2026

Notebook NTT Book B15

Life Cycle Assessment & Product Carbon Footprint

Prepared by Plan Be Eco for NTT System S.A.

Full LCA per ISO 14040/14044, GHG Protocol Product Standard & EN 15804+A2 (13 impact categories) · 17 September 2026

EXECUTIVE SUMMARY

Cradle-to-grave carbon & environmental footprint

Notebook NTT Book B15 · functional unit: 1 unit, ready for use, excluding packaging

172.59 **kg CO_2e / unit (GWP-total, cradle-to-grave)**

ISO 14040 / 14044 | GHG Protocol Product Standard | EN 15804+A2 · 13 impact categories | ecoinvent 3.12 (cut-off) · EF v3.1

This report presents a full Life Cycle Assessment (LCA) of the NTT Book B15 notebook, covering all 13 environmental impact categories defined under EN 15804+A2, with Global Warming Potential (GWP-total) reported as the headline indicator. The assessment is based on primary bill-of-materials, compliance and test data supplied by NTT System S.A. (BOM, MSDS, RoHS declarations, IEC 62474 material declarations), combined with secondary background data from the ecoinvent 3.12 database (cut-off system model) and the EF 3.1 characterisation method.

Key findings

- **Total footprint: 172.59 kg CO_2e** per unit over its full cradle-to-grave life cycle (raw materials & production, transport, a 6-year use phase, and end of life).
- The **use phase (module B)** is the single largest contributor at 34.5% of the total, driven by the assumed Polish grid electricity mix over the product's use.
- Combined, **raw materials and production (A1–A3)** account for 57.2% of the total, with electronic sub-components (memory, storage and integrated circuits) as the dominant materials hotspot.
- **Air freight** accounts for 99.9% of upstream transport emissions (module A2), despite representing a small share of total transport legs — a concrete, actionable reduction lever.
- Two genuine data gaps affect the twelve non-GWP indicators and are disclosed transparently in this report: production-process impacts (A3) were quantified for GWP-total only, and end-of-life recycling credits (module D) were not modelled. See *Data Quality & Limitations*.
- **Primary Energy Demand (PED)** — an additional EN 15804 "use of resources" indicator outside the 13 core categories — is reported for raw materials and transport (A1, A2, A4). See page 8.

> **Compliance note.** This assessment has not undergone independent critical review under ISO 14044 clause 6.3. It is intended to support NTT System S.A.'s internal environmental decision-making and EPD/ESG preparation, and is **not** intended for comparative assertions disclosed to the public without such a review.

METHODOLOGY

Goal, scope & assessment framework

How this LCA was performed

Goal & intended application

The goal of this study is to quantify the cradle-to-grave environmental impact of one NTT Book B15 notebook across the 13 impact categories of EN 15804+A2, to identify environmental hotspots, and to support NTT System S.A.'s environmental disclosure and product-improvement decisions. The intended audience is the manufacturer (business use); the study has not been prepared for public comparative assertions.

Standards applied

- **ISO 14040:2006 / ISO 14044:2006** — principles, framework, requirements and guidelines for life cycle assessment.
- **GHG Protocol Product Life Cycle Accounting and Reporting Standard** — GHG accounting and boundary-setting conventions.
- **ISO 14067:2018** — carbon footprint of products, informing the GWP headline metric.
- **EN 15804+A2** — core product category rules, adapted here from construction products to electronics for its module lettering (A1–A3, A4, B1–B7, C1–C4, D) and its set of 13 characterised impact categories.

Functional unit & system boundary

Functional unit	1 unit of NTT Book B15 notebook, assembled and ready for use, excluding packaging
Reference product mass	1,720 g (1.72 kg)
Configuration assessed	Intel Core i7-1355U, 32 GB DDR4, 1 TB SSD (1 of the manufacturer's configurations)
System boundary	Cradle-to-grave: A1–A3 (raw material supply & production), A4 (transport to distribution), B (use-phase electricity), C (end of life). Module D (reuse/recovery/recycling potential) is within scope but was not quantified — see limitations.
Geographic scope	Global component supply chain (China, Taiwan, Hong Kong, France, Poland); production and use phase modelled for Poland
Time period	Reference year 2025/2026; data collected 2026

Life cycle inventory (LCI) data sources

Primary (foreground) data: component-level bill of materials, mass declarations, RoHS test reports (multiple accredited labs), battery and RTC-cell MSDS, and IEC 62474 / IPC-1752A material declarations supplied directly by NTT System S.A., cross-checked against declared component masses and chemical compositions during data collection.

Secondary (background) data: ecoinvent 3.12, cut-off system model, characterised with the **EF v3.1** (Environmental Footprint) method, covering material production, transport and electricity-mix datasets. Where a component was documented only by unit count, area or a non-mass unit, mass was derived using standard material densities and geometry (e.g. PCB laminate, die area); these engineering conversions are logged in the underlying calculation file.

Impact assessment method

Life Cycle Impact Assessment (LCIA) was carried out using the EF v3.1 characterisation factors, reported against the 13 EN 15804+A2 impact categories: GWP-total, GWP-fossil, GWP-biogenic, GWP-LULUC, ODP, AP, EP-freshwater, EP-marine, EP-terrestrial, POCP, ADP-minerals&metals, ADP-fossil and WDP. GWP-total is reported as the headline metric consistent with the ISO 14067 carbon-footprint convention.

Basic information

Key parameters of the assessed product and study, at a glance.

Product	Notebook NTT Book B15 (NTT System S.A.)
Product weight	1.72 kg (excl. packaging)
Annual production volume (model)	358 units / 2025
Assumed minimum use-phase lifespan	6 years
Annual energy demand (TEC)	17.96 kWh / year
Total lifetime use-phase energy	107.76 kWh
Use-phase electricity mix	0.553 kg CO_2e / kWh (grid mix; geography to be confirmed – representative of Poland)
LCI database	ecoinvent 3.12, cut-off system model
LCIA method	EF v3.1 (Environmental Footprint), EN 15804+A2 category set
Headline result (GWP-total)	**172.59 kg CO_2e / unit**
Report date	17 September 2026 · underlying LCI data compiled 10 September 2026
Prepared by	Plan Be Eco, for NTT System S.A.
Critical review	Not performed (ISO 14044 §6.3) — not for public comparative assertions

Life cycle modules covered

- **A1** — raw material supply
- **A2** — transport of raw materials to production
- **A3** — production processes
- **A4** — transport to distribution
- **B** — use phase (electricity consumption)
- **C** — end of life
- **D** — reuse, recovery, recycling potential (in scope, not quantified)

> Modules B2–B7 (maintenance, repair, replacement, refurbishment) and A5 (installation) are not applicable to a consumer notebook used as delivered and are excluded from the system boundary by definition, not by data limitation.

RESULTS

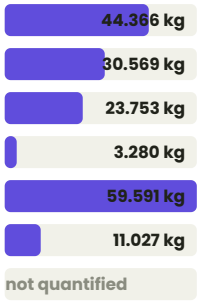
Carbon footprint by life cycle module

GWP-total (headline indicator), fully aggregated across all six quantified modules

172.59 **kg CO_2e / unit**

Mod.	Life cycle module	kg CO_2e	Share
A1	Raw material supply	44.366	25.7%
A2	Transport, raw materials to production	30.569	17.7%
A3	Production processes	23.753	13.8%
A4	Transport to distribution	3.280	1.9%
B	Use phase (electricity consumption)	59.591	34.5%
C	End of life	11.027	6.4%
D	Reuse, recovery, recycling potential	not quantified*	—
Total (A1–A3 + A4 + B + C, cradle-to-grave; D not quantified)		**172.6**	**100.0%**

* Module D is within the system boundary but was not quantified in this assessment (no end-of-life recycling credit data available) — see Data Quality & Limitations.



Reading the result. The use phase (B) is the largest single module (34.5%), ahead of raw materials (A1, 25.7%). Combined, upstream materials and production (A1+A2+A3) account for 57.2% of the total — larger in aggregate than the use phase, but distributed across three modules rather than concentrated in one.

Full LCA results — all 13 impact categories

Per the user's requested scope, results below cover the complete EN 15804+A2 indicator set (not GWP alone), broken down by life cycle module. Figures are per functional unit (1 notebook).

Climate change & ozone depletion

Module	GWP-total [kg CO2 eq]	GWP-fossil [kg CO2 eq]	GWP-biogenic [kg CO2 eq]	GWP-LULUC [kg CO2 eq]	ODP [kg CFC11 eq]
A1	44.366	44.096	0.09691	0.09231	2.384e-06
A2	30.569	25.203	0.00183	0.00193	3.903e-07
A3	23.753	—	—	—	—
A4	3.280	0.27769	5.462e-05	9.361e-05	6.308e-09
B	59.591	59.591	0.01961	0.00948	1.250e-06
C	11.027	10.561	1.823e-04	1.667e-04	5.693e-10
D	—	—	—	—	—
Total	**172.6**	**139.7**	**0.11859**	**0.10398**	**4.032e-06**

Acidification, eutrophication & photochemical ozone formation

Module	AP (acidification) [mol H+ eq]	EP-freshwater [kg P eq]	EP-marine [kg N eq]	EP-terrestrial [mol N eq]	POCP (photochemical ozone formation) [kg NMVOC eq]
A1	0.42057	0.06413	0.07026	0.71008	0.20627
A2	0.10382	3.680e-04	0.04291	0.46809	0.15275
A3	—	—	—	—	—
A4	0.00125	1.986e-05	5.020e-04	0.00548	0.00193
B	0.70906	0.03879	0.08933	0.91488	0.26509
C	4.747e-04	4.197e-05	8.961e-05	9.598e-04	2.649e-04
D	—	—	—	—	—
Total	**1.235**	**0.10335**	**0.20309**	**2.099**	**0.62630**

Full LCA results — resource use & water (cont.)

Resource use & water deprivation

Module	ADP-minerals & metals [kg Sb eq]	ADP-fossil [MJ]	WDP (water deprivation) [m3 depriv.]
A1	0.01678	614.2	81.804
A2	5.567e-06	333.1	0.44912
A3	—	—	—
A4	9.361e-07	3.972	0.02188
B	5.043e-04	1,217.7	10.173
C	8.170e-07	1.097	0.02116
D	—	—	—
Total	**0.01730**	**2,170.0**	**92.469**

* A3 (production processes) is quantified for GWP-total only in the underlying dataset; its contribution to the twelve non-GWP indicators above is a genuine data gap (not a true zero) and totals for those columns should be read as partial. Module D (reuse/recovery/recycling potential) was not modelled for any indicator—see Data Quality & Limitations.

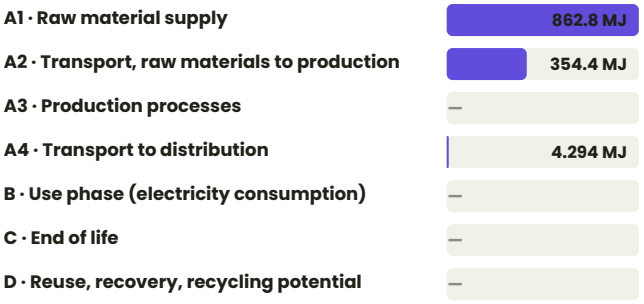
Interpretation note

For GWP-total, all six quantified modules contribute and the total (172.59 kg CO_2e) is complete. For the remaining twelve indicators, module A3 (production processes) contributes zero because it was characterised for GWP-total only in the underlying calculation — a genuine data gap, not a finding that production processes have no acidification, eutrophication, resource-depletion or water-use impact. Totals for those twelve columns should therefore be read as a partial, conservative lower bound rather than a complete result. Closing this gap (obtaining ecoinvent factors for the full EF v3.1 category set for the production-process dataset) is the single highest-value next step to strengthen this assessment.

Primary Energy Demand (PED)

PED-total (renewable + non-renewable primary energy combined) is reported here as an additional indicator from EN 15804+A2's "use of resources" parameter block, alongside the 13 core impact categories presented earlier. It is characterised using the Cumulative Energy Demand (CED) method, ecoinvent 3.12 (cut-off), and covers raw material supply and transport (A1, A2, A4).

Mod.	Life cycle module	MJ
A1	Raw material supply	862.8
A2	Transport, raw materials to production	354.4
A3	Production processes	–
A4	Transport to distribution	4.294
B	Use phase (electricity consumption)	–
C	End of life	–
D	Reuse, recovery, recycling potential	–
Total (A1 + A2 + A4)		**1,221.5**



Figures cover A1, A2 and A4. A3, B, C and D are outside the current PED scope, consistent with the module coverage noted for the twelve non-GWP indicators on the preceding page.

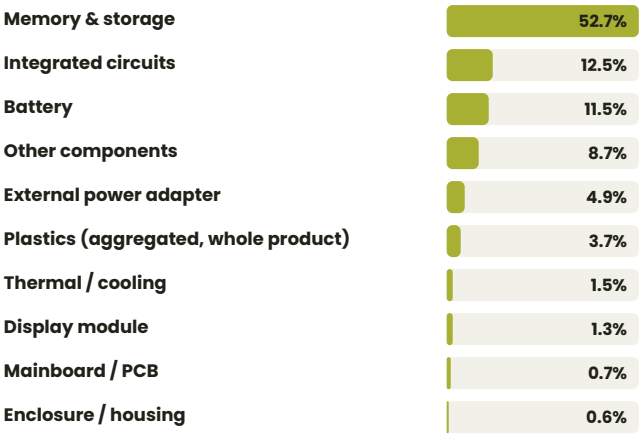
ANALYSIS OF RESULTS

Where the footprint comes from

Material-category hotspots within A1 — Raw material supply

Within A1 (raw material supply, 44.37 kg CO_2e, 25.7% of the total footprint), impact is heavily concentrated in electronic sub-components rather than structural materials:

Component category	kg CO_2e	% of A1	% of total
Memory & storage	23.369	52.7%	13.5%
Integrated circuits	5.551	12.5%	3.2%
Battery	5.121	11.5%	3.0%
Other components	3.854	8.7%	2.2%
External power adapter	2.157	4.9%	1.3%
Plastics (aggregated, whole product)	1.640	3.7%	1.0%
Thermal / cooling	0.65924	1.5%	0.4%
Display module	0.59568	1.3%	0.3%
Mainboard / PCB	0.31318	0.7%	0.2%
Enclosure / housing	0.25920	0.6%	0.2%
Critical / trace metals control items (Au, Ag, Pd, Pt, Ta, Ga, Ge, In, Nd, Co —flagged for inclusion)	**0.84687**	**1.9%**	**0.5%**
A1 — Raw material supply, total	**44.366**	**100.0%**	**25.7%**



Memory & storage alone accounts for 52.7% of A1 (13.5% of the total footprint) — by far the single largest materials hotspot, consistent with the high embodied emissions of semiconductor fabrication. Integrated circuits (12.5% of A1) and the battery (11.5% of A1) follow. Structural materials — the enclosure and mainboard substrate — together contribute only 1.3% of A1.

> A further 0.85 kg CO_2e (1.9% of A1) is attributable to critical/trace metals (gold, silver, palladium, platinum, tantalum, gallium, germanium, indium, neodymium, cobalt) that were tracked separately to avoid double-counting with the bulk components they are embedded in, and flagged for inclusion in the total. See the underlying calculation file's "critical metals control" sheet for the item-level breakdown.

Upstream transport (A2) — route detail

A2 (transport of raw materials/sub-components to the production site) totals 30.57 kg CO_2e (17.7% of the total footprint), modelled as seven individual legs across the component supply chain.

#	Route	Mode	Distance [km]	Mass [kg]	GWP-total [kg CO_2e]
1	Magnice (PL) -> Zakret (PL)	Truck	393.7	0.100	0.00703
	Merignac (FR) -> Zakret (PL)	Truck	2,199.5	0.040	0.01571
	Hong Kong SAR -> Warsaw Chopin Airport (PL)	Air freight	8,261.7	3.000	25.254
	Warsaw Chopin Airport -> Zakret (PL)	Truck	31.6	3.000	0.01694
2	Shanghai (CN) -> Hong Kong SAR	Air freight	1,432.0	3.000	4.377
3	Taipei (TW) -> Wroclaw Airport (PL)	Air freight	8,817.6	0.100	0.89843
	Wroclaw Airport -> Magnice (PL)	Truck	20.2	0.100	3.601e-04
Total — A2 upstream transport					**30.569**

Air freight dominates. The three air-freight legs (Hong Kong → Warsaw, Shanghai → Hong Kong, Taipei → Wrocław) account for **99.9%** of A2's impact, despite truck legs covering comparable or greater distances for lower-mass shipments. The single Hong Kong → Warsaw air leg alone (25.25 kg CO_2e) represents 82.6% of all upstream transport emissions. Shifting long-haul component logistics from air to sea/rail-plus-truck, where lead times allow, is the most impactful lever available for reducing module A2.

DATA QUALITY

Assumptions, limitations & uncertainty

Disclosed per ISO 14044 completeness and data-quality requirements

Data quality by module

- **A1 (raw materials):** good quality — primary component masses and compositions from NTT-supplied BOM, MSDS and RoHS/IEC 62474 declarations, verified against source documents during data collection (one material discrepancy – cobalt content of the battery cathode – was identified and corrected against the cell MSDS). A small number of items (LED mass, PCB copper content, RTC cell mass) were estimated from standard densities/geometry where the supplier could not provide a direct mass; these are engineering estimates, not primary data.
- **A2 (transport, raw materials):** good quality — route- and mode-specific, based on documented origin sites for seven components/sub-assemblies.
- **A3 (production processes): incomplete** — quantified for GWP-total only; ecoinvent factors for the remaining 12 EN 15804+A2 indicators were not available at the time of this assessment. This is a genuine data gap, disclosed rather than approximated as zero.
- **A4 (transport, distribution):** good quality — single representative distribution leg (600 km, truck).
- **B (use phase):** based on declared annual energy demand (17.96 kWh/yr) and an assumed 6-year use-phase lifetime; a single national grid electricity-mix factor was applied. Actual emissions will vary with the electricity mix and usage pattern of the end user's country.
- **C (end of life):** a single blended WEEE (waste electrical and electronic equipment) processing factor was applied to the product's *total* mass (1.72 kg) as a simplification, rather than routing each material category (plastics, metals, PCB, battery) through material-specific end-of-life pathways. This is a conservative simplification appropriate for an indicative assessment, but understates the benefit of material-specific recycling routes.
- **D (reuse, recovery, recycling potential): not quantified** — no recycling-credit data (e.g. avoided-burden factors for recovered metals/plastics) was available. The reported total is therefore a gross cradle-to-grave figure and does not net off any circular-economy benefit.

Key sources of uncertainty

- **Background data representativeness:** ecoinvent 3.12 datasets are predominantly geography-generic (RoW/GLO) rather than site-specific to the actual component manufacturers, which is standard practice for this data quality tier but introduces variability versus site-specific data.
- **Use-phase assumptions:** the 6-year lifetime and single national grid factor are scenario assumptions; actual in-use emissions are sensitive to both variables.
- **Engineering-estimated masses:** a small number of components (see A1 above) rely on density/geometry conversions rather than supplier-declared mass, and carry correspondingly higher uncertainty.
- **Incomplete multi-indicator coverage of A3:** the twelve non-GWP totals reported in this document are partial (see previous page) and should not be used for cross-category comparison without closing this gap.
- **Primary Energy Demand (page 8):** covers A1, A2 and A4, characterised via the Cumulative Energy Demand method (ecoinvent 3.12 cut-off), consistent with the module scope disclosed for the twelve non-GWP indicators above.

> Overall, the GWP-total headline result (172.59 kg CO_2e) is considered **complete and fit for its intended purpose** (internal decision support, hotspot identification). The twelve non-GWP indicators are **directionally informative but incomplete** pending A3 multi-indicator data, and the total excludes any Module D recycling benefit.

Conclusions & recommendations

The life cycle carbon footprint of the NTT Book B15 notebook is **172.59 kg CO_2e per unit** (GWP-total, cradle-to-grave, ISO 14040/14044). Three modules together account for over three-quarters of the result: the use phase (B, 34.5%), raw material supply (A1, 25.7%) and upstream transport (A2, 17.7%).

Recommendations, in order of expected impact

- **1. Reduce use-phase energy demand.** With B contributing over a third of the total and being directly proportional to the declared annual energy demand (17.96 kWh/yr) and the assumed 6-year lifetime, firmware/BIOS power-management defaults and component-level power efficiency offer the largest single lever — amplified in carbon-intensive grid markets such as Poland.
- **2. Engage memory, storage and IC suppliers on decarbonisation.** Memory & storage alone drives 13.5% of the total footprint (52.7% of A1); integrated circuits add a further 3.2%. Supplier-level renewable-electricity procurement or lower-carbon fabrication nodes would materially reduce this hotspot.
- **3. Shift long-haul component logistics away from air freight.** Air freight drives 99.9% of A2 (17.7% of the total); moving the Hong Kong → Warsaw and Shanghai → Hong Kong legs to sea or rail-based multimodal transport, where lead times allow, would materially cut this module.
- **4. Close the A3 and Module D data gaps.** Obtaining multi-indicator ecoinvent factors for the production-process dataset, and end-of-life recycling-credit data, would convert this from an indicative assessment into one suitable for full EPD-grade disclosure across all 13 categories.
- **5. Consider design-for-disassembly and take-back.** End of life (C, 6.4%) was modelled with a single blended WEEE factor; material-specific recycling routes (e.g. for the aluminium enclosure and battery) would likely reduce this module's real-world impact below the conservative figure reported here, and would enable a credible Module D benefit once quantified.

SUMMARY

Notebook NTT Book B15 — Life Cycle Assessment

Prepared in accordance with ISO 14040/14044, the GHG Protocol Product Standard and EN 15804+A2, covering all 13 impact categories · 17 September 2026

The cradle-to-grave carbon footprint of one NTT Book B15 notebook is **172.59 kg CO_2e**, assessed across the full EN 15804+A2 indicator set.

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