT Program. See the Appendix: Review matrix.

According to the ISO 14044: *A critical review may be carried out by an internal or external expert. In such a case, an expert independent of the LCA shall perform the review. The review statement, comments of the practitioner and any response to recommendations made by the reviewer shall be included in the LCA report.*

EPEAT Conformity Statement

Marie Bellemare Consulting
The option for low environmental solutions

Life Cycle Assessment (LCA) Review Statement		
Applicant Manufacturer Name and Address	CIARA 9300 Trans-Canada Highway Saint-Laurent (QC) Canada H4S 1K5	CIARA a Hypertec brand
Product Name	Astro PB62, Astro PN64, Horizon D11750, Horizon D12170, Horizon D12750, Horizon T11170, Horizon T11750, Horizon T12170, Horizon T12560, Horizon T12750, Kronos 540 and Kronos 545	
Year of reported manufacturer primary data	2023	
LCA Software and Version Number	OpenLCA v 2.2.0	
LCI database and version Number	Ecoinvent 3.8 database	
LCIA Methodology and Version Number	TRACI 2.1	
This life cycle assessment was conducted in accordance with ISO 14040-44 by	CIARA 9300 Trans-Canada Highway Saint-Laurent (QC) Canada H4S 1K5	CIARA a Hypertec brand
Third-Party Reviewer		
Name of reviewer	Marie Bellemare	
Organization	Marie Bellemare Consulting 5302, 5E Avenue Montreal (QC) Canada H1Y 2S5	MB Consulting
Years in LCA Field[1]	15	
No. of LCAs reviewed	14	
No. of LCAs conducted	15	

[1] This LCA field experience includes the carbon footprint and GHG assessment. LCA can be used to assess several environmental impacts such as water footprint, toxicity potential, acidification potential, and resource depletion, etc. (International Organization for Standardization [ISO], 2006). The carbon impacts of transportation was always included in the LCA reviewed or conducted by the Third-Party Reviewer. The LCA shall always include the transportation impacts: according to ISO 14001 (2015) the LCA is a *Consecutive and interlinked stages of a product (or service) system, from the raw material acquisition or generation from natural resources to final disposal. Life cycle stages include the acquisition of raw materials, design, production, transportation/delivery, use, end-of-life treatment, and final disposal*.

	Contact Information	Email: mariebellemareconsulting@protonmail Phone: 438.345.0200
EPEAT Criteria		
4.8.1.1 – Product life cycle assessment and public disclosure of analysis	Part A: This life cycle assessment was independently verified in accordance with ISO 14040/14044	Marie Bellemare Third-Party /External reviewer MB Consulting
	Part B: Public disclosure of analysis	The URL where manufacturer has publicly posted the summary of these LCA results (at a minimum Global Warming Potential, Water Consumption, and Primary Energy Demand) publicly available: https://ciaratech.com/epeat/
4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044)	Part A: Public disclosure of analysis	Marie Bellemare Third-Party /External reviewer MB Consulting
	Part B: Public disclosure of analysis updated at least once every three years	The URL where the manufacturer has publicly posted the summary of these LCAs, including the inputs used in the assessment; the total life cycle carbon footprint and the carbon footprint of the product's life cycle stages; and an explanation of uncertainty, addressed either through a statistical assessment or a publicly available disclaimer statement: https://ciaratech.com/epeat/
4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 for the calculations) and The Greenhouse Gas Protocol for the reporting methodology	This CCF was independently verified in accordance with ISO 14040/14044 and The Greenhouse Gas Protocol	Marie Bellemare Third-Party /External reviewer MB Consulting
	The URL where manufacturer has publicly posted the summary of this CCF results at: https://ciaratech.com/epeat/	
4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework v3.1)	Third-party verification in accordance with the GLEC Framework. Marie Bellemare MB Consulting	
	Number of years of experience in assessing carbon impacts of transportation according the GLEC Framework	5
	Number of studies reviewed on the carbon impacts of transportation according the GLEC Framework	4
	The URL where manufacturer has publicly posted the annual summary of results, transport supply chain GHG emission	

<table>
<tr><td></td><td colspan="2">reduction goal, and progress report toward the goal:
https://ciaratech.com/epeat/</td></tr>
<tr><td rowspan="3">4.9.2.1 – Corporate Reporting and Public Disclosure of Energy, Water and GHG emissions: (GRI) 302, 303, 305 and Material Topics 2021</td><td>Applicable scope of impact</td><td>Portion of the building located at 9300 Trans-Canada Highway, Saint-Laurent, Québec, Canada, H4S 1K5 where Ciara has significant responsibility for the design and manufacture of declared products conforming to the IEEE 1680.1:2018 standard. Consequently, this part of the building excludes portion rented to other companies.</td></tr>
<tr><td colspan="2">The URL where manufacturer has publicly posted the annual summary of results of water use, energy use, and greenhouse gas emissions: https://ciaratech.com/epeat/</td></tr>
<tr><td colspan="2">The environmental data for each GRI aspect is assured by an independent third party
Marie Bellemare
MB Consulting</td></tr>
</table>

Marie Bellemare

Recognized LCA and EPD verifier

Complies with the requirements of 8.2.2 of CAN/ CSA-ISO 14025 by :

- CSA Group
- International EPD

For EPEAT for the following criteria:

- 4.8.1.1 - Life cycle analysis, according to ISO 14040-44 standards
- 4.8.1.2 - Greenhouse gas emissions/ carbon footprint of the product, from extraction of raw materials to end of product life, according to ISO 14040-44 standards
- 4.8.2.1 - Company carbon footprint, according to ISO standards 14040-44
- 4.8.2.2 - Greenhouse gas emissions from the transport of products, in accordance with the framework GLEC
- 4.9.2.1 Corporate reporting and public disclosure

Logiciels

- Simapro
- OpenLCA
- Impact Estimator Building

Langue

- French (mother tongue)
- Spanish (advanced)
- English (intermediate-advanced)

Professional experience

Life Cycle Analysis Consultant

- **Marie Bellemare Consulting Service – Montreal, Canada (2019 – Present)**
  - Support for companies, architects and engineers in assessing and reducing the environmental impacts of their products, services and buildings.
  - Carrying out life cycle analyses (LCAs) and verifications of LCA reports and environmental product declarations (EPDs).
  - Examples of clients served: Englobe, Hypertec, Intertec, Tamperguard, Genyk, Papier Masson, Nature Fibre...

Analyst - Project Manager

- Vertima Inc. – Montreal/Québec, Canada (2018-2019)
  - Production and management of ACV, DEP and "Health Product Declaration" (HPD) for sustainable construction projects.

Ecodesign consultant

- Amesys Canada Inc. – Montreal, Canada (2012-2016)
  - Management and production of environmental deliverables for projects at Bombardier Transportation.
  - Data collection and analysis for LCA and EPD
  - Verification of chemical conformity of products.
  - Team training on ecodesign processes.

Education

- PhD student in industrial engineering, Polytechnique Montréal (2021 - planned for 2026)
- Master of Applied Sciences, Design & Complexity option, University of Montreal (2009-2011)
- Bachelor's degree in industrial design, University of Montreal (2005-2009)

Areas of expertise

- Life cycle analysis (LCA): Carrying out LCAs according to ISO standards 14040 and 14044 for different types of products and services (construction, transportation, IT, packaging, etc.). Mastery of LCA methodologies for Zero-Carbon Buildings (CBDCa) and LEED v4.
- Ecodesign: Support for companies in integrating ecodesign and life cycle analysis principles from the design phase.
- Chemical compliance: Verification of the compliance of products and materials with environmental regulations (RoHS, REACH).
- Sustainable development: Advice and support for companies in the implementation of sustainable development strategies.

Review timeline:	January 6, 2025 to March 5, 2025
Independent Review of LCA study of:	LIFE CYCLE ASSESSMENT (LCA) 2023 AND CARBON FOOTPRINT ASSESSMENT REPORT: CIRCULAR ECONOMY PERSPECTIVE HYPERTECHNOLOGIE CIARA INC.
Reviewer:	Marie Bellemare

REQUIREMENTS AND REFERENCES						REVIEW		FINAL REVIEWER STATEMENT
Standards		4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)	4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)	4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)	4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).	REVIEWER COMMENTS (JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE		CHECKED AND APPROVED
ISO 14044								
5,1	**General requirements and considerations**							
5.1.1	The type and format of the report shall be defined in the scope phase of the study. The results and conclusions of the LCA shall be completely and accurately reported without bias to the intended audience. The results, data, methods, assumptions and limitations shall be transparent and presented in sufficient detail to allow the reader to comprehend the complexities and trade-offs inherent in the LCA. The report shall also allow the results and interpretation to be used in a manner consistent with the goals of the study.	X	X	X		**REV 1:** General recommendations: * Adopt a standardized nomenclature for the life cycle stages (ISO 14040/14044 or GHG Protocol). * Clarify and justify methodological choices, assumptions, and exclusions. * Improve the data quality assessment by following a recognized scheme. Ex : like the" Data Quality Pedigree Matrix" from A. Edelen et W. Ingwersen, «Guidance on Data Quality Assessment for Life Cycle Inventory Data,» EPA, 2016.. * Provide a more in-depth interpretation of the LCA and LCIA results. * Ensure consistency between the different parts of the report and the objectives of the study. Additional points: * Consistency with the circular economy: *Clarify the company's position on product reuse and its consistency with the objective of a circular economy. Justify the exclusion of environmental benefits from recycling in the current system boundaries. Provide more information on the end-of-life packaging management strategy.* **REV 2:** Section Assumptions p13: The statement regarding resource allocation for unsold devices appears contradictory. It claims resource consumption cannot be allocated, yet allocates energy consumption (which is a resource). To address this (**mandatory**): *Acknowledge the inconsistency and provide a stronger justification for allocating energy consumption, specifically explaining why it was feasible while other resource consumption data was unavailable. *Explore alternative approaches like excluding unsold devices from the analysis or using proxy data based on similar devices or industry averages. * Revise the explanation for clarity and consistency, ensuring it accurately reflects the methodology used. Freshwater Calculation (**mandatory**): *Please clarify the scope of the freshwater consumption data. Is it solely for the freshwater used at the device assembly phase, or does it include other life cycle stages (e.g., manufacturing of components)? *Other comment: table 7 is located before table 6. see pp.11 and 12 **REV 3: Completed**	Please check the General Aspects in the report. Please review the Goal of the study; we have provided more explanation about it. Review our expalaination about Six impact categories **2.2 Intended application** We have added the reference for the service life period of our devices in Section **3.2, Functional Unit.** Please refer to Table 5, where we have updated the LCA stages and provided the rationale for excluding the C3-C4 and D phases Rev: 02 The revised assumption relating to unsold units: •For devices not sold in 2023, which fall outside the scope of this study, resource consumption (freshwater, natural gas, and electricity) was allocated, but this data is not presented in the report. Additionally, the provincial sales distribution, used to calculate the average transport distance to the client and determine the applicable energy mix, was unavailable, as these devices were not shipped to customers. Please refer to P23: The freshwater used in the process is sourced from tap water supplied by the municipal system in Quebec, which is used for human consumption and building operations.	X
5.1.2								
a)	modifications to the initial scope together with their justification;	X	X			**REV 1:** Objectives: Clearly describe the objectives of the LCA, specifying the reasons that motivate the company to carry out the study and the expected benefits. While the report mentions the desire to obtain EPEAT certification, it could be more explicit about the reasons that motivate the company to carry out this LCA and the expected benefits. made. The report references several ISO standards that are not relevant to this LCA, specifically ISO 14065, ISO 14064, and ISO 14025. These should be removed. * **ISO 14065** pertains to the validation and verification of greenhouse gases, which is not the purpose of this LCA. * **ISO 14064** provides guidance for quantifying and reporting GHG emissions at the organizational level. While relevant to the corporate carbon footprint, EPEAT specifically references the GHG Protocol for this purpose. Therefore, focusing on demonstrating compliance with the GHG Protocol is sufficient. * **ISO 14025** relates to environmental labeling, which is not within the scope of this LCA. **Regarding ISO 14067:** While ISO 14067 (carbon footprint of products) is relevant to the product carbon footprint aspect of this LCA, the report should clearly distinguish between the corporate carbon footprint (addressed by the GHG Protocol) and the product carbon footprint (addressed by ISO 14067). **Key Recommendations:** * Remove all references to ISO 14065, ISO 14064, and ISO 14025. * Clearly indicate that the corporate carbon footprint was calculated in accordance with the GHG Protocol. * Clarify the use of ISO 14067 and ensure its application is consistent with EPEAT requirements." **REV 2: Completed**	We have reformulated: GENERAL ASPECTS and Goal of the study	X
b)	system boundary, including – type of inputs and outputs of the system as elementary flows, – decision criteria;	X	X			**REV 1:** Standardized nomenclature: Use a standardized nomenclature for the life cycle stages. Possible confusion on the life cycle stages included in the analysis (non-standardized nomenclature) : To present the data according to modules A1 to C4 as per EN 15804+A2. In this case, it is necessary to follow it in a consistent manner: C2 transport, C3 waste processing, and C4 disposal, and explicitly refer to the fact that you are following the steps defined according to EN 15804+A2. **Please see additional detail at line 36** **REV 2: Please see additional detail at line 36** **REV 3:** **Completed**	Please refer to Table 5 in the section 3.7.1 , where we have updated the LCA stages and provid	X
c)	description of the unit processes, including – decision about allocation;	X	X			**REV 1:** See related comments **REV 2: See related comments - line 8** **REV 3: Completed**		X
d)	data, including – decision about data, – details about individual data, and – data quality requirements;	X	X			**REV 1:** The data quality assessment should include: **see line 49 for further explanations** * A more detailed evaluation of the quality of both primary and secondary data used in the study. * A clear declaration of the share of specific data contributing to the results. * Addressing any deviations from data quality requirements and justifying the use of any proxy data. To further enhance the assessment, consider using a recognized data quality assessment scheme, such as the "Data Quality Pedigree Matrix" from A. Edelen and W. Ingwersen's "Guidance on Data Quality Assessment for Life Cycle Inventory Data" (EPA, 2016). **REV 2: Completed**		X
e)	choice of impact categories and category indicators.	X				**REV 1:** * **Justify the selection of impact categories**:The report uses the TRACI 2.1 method, which includes six impact categories. However, it doesn't explicitly justify why these specific categories were chosen as the most relevant for the study. It should explain the reasoning behind the selection, considering the product's characteristics and life cycle. **See line 53 for further explanations** * **Consider additional impact categories**: The report could be strengthened by including other impact categories relevant to electronic products, such as: * Abiotic resource depletion (to account for the use of minerals and metals). * Human toxicity (to account for the potential impacts of toxic substances on human health). * Ecotoxicity (to account for the potential impacts of toxic substances on ecosystems). * Land use and land occupation (to account for the impacts related to land use for raw material extraction, manufacturing, and waste disposal). * **Reference the guide for freshwater consumption**: The report mentions using a reference guide for selecting inventory flows for freshwater consumption but doesn't specify which guide. It should provide a clear reference to ensure traceability and transparency. **REV 2: Missing the reference and justification about water footprint (mandatory).** **REV 3: Completed**	We have provided an explanation for our selection of the six categories.	X
5.1.3	A graphical presentation of LCI results and LCIA results as part of the report may be useful, but it should be considered that this invites implicit comparisons and conclusions.	X	X			Compliant		X
5,2	**Additional requirements and guidance for third-party reports**							
	When results of the LCA are to be communicated to any third party (i.e. interested party other than the commissioner or the practitioner of the study), regardless of the form of communication, a third-party report shall be prepared. The third-party report can be based on study documentation that contains confidential information that may not be included in the third-party report. The third-party report constitutes a reference document, and shall be made available to any third party to whom the communication is made. The third-party report shall cover the following aspects :							

	Standards	4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)	4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)	4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)	4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).	REVIEWER COMMENTS (JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE		CHECKED AND APPROVED
a)	General aspects:							
1)	LCA commissioner, practitioner of LCA (internal or external);		X			Compliant		X
2)	date of report;		X			Compliant		X
3)	statement that the study has been conducted according to the requirements of this International Standard.		X			Compliant		X
	4.8.1 Life cycle assessment and product carbon footprint : b) If claiming the additional point in accordance with Part B, demonstration of public disclosure (e.g., URL or other evidence of publication to peer-reviewed LCA journal, national database, and/or to the manufacturer's website).		X			Compliant		X
b)	Goal of the study:							
1)	reasons for carrying out the study;		X			**REV 1:** See related comments **REV 2: Completed**		X
2)	its intended applications;		X			**REV 1:** See related comments **REV 2: Completed**		X
3)	the target audiences;		X			Compliant		X
4)	statement as to whether the study intends to support comparative assertions intended to be disclosed to the public.		X			Compliant		X
c)	Scope of the study:							
1)	function, including							
	i) statement of performance characteristics, and		X			Compliant		X
	ii) any omission of additional functions in comparisons;		X			Compliant		X
2)	functional unit, including							
	i) consistency with goal and scope,		X			Compliant		X
	ii) definition,		X			**REV 1:** See related comments **REV 2: Completed**		X
	iii) result of performance measurement;		X			**REV 1:** See related comments **REV 2: Completed**		X
3)	system boundary, including							
	i) omissions of life cycle stages, processes or data needs,		X			**REV 1:** The nomenclature used (A1 + A2 - Pre-manufacturing, A3 - Manufacturing and packaging, etc.) is not standardized and can be confusing. Lack of clarity and standardization: * Non-standardized nomenclature: The nomenclature used for the life cycle stages does not conform to ISO 14040/14044 or other recognized methodologies such as the GHG Protocol or EN 15804 or ISO 21930. Proposing the use of the EN 15804 or ISO 21930 standard is a good practice that can improve the quality and credibility of the LCA report. By aligning with industry best practices and adopting standardized nomenclature, the company demonstrates its commitment to transparency and methodological rigor, but it is must be follow completly. * Possible confusion: The use of terms such as "Pre-manufacturing" and "Manufacturing and packaging" may create confusion about the specific life cycle stages that are included in each category. Lack of completeness: * Omission of potential stages: The note does not mention certain stages that could be relevant to the LCA of electronic devices, such as the extraction of raw materials, the production of components, and the treatment of waste at end-of-life. * Lack of clear definition of system boundaries: The note does not clearly define the system boundaries for each life cycle stage, which can make it difficult to understand the analysis. Recommendations: * Adopt a standardized nomenclature: Use a recognized nomenclature for the life cycle stages, such as that of ISO 14040/14044 * Describe each stage accurately: Provide a detailed description of each life cycle stage, specifying the activities and processes included. * Clearly define system boundaries: Specify the system boundaries for each life cycle stage, indicating what is included and what is excluded from the analysis. * Justify methodological choices: Explain the reasons for the choice of methodology and nomenclature used, and justify them in relation to the objectives of the study. Example of a more standardized nomenclature (based on ISO 14040/14044): * A1-A3: Raw material extraction and processing * A4: Transport * A5-A6: Manufacturing * B1-B7: Use * C1-C4: End-of-life (collection, transport, waste processing) * D: Benefits and burdens beyond the system boundaries **REV 2:** Table 6: Life cycle stages C3 and C4 are misspelled (**mandatory**): C3 is "Waste Processing" and C4 is "Disposal" Please clarify (**mandatory**): The ecoinvent process 'treatment of used desktop computer, mechanical treatment' appears incorrectly applied. This process represents C3 - Waste Processing, not C1 - Disassembly. As the LCA excludes recycling, C3 is not relevant. If the end-of-life assessment only considers transport to a treatment facility, then only C2 - Transport should be included. Please clarify the scope of the end-of-life stage and correct the ecoinvent process application. C1 means : De-installation from point of use. **REV 3:** Missing explanation about the end-of-life assumption C1. Please add futher explanation about this process, because C1 means "De-installation from point of use". Also, clarify table 5.	We have updated the LCA stages in Table 05 and provided details about the included and excluded processes in sections 3.7.2 and 3.7.3. Rev.02: The nomination has been corrected: C3 is "Waste Processing" and C4 is "Disposal." Please refer to page 12.	X
	ii) quantification of energy and material inputs and outputs, and		X			**REV 1:** Points to improve: * Justification of primary data: The report could provide more information on how the primary data were collected and measured, specifying the methods and tools used. The report states that the usage time of the device is 6 hours per day. This assumption appears low and needs further justification. Typically, for electronic products, the usage time should consider the total time spent in various modes of operation. The following modes should be considered (Ref. PCR ELECTRONIC AND ELECTRIC EQUIPMENT, AND ELECTRONIC COMPONENTS (NONCONSTRUCTION) PCR 2024:06 VERSION 1.0.1, 2024-12-09 by EPD International) * Off mode: The product is connected to the main power source but is switched off. * Standby mode: The product is connected to the main power source and is switched on but is not performing its main functions. * Active mode: The product is switched on and performing its main function(s). * Sleep mode: The product is in a low-power state from which it can be awakened to perform its main functions more rapidly than from the off mode. * Hibernate mode: The product is in a very low power state in which all data relating to the current state of operation is stored in a persistent memory and from which it can be awakened to perform its main functions. * Other modes: Any other relevant mode of operation. The sum of the time the device spends in each of these modes should equal 24 hours. The report should provide a breakdown of the time spent in each mode and justify the assumptions made for each mode. **REV 2: Completed**		X
	iii) assumptions about electricity production;		X			REV 1: See related comments **REV 2: Completed**		X
4)	cut-off criteria for initial inclusion of inputs and output, including							

	Standards	4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)	4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)	4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)	4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).	REVIEWER COMMENTS (JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE		CHECKED AND APPROVED
	i) description of cut-off criteria and assumptions,		X			**REV 1:** Cut-off criteria: Justify the choice of cut-off criteria used for the inclusion of processes in the LCA. The report should justify why the environmental benefits of recycling are not included in the current system boundaries. It could mention the difficulties of quantifying these benefits or the uncertainties related to the end-of-life of the products. Clarify the processes excluded from the analysis by providing a complete list of excluded elements and justifying their exclusion. Provide a more detailed justification for the exclusion of waste destined for landfill, specifying the types of waste involved and their potential environmental impact. Points to improve: * Justification of assumptions: Some assumptions are not sufficiently justified. For example, the assumption that the resource consumption for the assembly of devices not sold in 2023 is equal to that of other devices in the same range deserves a more detailed explanation. * Impact of assumptions: The report does not discuss the potential impact of assumptions on the LCA results. It would be relevant to assess the sensitivity of the results to the various assumptions made. * Assumptions about recycling: The assumption that waste destined for recycling has no environmental impact because it has an economic value on-site is questionable. Recycling has an environmental impact, even if it generates revenue. * Assumption about the copolymer: The assumption concerning the adjustment of the percentage of acrylonitrile-butadiene-styrene copolymer to match the total weight of the device in stage A1 is not clear and deserves to be explained in more detail. Recommendations: * Justify all assumptions in more detail, explaining the reasons behind them and the sources of information used. * Discuss the potential impact of assumptions on the LCA results, performing sensitivity analyses if necessary. * Review the assumption about waste recycling and take into account the environmental impact of recycling, even if it generates revenue. * Clarify the assumption about acrylonitrile-butadiene-styrene copolymer and explain the reasons for the percentage adjustment. * Ensure that all assumptions are documented in a transparent and traceable manner. Points to improve: * Justification of cut-off criteria: The report could justify the choice of the 1% threshold for the cut-off criteria, explaining why this threshold was considered appropriate for the study. **REV 2: Completed**	We have provided additional explanations regarding our assumptions in section 3.7.4. Regarding the cut-off criteria (3.7.5), we have explained the rationale behind our threshold selection.	X
	ii) effect of selection on results,		X					X
	iii) inclusion of mass, energy and environmental cut-off criteria.		X					X
d)	Life cycle inventory analysis:							
1)	data collection procedures;		X			**REV 1:** * Data collection: Describe the data collection method used, specifying the data sources, collection tools, and measurement techniques used. * Insufficient justification for the choice of the ecoinvent 3.7 database. * Insufficient justification of the assumptions made for the assembly of devices not sold in 2023. **REV 2: Completed**	Please refer to the description in Table 09.	X
2)	qualitative and quantitative description of unit processes;		X			**REV 1:** There is an inconsistency between Table 7 and Table 8 regarding the inclusion of train transport. * Table 7, which lists the inputs and outputs included in the system boundary, mentions "Transport of components and materials by train" within the A2 life cycle stage (Transport of components to assembly site). * However, Table 8, which provides a detailed description of the unit processes used to model the life cycle of the Astro PB62, does not include any process related to train transport. This inconsistency raises concerns about the completeness and accuracy of the inventory analysis. If train transport is indeed involved in the transportation of components to the assembly site, it should be included in the unit process description and accounted for in the impact assessment. Therefore, it is recommended to: * Review the data collection and modeling process to ensure that all relevant transport modes are accurately represented. * If train transport is indeed involved, include it in the unit process description in Table 8 and update the impact assessment calculations accordingly. * If train transport is not relevant, remove it from the list of inputs and outputs in Table 7. **REV 2: Completed**	Please refer to the explanation in Section 4 regarding the transportation mode.	X
3)	sources of published literature;		X			**REV 1:** Support the statement about the standard lifespan of desktop computers with data or references : see previous related comment The report states that the service life of the devices is estimated to be five years, based on the current industry standard for desktop computers. To support this claim, it would be beneficial to provide a specific and verifiable reference. This could include: Industry data: Studies or reports from the IT industry that indicate the average lifespan of desktop computers. For example, data from organizations like Gartner, IDC, or Forrester. Standards or regulations: Standards or regulations that specify a minimum lifespan for computer equipment. Market surveys or analyses: Surveys or market analyses that document the typical usage time of desktop computers by consumers or businesses. Internal company data: If the company has internal data on the lifespan of its own devices (e.g., warranty or maintenance data), this data could be used to support the five-year lifespan claim. The reference should be: Precise: It should clearly state the average lifespan of desktop computers or a recommended minimum lifespan. Verifiable: It should come from a reliable and accessible source, such as a scientific publication, a report from a recognized organization, or an official standard. Relevant: It should be relevant to the type of desktop computer studied in the LCA. **REV 2: Completed**	Please refer to Section 3.2, Functional Unit, where we have added the reference: https://hyper	X
4)	calculation procedures;		X			**REV 1:** * Detail the calculations performed to quantify the flows of materials and energy, specifying the formulas, data sources, and assumptions. * Justification of assumptions: Justify the assumptions made for the assembly of unsold devices, the choice of the ecoinvent database, energy consumption, and transport. * Lack of details on the method for calculating the average transport distance. **REV 2: Completed**	Regarding the energy consumption of device use, please refer to the reference mentioned in Section 4.4.1: https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Computers%20Version%208.0%20Final%20Specification%20Rev.%20July%202022.pdf Please refer to Section 4.4.2 for the average distance calculation method.	X
5)	validation of data, including							
	i) data quality assessment, and		X			**REV 1:** Data quality assessment: Describe the quality of the data used, specifying the criteria used and the results obtained. Points to improve: * Precision, consistency and alignment: The report does not explicitly address the precision, consistency and alignment of the data with the system boundaries, which are important aspects of data quality assessment according to ISO 14044. * Justification of completeness: Although the report mentions that all processes exceeding the cut-off threshold were included, it could provide a more detailed justification of this threshold and its impact on the completeness of the analysis. * More thorough assessment: The report could provide a more thorough assessment of data quality, using more quantitative methods or more precise quality indicators. * Assessment scheme: The report could use a recognized data quality assessment scheme, such as the one proposed in the UN guidelines for LCA database development or the PEF (Product Environmental Footprint) method. Recommendations: * Explicitly address the precision, consistency and alignment of the data with the system boundaries. * Further justify the completeness of the analysis and the choice of the cut-off threshold. * Consider a more thorough assessment of data quality, using more quantitative methods or more precise quality indicators. * Use a recognized data quality assessment scheme to structure the assessment and improve transparency. Ex : like the" Data Quality Pedigree Matrix" from A. Edelen et W. Ingwersen, «Guidance on Data Quality Assessment for Life Cycle Inventory Data,» EPA, 2016. **REV 2:** The recommendation to use more recent and specific primary data in future assessments is appreciated. However, the representativeness evaluation lacks clarity on the specific primary data used in this LCA. Please provide more details on this recommendation (**mandatory**). Also for a better understanfding (**optional**): •Types of primary data collected: Specify the exact types of primary data collected for this LCA (e.g., energy consumption data from the assembly facility, packaging material specifications). •Data collection methods: Describe the methods used to collect this primary data (e.g., measurements, monitoring, supplier questionnaires). •Data limitations: Explain any limitations associated with the primary data used (e.g., data gaps, measurement uncertainties). This clarification will help to better understand the data foundation of the LCA and assess the validity of the recommendation for future studies. **REV 3: mandatory comments completed**	Rev.02: We have reformulated the sentence to this: In this assessment, the data shows a good balance of representativeness and reliability. However, there are some limitations related to the age of the secondary data, particularly in terms of its temporal and technological relevance, which may affect the accuracy of the results. For future assessments, incorporating more up-to-date and specific data would enhance the robustness of the LCA. for types of primary data please refer to table09, P.18	X

	Standards	4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)	4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)	4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)	4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).	REVIEWER COMMENTS (JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE		CHECKED AND APPROVED
	ii) treatment of missing data;		X			**REV 1**: See related comments **REV 2: Completed**		X
6)	sensitivity analysis for refining the system boundary;		X			**REV 1:** Points to improve: * Justification of parameters: The report could justify the choice of the two key parameters for the sensitivity assessment, explaining why these parameters were considered the most important. * Choice of variations: The report could justify the choice of a 30% increase in the mass of components and double the electricity consumption for the sensitivity assessment. * Presentation of results: Although the report mentions that the results of the sensitivity assessment are presented in section 5.5, it could provide a brief summary of the main results in this section. * Justification of the allocation method: The report could justify the choice of the allocation method based on assembly time, explaining why this method was considered the most appropriate. Recommendations: * Justify the choice of key parameters for the sensitivity assessment. * Justify the choice of variations used for the sensitivity assessment. * Provide a brief summary of the main results of the sensitivity assessment in this section. * Justify the choice of the allocation method based on assembly time. * Carefully proofread the section to correct any grammar and style errors. **REV 2: Completed**	Please refer to the explanation in Section 4.6. Regarding allocation method, please refer to the section 4.7 Provide a brief summary of the main results of the sensitivity assessment in section 5.5.	X
7)	allocation principles and procedures, including							
	i) documentation and justification of allocation procedures, and		X			**REV 1**: Table 11. aims to illustrate the allocation of assembly time for the consumption of resources (water, electricity, natural gas) according to the type of device. For this table to be complete and informative, it is essential to include the quantity of each model produced. Here's why this information is important: * Production representation: The quantity of each model produced provides a better understanding of the distribution of production and the relative importance of each type of device. * Calculation of consumption per device: The quantity of each model is necessary to calculate the average resource consumption per device, which is an important indicator for the LCA. * Transparency and traceability: The inclusion of this data reinforces the transparency of the analysis and allows for tracing the calculations performed. **Recommendation:** It is strongly recommended to add a column to Table 11 to indicate the quantity of each device model produced in 2023. This will complete the information and make the analysis more transparent and understandable. *Note: If this information is sensitive, provide the details of the quantities per model directly to the verifier (in a separate document) and indicate that for confidentiality reasons this information is not provided in the report, but has been verified by a third party.* **REV 2:** Please share with the verifier the quantity of each device model produced in 2023 : **mandatory**	As this data is sensitive, we are unable to share it publicly. The details have already been provided to you in the Excel file. Rev.02 The produced quantity has been shared with the verifier.	X
	ii) uniform application of allocation procedures.		X			**REV 1:** To be assessed later **REV 2: see line 8** **REV 3: Completed**		X
e)	Life cycle impact assessment, where applicable:							
1)	the LCIA procedures, calculations and results of the study;		X			**REV 1: Life cycle impact assessment (LCIA):** * Method: Describe the impact assessment method used (TRACI 2.1) and justify its choice. * Impact categories: Justify the choice of impact categories considered in the LCIA. The report mentions the inclusion of six environmental impact indicators and one inventory indicator, but it could provide more information on these indicators and their relevance to the study. * Reference guide: Reference the guide used for the selection of inventory flows for freshwater consumption. * Interpretation of results: Analyze the contributions of the different life cycle stages to each impact category and identify environmental hotspots. * Uncertainty assessment: Assess the potential impact of uncertainties related to data, assumptions, and methodological choices on the results of the LCIA. * Consistency check: Check the consistency between the results of the LCIA and the results of the LCI. **Points to improve**: * Justification of impact categories: The report could justify the choice of the six impact categories, explaining why these categories were considered the most relevant to the study. * TRACI 2.1 method: The report could provide more information on the TRACI 2.1 method, explaining its principles and limitations. * Reference guide: The report mentions that the inventory flows for freshwater consumption are based on a reference guide, but does not specify which guide it is. It would be relevant to reference this guide to ensure the traceability of the method. * Additional indicators: The report could consider including other relevant environmental indicators, such as abiotic resource depletion or human toxicity. **Recommendations:** * Justify the choice of the six impact categories. * Provide more information on the TRACI 2.1 method. * Reference the guide used for the selection of inventory flows for freshwater consumption. * Consider including other relevant environmental indicators. **REV 2:** Missing the impact assesment method for water footprint and reference and justification (**mandatory**).	Rev.02: We have reformulated the sentence to this: In this assessment, the data shows a good balance of representativeness and reliability. However, there are some limitations related to the age of the secondary data, particularly in terms of its temporal and technological relevance, which may affect the accuracy of the results. For future assessments, incorporating more up-to-date and specific data would enhance the robustness of the LCA. for types of primary data please refer to table09, P.18	X
2)	limitations of the LCIA results relative to the defined goal and scope of the LCA;		X			**REV 1: Sections 5.2 and 5.3 – LCIA Results and GWP Results** These sections should be revised to: * **Interpret the LCIA and GWP results more thoroughly:** This includes: * Analyzing the contribution of each life cycle stage to each impact category, including GWP. * Identifying environmental hotspots for each device model. * Analyzing the differences in impact between models, considering their technical characteristics and use. * Discussing the reasons for varying contributions between life cycle stages. * **Conduct an uncertainty assessment**: This should include: * Discussing the sources of uncertainty (data, assumptions, and methodological choices). * Evaluating their potential impact on the LCIA and GWP results. * **Normalize the LCIA and GWP results** against a common functional unit (e.g., per year of use) to facilitate comparison between models. * **Present aggregate LCIA and GWP results** for all device models to provide an overview of the product range's environmental impact. * **Verify the consistency** between the LCIA results and the LCI results. **Sections 5.4 to 5.8** These sections should be revised to: * **Expand the discussion on the limitations of the study** in Section 5.6, including the potential impact of these limitations on the results and any other limitations not already mentioned (e.g., uncertainties in primary data). * **Provide a more detailed justification** of how the LCIA results meet the goal and scope of the study in Section 5.7. * **Remove references to ISO 14025 and ISO 14064** in section 5.7, as these standards are not directly relevant to this LCA. * **Analyze in more detail the contributions of elementary flows** to each impact category in Section 5.8, explaining the reasons for these contributions and their implications. * **Integrate the sensitivity assessment in Section 5.5** into a more comprehensive uncertainty analysis. **REV 2: Completed**		X
3)	the relationship of LCIA results to the defined goal and scope, see 4.2;		X					X
4)	the relationship of the LCIA results to the LCI results, see 4.4;		X				Please refer to sections: 5.4.6 regarding the limitations of study We have added explanation in the sentivitivity section 5.5 The eferences to ISO 14025 and ISO 14064 in section 5.7, are removed	X
5)	impact categories and category indicators considered, including a rationale for their selection and a reference to their source;		X			**REV 1**: See related comments **REV 2**: See related comments **REV 3: Completed**		X
6)	descriptions of or reference to all characterization models, characterization factors and methods used, including all assumptions and limitations;		X			**REV 1**: See related comments **REV 2**: See related comments **REV 3: Completed**		X

	Standards	4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)	4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)	4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)	4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).	REVIEWER COMMENTS (JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE		CHECKED AND APPROVED
7)	descriptions of or reference to all value-choices used in relation to impact categories, characterization models, characterization factors, normalization, grouping, weighting and, elsewhere in the LCIA, a justification for their use and their influence on the results, conclusions and recommendations;		X			**REV 1**: See related comments **REV 2**: See related comments **REV 3: Completed**		X
8)	a statement that the LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. and, when included as a part of the LCA, also:		X			**REV 1**: Missing : to be added **REV 2: Completed**		X
	i) a description and justification of the definition and description of any new impact categories, category indicators or characterization models used for the LCIA,		X			N/A		N/A
	ii) a statement and justification of any grouping of the impact categories,		X			N/A		N/A
	iii) any further procedures that transform the indicator results and a justification of the selected references, weighting factors, etc.,		X			N/A		N/A
	iv) any analysis of the indicator results, for example sensitivity and uncertainty analysis or the use of environmental data, including any implication for the results, and		X			**REV 1: Points to improve:** * Justification of parameters: The report could more clearly justify the choice of the two key parameters for the sensitivity assessment, explaining why these parameters were considered the most important or the most uncertain. * Choice of variations: The report could justify the choice of a 30% increase in the mass of components and a doubling of electricity consumption for the sensitivity assessment. It would be relevant to explain why these variations were considered representative of possible uncertainties or variations. * Analysis of results: The analysis of the results of the sensitivity assessment could be more in-depth. The report could discuss the implications of the observed variations for each impact category and for the overall interpretation of the LCA results. * Uncertainty assessment: The sensitivity assessment could be integrated into a more comprehensive uncertainty analysis, which would take into account other sources of uncertainty (data, assumptions, methodological choices) and would allow quantifying the overall uncertainty of the LCA results. **Mandatory requirements according to ISO 14040/14044 and 14067:** * Uncertainty assessment: ISO 14040/14044 standards require an assessment of the uncertainties associated with the LCA results. The sensitivity assessment can be considered as part of this uncertainty assessment, but it does not completely replace it. * Interpretation of results: ISO 14040/14044 and 14067 standards require an interpretation of the LCA results, including an analysis of uncertainties and their potential impact on the study's conclusions. **Recommendations:** * More clearly justify the choice of key parameters for the sensitivity assessment. * Justify the choice of variations used for the sensitivity assessment. * Deepen the analysis of the results of the sensitivity assessment. * Integrate the sensitivity assessment into a more comprehensive uncertainty analysis. * Carefully proofread the section to correct any grammar and style errors. **REV 2:** Optional (**not mandatory**): Here are some recommendations to improve the sensitivity study and deepen the analysis of the impact of materials 1. Expand the range of variation: • Mass increase: Test larger mass increases (e.g., 50% or 100%) to observe the evolution of environmental impacts and identify possible critical thresholds. • Mass decrease: Also analyze the impact of decreasing the mass of components (e.g., 10%, 20%, 30%) to identify the potential for reducing the environmental footprint. 2. Vary the types of materials: • Compare different materials: Integrate in the sensitivity study the comparison of different types of materials to identify the most sustainable options. 3. Deepen the transport analysis: • Transport distances: Vary the transport distances of materials and components to assess the influence of the origin of materials on the environmental footprint. • Transport modes: Compare the impact of different transport modes (plane, boat, train, truck) on GHG emissions and energy consumption. • Logistics optimization: Study the impact of different logistics optimization strategies (bulk shipments, optimized routes, etc.) on the environmental footprint. 4. Consider the impact of end-of-life: • Recyclability: Integrate into the sensitivity study the impact of the recyclability of materials on the overall environmental footprint. • Reuse and revalorization: Analyze the impact of the reuse and revalorization of end-of-life components.	Thank you for the recommendations. We will address them in the next report.	X
	v) data and indicator results reached prior to any normalization, grouping or weighting shall be made available together with the normalized, grouped or weighted results.		X			**REV 1:** See related comments **REV 2: Completed**		X
f)	Life cycle interpretation:							
1)	the results;		X			**REV 1:** This mention in section 5.4.5 is not sufficient to fully meet the requirements for interpreting results according to ISO 14040/14044 and 14067. Although it identifies the main stages contributing to the Global Warming Potential (GWP) for each type of device, it lacks an in-depth analysis of why these stages have a greater impact and the differences between models. **Here's what's missing to meet the standards' requirements:** * Analysis of causes: Explain why component manufacturing has a greater impact for some models, and why device use is more significant for others. * Discussion of differences: Analyze the differences in impact between models and device types, taking into account their technical characteristics, composition, and use. * Link with other impact categories: Relate the GWP results to the results of other impact categories to identify potential synergies and trade-offs. * Implications for ecodesign: Discuss the implications of the results for the ecodesign of devices, identifying areas for improvement to reduce environmental impact. By adding these elements of analysis and interpretation, section 5.4.5 will better meet the requirements of ISO 14040/14044 and 14067, and will provide a more solid basis for decision-making and continuous improvement. **REV 2: Completed**	Please refer to the explanation added in the section 5.4.5	X
2)	assumptions and limitations associated with the interpretation of results, both methodology and data related;		X			**REV 1:** * Insufficient interpretation of the LCIA results. * Lack of normalization of results against a common functional unit. * Lack of uncertainty analysis. * Lack of aggregated results for all device models. * Conclusions: Draw clear and concise conclusions on the results of the LCA, meeting the objectives of the study. * Recommendations: Make recommendations for improving the environmental performance of the devices. * Limitations: Discuss the limitations of the study, specifying their potential impact on the results and conclusions. **REV 2: Completed**		X
3)	data quality assessment;		X			**REV 1:** See related comments **REV 2:** see line 50 **REV 3: Completed**		X
4)	full transparency in terms of value-choices, rationales and expert judgements.		X			**REV 1:** See related comments **REV 2:** See related comments **REV 3:** See related comments **REV 4:** Completed		X
	others:		X			**REV 1**: Section 6 (Conclusion) of the report, taking into account the requirements of ISO 14040/14044 and 14067: **Mandatory requirements according to ISO 14040/14044 and 14067:** * Conclusions and recommendations: ISO 14040/14044 standards require that the LCA report contains clear conclusions and recommendations, which are derived from the results of the study and which meet the objectives of the LCA. **Recommendations**: * Correct the inconsistency on the number of devices studied. * Add more specific conclusions on the other impact categories. * Make recommendations for improving the environmental performance of the devices. * Mention the next steps envisaged by the company. **REV 2: Completed**		X

Standards		4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)	4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)	4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)	4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).	REVIEWER COMMENTS (JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE		CHECKED AND APPROVED
g)	Critical review, where applicable:							
1)	name and affiliation of reviewers;		X			Compliant		X
2)	critical review reports;		X			Compliant		X
3)	responses to recommendations.		X			Compliant		X
The Greenhouse Gas Protocol								
	Based on EPEAT, a public GHG emissions report in accordance with the GHG Protocol Corporate Standard shall include the following information:							
	1. Description of the Company and Inventory Boundary * An outline of the organizational boundaries chosen, including the chosen consolidation approach. * An outline of the operational boundaries chosen, and if scope 3 is included, a list specifying which types of activities are covered. * The reporting period covered.			X		**REV 1:** Clarify the system boundaries for product transport emissions and avoid double-counting between the corporate carbon footprint and product transport sections. **REV 2: Completed**		X
	2. Information on Emissions * Total scope 1 and 2 emissions independent of any GHG trades such as sales, purchases, transfers, or banking of allowances. * Emissions data separately for each scope * Emissions data for all six GHGs separately (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in metric tonnes and tonnes of CO_2 equivalent. * Year chosen as the base year, and an emissions profile over time that is consistent with and clarifies the chosen policy for making base year emissions recalculations. * Appropriate context for any significant emissions changes that trigger base year emissions recalculation (acquisitions/divestitures, outsourcing/insourcing, changes in reporting boundaries or calculation methodologies, etc.). * Emissions data for direct CO_2 emissions from biologically sequestered carbon (e.g., CO_2 from burning biomass/biofuels), reported separately from the scopes. * Methodologies used to calculate or measure emissions, providing a reference or link to any calculation tools used. * Any specific exclusions of sources, facilities, and/or operations.			X		**REV 1**: The report appears to conflate the corporate carbon footprint with the product life cycle assessment, leading to potential inconsistencies and double-counting of emissions. Key issues and recommendations: * **Scope 3 Emissions:** The report incorrectly includes product life cycle emissions within the corporate carbon footprint's Scope 3. Scope 3 should focus solely on indirect emissions from the company's activities (e.g., business travel, waste disposal, employee commuting), as defined by the GHG Protocol. Product life cycle emissions should be addressed separately according to ISO 14067. * **System Boundaries:** The report lacks clarity and consistency in defining system boundaries. It needs to clearly specify: * The organizational boundaries and consolidation approach used for the corporate carbon footprint. * Which life cycle stages are included in each assessment (e.g., raw material extraction, production, use, end-of-life), ensuring consistency between the different sections of the report (e.g., Table 7 and Table 8). * Details on transport modes, distances, and whether upstream and downstream transportation is included. * **Exclusions:** Any exclusions from the corporate carbon footprint (e.g., employee commuting, office supplies) must be explicitly justified. * **Methodology:** The report needs a more detailed and transparent description of the methodologies used to calculate both the corporate carbon footprint and the product life cycle emissions, including: * Specific emission factors and their sources (with references), addressing the lack of references for GHG emission factors. * Data sources and their quality. * All assumptions made, with clear justification and discussion of their potential impact on the results. * An emissions profile over time, with a defined base year. * Separate reporting of emissions for all six GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in metric tonnes and tonnes of CO_2 equivalent. * Separate reporting of emissions from biologically sequestered carbon (if applicable). * **Double Counting:** The report's current methodology for calculating Scope 3 emissions indicates a risk of double-counting, particularly due to the inclusion of product life cycle emissions and the subtraction of Scope 1 and 2 emissions. **Recommendations:** * Clearly distinguish between the corporate carbon footprint (following the GHG Protocol) and the product life cycle assessment (following ISO 14067). * Precisely define the system boundaries for both assessments, providing comprehensive details and ensuring consistency throughout the report. * Transparently justify any exclusions from the corporate carbon footprint. * Provide a detailed description of the calculation methodologies, including all the elements mentioned above. * Ensure consistency with EPEAT requirements for both the corporate carbon footprint and the product LCA. * Review and revise the Scope 3 calculation method to avoid double-counting. This may involve: * Clearly delineating the system boundaries for Scope 3 to focus on upstream and downstream emissions, excluding those already accounted for in Scopes 1 and 2. * Using specific inventory data for Scope 3 activities. * Choosing appropriate emission factors that do not overlap with those used in Scopes 1 and 2. * Considering a "consumption" approach for Scope 3, focusing on emissions related to product use and end-of-life. * Document the subtraction method if the subtraction of Scopes 1 and 2 from Scope 3 is maintained, ensuring transparency and traceability. **REV 2:** Missing (**mandatory**) * An emissions profile over time, with a defined base year. * Separate reporting of emissions for all six GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in metric tonnes and tonnes of CO_2 equivalent. **REV 3:** **Mandatory Elements Missing:** Clarify: Explicitly state whether the CCF assessment has undergone third-party verification. Provide Documentation: include the verification statement and verifier credentials in the documentation (To be assessed at the end) **Recommendations for Enhancement (Not Mandatory):** *Detailed Scope 3 Breakdown: Providing a more detailed breakdown of Scope 3 emissions, including specific data sources and calculation methods for each category, would enhance transparency and comprehensiveness. *Supply Chain Emissions: While the document mentions considering supply chain emissions, offering more specific information on how these are accounted for would be beneficial. **REV 4:** Considered compliant if the verification statement and verified credentials is included in the documentation*	We have reviewed the scope and included explanations for the categories excluded from our study. Additionally, we have incorporated the other parameters related to GHG emissions. Rev.02: Please refer to Table 22. We have added the indicators for CO_2, CH_4, N_2O, and the total CO_2 equivalent in tons. Regarding the indicators for HFCs, PFCs, and SF_6, we have concluded that emissions of these gases are negligible or zero for our company. I have mentioned the reasons on page 43. We have specified the baseline for our emissions calculation on page 41 and included the link to our public disclosure: Hypertec Corporate Sustainability Report 2023.- https://hypertec.com/download/48111/?tmstv=1734719716	X*
	Optional information ***A public GHG emissions report should include, when applicable, the following additional information:***							
	To summarize, here are the key points to verify for compliance with the EPEAT corporate carbon footprint (CCF) criterion: * **Annual CCF:**Verify that the manufacturer conducts a CCF annually, including emissions from owned/leased facilities, the supply chain, product use, and end-of-life. * **Scope Definition**: Ensure the CCF scope includes all facilities with significant					**REV 1: Points to Improve** * The report lacks clarity on the organizational and operational boundaries of the inventory. It should explicitly state the consolidation approach used and provide a more detailed breakdown of the activities included in Scope 3. * The report does not provide the total Scope 1 and Scope 2 emissions independently of any GHG trades such as sales, purchases, transfers, or banking of allowances. It should report these figures separately to enhance transparency. * While the report mentions using the best available data, it does not provide specific methodologies used to calculate or measure emissions for each source. More details on the calculation methods, emission factors, and data sources are needed. * The report does not include an emissions profile over time, which is essential for tracking progress and identifying trends. It should establish a base year and report emissions for multiple years to provide context. * The report does not mention the specific types of activities covered in Scope 3. It should provide a list of the included Scope 3 categories to ensure transparency and avoid confusion. * The report should more clearly distinguish between the corporate carbon footprint and the product carbon footprint to avoid confusion and potential double-counting of emissions. * The report should provide more detailed justifications for the exclusion of certain Scope 3 categories, such as employee commuting and business travel. * The report should include emissions data for all six GHGs separately (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in metric tonnes and tonnes of CO_2 equivalent. * The report should include emissions data for direct CO_2 emissions from biologically sequestered carbon, reported separately from the scopes. * The report needs to include a URL or other evidence of public disclosure of the CCF results. This allows stakeholders to easily verify and scrutinize the company's emissions information.		

<table>
<tr>
<th colspan="2">Standards</th>
<th>4.8.1.1 – Conduct Life Cycle Assessment (confirming to ISO 14040, ISO 14044)</th>
<th>4.8.1.2 – Green House Gas Emissions/Product carbon footprint of raw material extraction through to product End of Life (using ISO 14040 & 14044 and ISO 14067)</th>
<th>4.8.2.1 – Corporate carbon footprint (using ISO 14040 & 14044 and GHG Protocol)</th>
<th>4.8.2.2 – Green House Gas Emissions from product transport (conforming to GLEC Framework).</th>
<th>REVIEWER COMMENTS
(JUSTIFICATION FOR CHANGE)/PROPOSED CHANGE</th>
<th></th>
<th>CHECKED AND APPROVED</th>
</tr>
<tr>
<td></td>
<td>responsibility for the declared products and that the manufacturer has documented how they define "significant responsibility."
* Verification and Disclosure:Verify that the CCF results are third-party verified annually and publicly disclosed, with evidence provided (e.g., a URL to the report).
* Exclusions:Check for documentation of any excluded GHG emissions.
* Product Coverage: Ensure the CCF scope includes the declared products.
* Standards and Methodology:Verify the use of an acceptable CCF standard (or combination of standards) and that the methodology aligns with the chosen standard(s).</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Recommendations
* Clarify the organizational and operational boundaries of the inventory, including the consolidation approach and the specific Scope 3 categories covered.
* Report total Scope 1 and Scope 2 emissions independently of any GHG trades.
* Provide detailed methodologies for calculating or measuring emissions for each source, including emission factors, data sources, and any assumptions made.
* Establish a base year and provide an emissions profile over time to track progress and identify trends.
* Clearly distinguish between the corporate carbon footprint and the product carbon footprint.
* Provide detailed justifications for any excluded Scope 3 categories.
* Report emissions data for all six GHGs separately and in CO2 equivalent.
* Report emissions data for direct CO2 emissions from biologically sequestered carbon separately.
* Include a URL or other evidence of public disclosure of the CCF results.

REV 2: Missing (mandatory)
* An emissions profile over time, with a defined base year.
* Separate reporting of emissions for all six GHGs (CO2, CH4, N2O, HFCs, PFCs, SF6) in metric tonnes and tonnes of CO2 equivalent.
* Include a URL or other evidence of public disclosure of the CCF results. (to be assessed)

REV 3: Completed</td>
<td>We have provide detailed methodologies for calculating or measuring emissions for each source, including emission factors</td>
<td>X</td>
</tr>
<tr>
<td>Green House Gas Emissions from product transport (conforming to GLEC Framework).</td>
<td>EPEAT's criterion for greenhouse gas emissions from product transport requires manufacturers to:

* Conduct an annual assessment:Assess GHG emissions from transporting the declared products, including well-to-wheel emissions from final assembly to the purchaser.
* Include all transport modes: Cover all modes of freight movement (road, air, sea, inland waterways, rail).
* Use approved methodologies: Use the GLEC Framework or mode-specific methodologies (with well-to-tank emissions assessed if not included in the mode-specific methodology).
* Publicly disclose results:Disclose annually a summary of absolute and/or normalized GHG emissions.
* Set and report on an emission reduction goal: Develop and publicly report progress towards a transport-related GHG emission reduction goal.

Verification Requirements:
* Scope alignment:Document how the assessment scope aligns with the criterion.
* Methods used: List the methods used for the assessment.
* Public disclosure: Provide the location of the publicly posted results, emission reduction goal, and progress report.</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>REV 1: The section on GHG emissions from product transport is generally consistent with the GLEC Framework but needs improvement in clarity, completeness, and consistency. Key Issues: * Terminology: The report uses ""Scope 1, 2, and 3"" to categorize transport emissions, conflicting with the GLEC Framework's terminology (Well-to-Tank (WTT), Tank-to-Wheel (TTW), and Other) and potentially causing confusion with the corporate carbon footprint scopes. * Double Counting: There is a high risk of double-counting transport emissions, as these may already be included in the corporate carbon footprint's Scope 3. * System Boundaries: The report lacks clarity on which transport stages are included (e.g., only finished goods or also raw materials/components). Recommendations: * Clarify Terminology: Use the GLEC Framework's WTT, TTW, and Other categories to avoid confusion. * Prevent Double Counting: Ensure transport emissions are accounted for only once, either within the corporate carbon footprint or in a separate product transport section. * Define System Boundaries: Clearly specify which transport stages are included in the analysis. * Justify Methodology: Provide a detailed explanation of the Well-to-Wheel methodology and its application to this LCA, including the reasons for choosing this approach. * Enhance Data Description: Provide more information on the collection and calculation of activity data (e.g., distance, mass, transport modes) and justify the chosen emission factors. * Present Results Clearly:Use the GLEC Framework terminology and appropriate units (e.g., kg CO2e/tonne-km) when presenting results. Consider a table format like the one you provided for clarity. By implementing these recommendations, the report will be more aligned with the GLEC Framework, ensuring a more accurate, transparent, and credible assessment of transport-related emissions. Example of how to present the results: | Element	Quantity	Unit	GHG Emissions (t CO2 eq)
Well-to-Tank (WTT)	\[Quantity of fuel consumed]	\[Unit]	\[WTT emissions]
Tank-to-Wheel (TTW)	\[Distance travelled]	\[Unit]	\[TTW emissions]
Total			\[Total emissions] | * Include a URL or other evidence of public disclosure of the results. REV 2: To be assessed REV 3: Mandatory: *Verification Requirement: EPEAT 4.8.2.2 mandates that the GHG assessment undergoes third-party verification. The verification statement should be included in your documentation, along with the verifier's credentials and contact information (To be assessed at the end) *Public Disclosure Requirement: EPEAT 4.8.2.2 requires annual public disclosure of both absolute GHG emissions (e.g., annual tons of CO2e) and/or normalized GHG emissions (e.g., grams of CO2e per ton-km). Comment: While your report presents a summary of these results, it doesn't explicitly state that this information is publicly disclosed. Please ensure the summary of results, including the location where it is publicly accessible (e.g., a website URL), is clearly stated in your documentation. *Emission Reduction Goal Requirement: EPEAT 4.8.2.2 mandates the development of an emission reduction goal and annual public reporting of progress towards meeting this goal. Comment: Your current documentation lacks an emission reduction goal and a plan for reporting progress. Please define a specific, measurable, achievable, relevant, and time-bound (SMART) emission reduction goal related to product transport. Include a plan to track and publicly report progress towards this goal annually. *Clarification on Distance Type Requirement: The type of distance used in the calculations (transport distance or travel distance) should be clearly specified. Comment: Your document mentions using distances between the plant and client postal codes but doesn't explicitly define the type of distance used. Please clarify whether the distances used represent "transport distance" or "travel distance" to ensure consistency and transparency. Transport Distance vs. Travel Distance Transport Distance: This refers to the actual distance covered by the vehicle transporting the goods. It considers the specific route taken, including any detours, road conditions, or traffic that might affect the total distance traveled. Travel Distance: This is the straight-line or 'as-the-crow-flies' distance between the origin and destination points. It doesn't account for the actual path taken by the vehicle. The comment is asking Hypertechnologie Ciara Inc. to explicitly state which type of distance they used in their calculations. Since they mention using distances between the plant and client postal codes, it's possible they used travel distance (straight-line distance). If this is the case, they should clarify it. If they used transport distance (actual route distance), they should also clearly state this and, ideally, provide information on how they determined these distances (e.g., using GPS data, route planning tools, etc.). Recommendations for Enhancement (optional): *Data Source Transparency: Provide more detailed explanations and references for data sources, including specific data points like average distances and emission factors. * Explicit Emission Breakdown: While using the well-to-wheel (WTW) approach, explicitly state the operational and energy provision emissions separately. *Energy Carrier Breakdown: Include a breakdown of emissions by energy carrier (diesel) to provide a more comprehensive understanding of the emissions sources. REV 4: Considered compliant if the verification statement and verified credentials is included in the documentation*</td>
<td>Please refer to the new calculation:Table 25: Product Transportation Emissions Inventory based on CLEC methodology</td>
<td>X*</td>
</tr>
</table>

Critical Review Report

This review, with the following matrix, assures if the issue is described in the Environmental Data Disclosure Hypertec Group Civil Year 2023 (DOC. #: RP_HYP_QA011_Rev.01) published on CIARA's website and if it is produced according to the requirements and guidelines in the applicable reference as EPEAT Program.

Third-party verification of **data published on CIARA's website** according to the requirements of the 4.9.2.1 criterion of EPEAT

GRI 302: Energy Reporting Requirements
GRI 303: Water and Effluents Reporting Requirements
GRI 305: Emissions Reporting requirements
GRI 3: Material Topics 2021

GRI 302: Energy Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
Management approach disclosures			
1.1 The reporting organization shall report its management approach for energy using *GRI 3: Material Topics 2021*	Completed	**V1:** The report lacks a description of the management approach for energy using GRI 3: Material Topics 2021. **V2:** Renewable Energy Reporting: The report mentions that Hypertec procures Renewable Energy Certificates (RECs) to reduce Scope 2 emissions. However, it's unclear how these RECs are accounted for in the energy consumption and emissions data. Further clarification is needed on whether the reported renewable energy consumption includes the RECs or if they are treated separately.	V1: Please refer to the section I have added Management Approach P.4 V2: Please refer to the explanation added: P. 13
Disclosure 302-1 Energy consumption within the organization			
The reporting organization shall report the following information:	Completed	The report does not provide information on total fuel consumption from renewable	- Please refer to this note: ' Hypertec's heating and cooling

GRI 302: Energy Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
a. Total fuel consumption within the organization from non-renewable sources, in joules or multiples, and including fuel types used. b. Total fuel consumption within the organization from renewable sources, in joules or multiples, and including fuel types used. c. In joules, watt-hours or multiples, the total: i. electricity consumption ii. heating consumption iii. cooling consumption iv. steam consumption d. In joules, watt-hours or multiples, the total: i. electricity sold ii. heating sold iii. cooling sold iv. steam sold e. Total energy consumption within the organization, in joules or multiples. f. Standards, methodologies, assumptions, and/or calculation tools used. g. Source of the conversion factors used		sources, total heating consumption, total cooling consumption, total steam consumption, and the source of conversion factors used.	systems operate entirely on electricity. As a result, the reported electricity consumption includes energy used for climate control (heating and cooling), eliminating the need for separate reporting under heating and cooling categories.' - Steam Consumption: "Hypertec does not utilize steam in its operations. Our energy needs for heating and cooling are entirely met through electricity consumption. As such, the consumption of steam is not applicable to our energy reporting -The source of conversion factors has been added in the footnotes section: **Ministry-Environment Conversion-Table-GHG**
Disclosure 302-2 Energy consumption outside of the organization			
The reporting organization shall report the following information: a. Energy consumption outside of the organization, in joules or multiples. b. Standards, methodologies, assumptions, and/or calculation tools used. c. Source of the conversion factors used.	N/A	The report does not provide any information on energy consumption outside the organization.	N/A Please refer to section 302-2 in the index P.18: 'This metric does not apply to Hypertec Group's activities and energy consumption scope.'
Disclosure 302-3 Energy intensity			
The reporting organization shall report the following information: a. Energy intensity ratio for the organization. b. Organization-specific metric (the denominator) chosen to calculate the ratio. c. Types of energy included in the intensity ratio; whether fuel, electricity, heating, cooling, steam, or all.	Completed	**V1:** The report does not provide information on the energy intensity ratio, the organization-specific metric used, and the types of energy included **in the ratio.** **V2:**	V1: Please refer to the section on Intensity Value (4.4.2, P.17) and description of Energy/ GHG emissions Intensity Ratio P.5

GRI 302: Energy Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
d. Whether the ratio uses energy consumption within the organization, outside of it, or both.		• Explanation of Scope 3 Increase: The report attributes the significant increase in Scope 3 emissions to the expansion of the work scope and inclusion of additional categories. However, it would be beneficial to provide more specific details about the impact of each new category on Scope 3 emissions and the reasons for the substantial increase (p.17) • Energy Consumption Table: In the "Source of Energy" table, the total renewable energy for 2020 is listed as 50,1900 MWh, which seems to be an error with an extra zero. The correct value should likely be 50,190 MWh (Table 4.2.3.4 *Source of Energy* p.9)	V2: I have added an explanation for the significant increase in Scope 3 on page 17 Energy Consumption Table: It was an error I have corrected it
Disclosure 302-4 Reduction of energy consumption			
The reporting organization shall report the following information: a. Amount of reductions in energy consumption achieved as a direct result of conservation and efficiency initiatives, in joules or multiples. b. Types of energy included in the reductions; whether fuel, electricity, heating, cooling, steam, or all. c. Basis for calculating reductions in energy consumption, such as base year or baseline, including the rationale for choosing it. d. Standards, methodologies, assumptions, and/or calculation tools used.	Completed	The report does not provide information on the amount of energy consumption reductions achieved, the types of energy included in the reductions, and the basis for calculating reductions.	I have added the variation in both amount and percentage. Additionally, I have included a paragraph in the scope section detailing the reduction calculation methodology.
Disclosure 302-5 Reductions in energy requirements of products and services			
The reporting organization shall report the following information: a. Reductions in energy requirements of sold products and services achieved during the reporting period, in joules or multiples.	Completed	The report does not provide any information on reductions in energy requirements of sold products and services.	Please refer to the section (4.2.4) P.9

GRI 302: Energy Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
b. Basis for calculating reductions in energy consumption, such as base year or baseline, including the rationale for choosing it. c. Standards, methodologies, assumptions, and/or calculation tools used.			

GRI 303: Water and Effluents Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
Management approach disclosures			
The reporting organization shall report its management approach for water and **effluents** using *GRI 3: Material Topics 2021*	Completed	The report lacks a description of the management approach for water and effluents using GRI 3: Material Topics 2021.	
Disclosure 303-1 Interactions with water as a shared resource			
The reporting organization shall report the following information: a. A description of how the organization interacts with water, including how and where water is withdrawn, consumed, and discharged, and the water-related impacts caused or contributed to, or directly linked to the organization's activities, products, or services by a business relationship (e.g., impacts caused by runoff). b. A description of the approach used to identify water-related impacts, including the scope of assessments, their timeframe, and any tools or methodologies used. c. A description of how water-related impacts are addressed, including how the organization works with stakeholders to steward water as a shared resource, and how it engages with suppliers or customers with significant water-related impacts. d. An explanation of the process for setting any water-related goals and targets that are part of the organization's management approach, and how they relate to public policy and the local context of each area with water stress.	N/A	The report does not provide any information on interactions with water as a shared resource.	This section is not applicable to Hypertec.
Disclosure 303-2 Management of water discharge-related impacts			
The reporting organization shall report the following information: a. A description of any minimum standards set for the quality of effluent discharge, and how these minimum standards were determined, including: i. how standards for facilities operating in locations with no local discharge requirements were determined. ii. any internally developed water quality standards or guidelines. iii. any sector-specific standards considered. iv. whether the profile of the receiving waterbody was considered.	N/A	The report does not provide any information on the management of water discharge-related impacts.	This section is not applicable to Hypertec.
Disclosure 303-3 Water withdrawal			
The reporting organization shall report the following information:	N/A	The report does not provide any information on water withdrawal.	This section is not applicable to Hypertec.

GRI 303: Water and Effluents Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
a. Total water withdrawal from all areas in megaliters, and a breakdown of this total by the following sources, if applicable: i. Surface water. ii. Groundwater. iii. Seawater. iv. Produced water. v. Third-party water. b. Total water withdrawal from all areas with water stress in megaliters, and a breakdown of this total by the following sources, if applicable: i. Surface water. ii. Groundwater. iii. Seawater. iv. Produced water. v. Third-party water, and a breakdown of this total by the withdrawal sources listed in i-iv. c. A breakdown of total water withdrawal from each of the sources listed in Disclosures 303-3-a and 303-3-b in megaliters by the following categories: i. Freshwater (≤1,000 mg/L Total Dissolved Solids). ii. Other water (>1,000 mg/L Total Dissolved Solids). d. Any contextual information necessary to understand how the data have been compiled, such as any standards, methodologies, and assumptions used.			
Disclosure 303-4 Water discharge			
The reporting organization shall report the following information: a. Total water discharge to all areas in megaliters, and a breakdown of this total by the following types of destination, if applicable: i. Surface water. ii. Groundwater. iii. Seawater. iv. Third-party water, and the volume of this total sent for use to other organizations, if applicable. b. A breakdown of total water discharge to all areas in megaliters by the following categories:	N/A	The report does not provide any information on water discharge.	This section is not applicable to Hypertec.

GRI 303: Water and Effluents Reporting Requirements	Status	Verifier's Comments	CIARA's Comments
i. Freshwater (≤1,000 mg/L Total Dissolved Solids). ii. Other water (>1,000 mg/L Total Dissolved Solids). c. Total water discharge to all areas with water stress in megaliters, and a breakdown of this total by the following categories: i. Freshwater (≤1,000 mg/L Total Dissolved Solids). ii. Other water (>1,000 mg/L Total Dissolved Solids). d. Priority substances of concern for which discharges are treated, including: i. how priority substances of concern were defined, and any international standard, authoritative list, or criteria used. ii. the approach for setting discharge limits for priority substances of concern. iii. number of incidents of non-compliance with discharge limits. e. Any contextual information necessary to understand how the data have been compiled, such as any standards, methodologies, and assumptions used.			
Disclosure 303-5 Water consumption			
The reporting organization shall report the following information: a. Total water consumption from all areas in megaliters. b. Total water consumption from all areas with water stress in megaliters. c. Change in water storage in megaliters if water storage has been identified as having a significant water-related impact. d. Any contextual information necessary to understand how the data have been compiled, such as any standards, methodologies, and assumptions used, including whether the information is calculated, estimated, modeled, or sourced from direct measurements, and the approach taken for this, such as the use of any sector-specific factors.	Completed	**V1:** The report does not provide contextual information on how the water consumption data has been compiled. **V2:** Water Consumption Data: The report presents water consumption data in megaliters (ML) but doesn't specify whether this represents water withdrawal or consumption. Clarifying this distinction would be important for accuracy.	V1: Please refer to the assessment description for water consumption on page 4. V2: The data presented represents actual water consumption, we have already explained the methodology in P. 6

GRI 305: Emissions Reporting requirements	Status	Verifier's Comments	CIARA's Comments
Management approach disclosures			
1.1 The reporting organization shall report its management approach for emissions using *GRI 3: Material Topics 2021*	Completed	The report does not explain whether offsets were used to meet GHG emissions targets.	"Hypertec utilizes Renewable Energy Certificates (RECs: 3474 for CY2023) " Please refer to management approach section P.4

GRI 305: Emissions Reporting requirements	Status	Verifier's Comments	CIARA's Comments
1.2 When reporting on GHG emissions targets, the reporting organization shall explain whether offsets were used to meet the targets, including the type, amount, criteria, or scheme of which the offsets are part.			
Disclosure 305-1 Direct (Scope 1) GHG emissions			
The reporting organization shall report the following information: a. Gross direct (Scope 1) GHG emissions in metric tons of CO_2 equivalent. b. Gases included in the calculation; whether CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, or all. c. Biogenic CO_2 emissions in metric tons of CO_2 equivalent. d. Base year for the calculation, if applicable, including: i. the rationale for choosing it. ii. emissions in the base year. iii. the context for any significant changes in emissions that triggered recalculations of base year emissions. e. Source of the emission factors and the global warming potential (GWP) rates used, or a reference to the GWP source. f. Standards, methodologies, assumptions, and/or calculation tools used.	Completed	The report does not provide information on biogenic CO_2 emissions, the base year for the calculation, and the source of emission factors and GWP rates used.	Hypertec does not use biogenic energy sources in its operations; therefore, no significant biogenic emissions are reported. Please refer to the description on page 10.
Disclosure 305-2 Energy indirect (Scope 2) GHG emissions			
The reporting organization shall report the following information: a. Gross location-based energy indirect (Scope 2) GHG emissions in metric tons of CO_2 equivalent. b. If applicable, gross market-based energy indirect (Scope 2) GHG emissions in metric tons of CO_2 equivalent. c. If available, the gases included in the calculation; whether CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, or all. d. Base year for the calculation, if applicable, including: i. the rationale for choosing it. ii. emissions in the base year. iii. the context for any significant changes in emissions that triggered recalculations of base year emissions. e. Source of the emission factors and the global warming potential (GWP) rates used, or a reference to the GWP source.	Completed	The report does not provide information on market-based energy indirect (Scope 2) GHG emissions, gases included in the calculation, and the consolidation approach for emissions.	Please refer to the description on page 11.

GRI 305: Emissions Reporting requirements	Status	Verifier's Comments	CIARA's Comments
f. Consolidation approach for emissions; whether equity share, financial control, or operational control. g. Standards, methodologies, assumptions, and/or calculation tools used.			
Disclosure 305-3 Other indirect (Scope 3) GHG emissions			
The reporting organization shall report the following information: a. Gross other indirect (Scope 3) GHG emissions in metric tons of CO_2 equivalent. b. If available, the gases included in the calculation; whether CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, or all. c. Biogenic CO_2 emissions in metric tons of CO_2 equivalent. d. Other indirect (Scope 3) GHG emissions categories and activities included in the calculation. e. Base year for the calculation, if applicable, including: i. the rationale for choosing it. ii. emissions in the base year. iii. the context for any significant changes in emissions that triggered recalculations of base year emissions. f. Source of the emission factors and the global warming potential (GWP) rates used, or a reference to the GWP source. g. Standards, methodologies, assumptions, and/or calculation tools used.	Completed	**V1:** The report does not provide information on biogenic CO_2 emissions, the base year for the calculation, and the source of emission factors and GWP rates used. **V2:** Scope 3 Emission Factor Source: The report states that emission factors for Scope 3 emissions are sourced from the GHG Protocol for general ones and the EPA database for IT equipment. However, specific details about which emission factors were used from each source are not provided. To ensure transparency and clarity, the report should provide specific details about the emission factors used for each Scope 3 category. This could include: • Listing the specific emission factors: For each category, list the emission factors used from the GHG Protocol and the EPA database. • Providing references: Include references to the specific sources within the GHG Protocol and EPA database where the emission factors were obtained.	There is no biogenic energy sources used in its operations Please refer to the description (Scope 3) P.11 V2: please refer the annex 2 for the emission factors used in the report

GRI 305: Emissions Reporting requirements	Status	Verifier's Comments	CIARA's Comments
		• Explaining any adjustments: If any adjustments were made to the default emission factors, explain the reasons for the adjustments and the methodology used.	
Disclosure 305-4 GHG emissions intensity			
The reporting organization shall report the following information: a. GHG emissions intensity ratio for the organization. b. Organization-specific metric (the denominator) chosen to calculate the ratio. c. Types of GHG emissions included in the intensity ratio; whether direct (Scope 1), energy indirect (Scope 2), and/or other indirect (Scope 3). d. Gases included in the calculation; whether CO2, CH4, N2O, HFCs, PFCs, SF6, NF3, or all.	Completed	The report does not provide information on the GHG emissions intensity ratio, the organization-specific metric used, and the types of GHG emissions included in the intensity ratio.	Please refer to the section on Intensity Value (4.4.2, P.13) and description of Energy/ GHG emissions Intensity Ratio P.5
Disclosure 305-5 Reduction of GHG emissions			
The reporting organization shall report the following information: a. GHG emissions reduced as a direct result of reduction initiatives, in metric tons of CO2 equivalent. b. Gases included in the calculation; whether CO2, CH4, N2O, HFCs, PFCs, SF6, NF3, or all. c. Base year or baseline, including the rationale for choosing it. d. Scopes in which reductions took place; whether direct (Scope 1), energy indirect (Scope 2), and/or other indirect (Scope 3). e. Standards, methodologies, assumptions, and/or calculation tools used.	Completed	The report does not provide information on GHG emissions reduced, gases included in the calculation, and the base year or baseline.	Please refer to the section on Absolute Value 4.4.1 (Variation & Improvement)
Disclosure 305-6 Emissions of ozone-depleting substances (ODS)			
The reporting organization shall report the following information: a. Production, imports, and exports of ODS in metric tons of CFC-11 (trichlorofluoromethane) equivalent. b. Substances included in the calculation. c. Source of the emission factors used. d. Standards, methodologies, assumptions, and/or calculation tools used.	N/A	The report does not provide any information on emissions of ozone-depleting substances	Not applicable: Our activities focus on assembling IT equipment, a process that does not require the use of ODS.
Disclosure 305-7 Nitrogen oxides (NOX), sulfur oxides (SOX), and other significant air emissions			

GRI 305: Emissions Reporting requirements	Status	Verifier's Comments	CIARA's Comments
The reporting organization shall report the following information: a. Significant air emissions, in kilograms or multiples, for each of the following: i. NOX ii. SOX iii. Persistent organic pollutants (POP) iv. Volatile organic compounds (VOC) v. Hazardous air pollutants (HAP) vi. Particulate matter (PM) vii. Other standard categories of air emissions identified in relevant regulations b. Source of the emission factors used. c. Standards, methodologies, assumptions, and/or calculation tools used.	N/A	The report does not provide any information on nitrogen oxides, sulfur oxides, and other significant air emissions.	Not applicable: Our company does not generate significant NOx, SOx, or other air emissions, as our activities focus on IT equipment assembly, which does not involve combustion or industrial processes that release these pollutants. However, we ensure that our suppliers comply with air quality regulations and adopt best practices to minimize emissions.

Disclosure 3-3 Management of material topics	Status	Verifier's Comments	CIARA's Comments
Disclosure 3-3 Management of material topics			
For each material topic reported under Disclosure 3-2, the organization shall: a. describe the actual and potential, negative and positive impacts on the economy, environment, and people, including impacts on their human rights; b. report whether the organization is involved with the negative impacts through its activities or as a result of its business relationships, and describe the activities or business relationships; c. describe its policies or commitments regarding the material topic; d. describe actions taken to manage the topic and related impacts, including: i. actions to prevent or mitigate potential negative impacts; ii. actions to address actual negative impacts, including actions to provide for or cooperate in their remediation; ii. actions to manage actual and potential positive impacts; e. report the following information about tracking the effectiveness of the actions taken: i. processes used to track the effectiveness of the actions; ii. goals, targets, and indicators used to evaluate progress;	Completed	The report does not describe the actual and potential impacts of material topics on the economy, environment, and people, including impacts on human rights.	Please refer to: Impacts on the Economy, Environment, and People section P. 5

Disclosure 3-3 Management of material topics	Status	Verifier's Comments	CIARA's Comments
iii. the effectiveness of the actions, including progress toward the goals and targets; iv. lessons learned and how these have been incorporated into the organization's operational policies and procedures; f. describe how engagement with stakeholders has informed the actions taken (3-3-d) and how it has informed whether the actions have been effective (3-3-e).			
Topic management disclosures: additional requirements GHG emissions			
When reporting on GHG emissions targets, the reporting organization shall explain whether offsets were used to meet the targets, including the type, amount, criteria or scheme of which the offsets are part	Completed	The report does not explain whether offsets were used to meet GHG emissions targets.	We have added a description below the table of: Procurement of Renewable Energy Certificates (REC) P.12
General Reporting Clarity	Completed	Specific tables in the report that have inconsistent formatting or missing units, particularly those related to Scope 3 emissions: **Scope 3 Emissions Tables:** **Category 1: Purchased Goods and Services:** This table is missing units for the "Intensity Metric" columns. It's unclear whether the values are in t CO_2-e / sq.ft or t CO_2-e / $ CAD Revenue. **Category 2: Capital Goods:** Like Category 1, this table lacks units for the "Intensity Metric" columns. **Category 3: Fuel-and-Energy Activities:** This table has inconsistent formatting compared to other Scope 3 tables, using "t CO_2-e / sq.ft" instead of separating the units into individual columns for each metric.	V2: Regarding the Intensity Metric columns, we have presented intensity metrics in relation to both building surface area (square feet) and revenue (Canadian dollars). Therefore, we included both units: metric tonnes of CO_2 equivalent per square foot (t CO_2-e / sq.ft) and metric tonnes of CO_2 equivalent per Canadian dollar of revenue (t CO_2-e / $ CAD Revenue) to provide a comprehensive view of our emissions intensity

Disclosure 3-3 Management of material topics	Status	Verifier's Comments	CIARA's Comments
		Category 4: Upstream Transportation and Distribution: This table uses inconsistent abbreviations for units, using "t CO_2-e" in the first column but "tCO_2-e" in the "Intensity Metric" columns. **Category 5: Waste Generated in Operations:** This table also lacks units for the "Intensity Metric" columns. **Category 6: Business Travel:** This table has the same issue with missing units for the "Intensity Metric" columns. **Category 7: Employee Commuting:** This table is missing units for the "Intensity Metric" columns. **Category 8: Upstream Leased Assets:** This table lacks units for the "Intensity Metric" columns. **Category 9: Downstream Transportation and Distribution:** This table has missing units for the "Intensity Metric" columns. **Category 11: Use of Sold Products:** This table also lacks units for the "Intensity Metric" columns. **Total Gross Scope 3:** This table has missing units for the "Intensity Metric" columns. **Additional Tables with Minor Inconsistencies:** **Oil Fuel (Diesel) from Stationary and Mobile Sources:** This table has a missing	

Disclosure 3-3 Management of material topics	Status	Verifier's Comments	CIARA's Comments
		value in the "Annual Variation (%)" column for 2022. **Source of Energy:** This table has inconsistent formatting for the "Variation vs 2019" rows, using different spacing and alignment compared to other tables. **Recommendations:** **Add Missing Units:** Ensure that all tables have clear and consistent units for all columns, especially those related to Scope 3 emissions. **Standardize Formatting:** Use consistent formatting for all tables, including column headers, units, and alignment.	
	Completed	The report uses the terms "variation" and "improvement" interchangeably, which could lead to confusion. Using consistent terminology would improve clarity.	We have decided to use "Variation" to describe any increase or decrease to ensure consistency and clarity in the report.
	Completed	The descriptions of methodologies used for calculating energy and emissions data could be more detailed and specific. Providing more context on the data sources, assumptions, and calculation steps would enhance transparency.	