GLOBAL BATTERY ALLIANCE

BATTERIES POWERING SUSTAINABLE DEVELOPMENT

GBA BATTERY PASSPORT

The GBA Battery Passport 2024 Pilots

Overview, results and lessons learnt

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1.

Terminology and Abbreviations

GBA: The Global Battery Alliance

PoC: Proof of Concept – the first round of piloting for the GBA Battery Passport, conducted in 2022.

OEM: Original Equipment Manufacturer – a company that manufacturers the components of a finished product. In this context, an electric vehicle.

T&T provider: Track and Trace Solution Provider – an entity that tracks material and products through the supply chain, and/or traces the origin of materials and products. This can be a standalone commercial entity or a functional unit within a supply chain company.

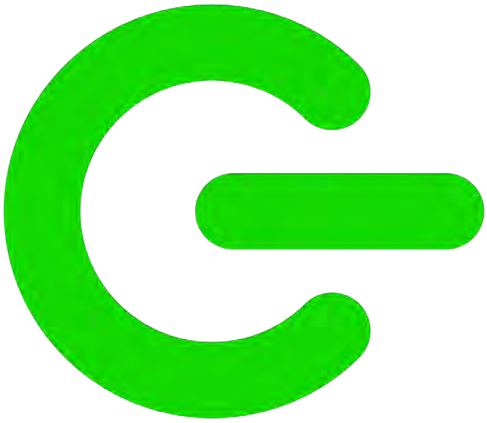
GHG: Greenhouse gases

Vertical integration: A supply chain structure in which several stages of material transformation are handled at a single site. E.G. a mine with an on-site ore concentrator and smelter.

Renormalisation: The mathematical process of changing calculation parameters in order to achieve a meaningful result. E.G. When averaging sustainability scores from several suppliers, by weight of material supplied, but only receiving data for 70% of supplied material: changing the divisor in the averaging calculation from the full weight of supplied material to 70% of total weight.

2.

Executive Summary



The Global Battery Alliance (GBA) piloted its flagship Battery Passport programme in 2024. This pilot marked a major milestone towards our goal of bringing a GBA sustainability certification for batteries to market by 2027, and to achieve our vision of a sustainable battery supply chain at scale, in 2030. The 2024 Battery Passport piloting exercise was the largest pre-competitive initiative to date for a digital product passport approach to supply chain sustainability. The exercise involved battery cell producers comprising 80% of global manufacturing capacity, major global players in mineral production and processing, and in automotive manufacturing, small and medium sized traceability providers and digital solution innovators, and multinational assurance firms.

The 2024 piloting exercise was designed to test components of the GBA Battery Passport in an operational environment, in which real-life sustainability data was gathered, scored, aggregated along the supply chain, and translated at the battery level into indicators of supply chain sustainability performance. 10 consortia successfully completed the exercise, each including a cell manufacturer and a track and trace solution provider, and generally also including an automotive OEM. Many more companies were involved indirectly, through consortia's engagement with their upstream minerals and metals supply chains. Five consortia engaged in elements of data verification, which were conducted by three independent 3rd party verifiers. Reporting was conducted on the supply chains of aluminium, cobalt, copper, artificial graphite, iron phosphate, lithium and nickel, across all five major continents: Africa, the Americas, Asia, Australasia and Europe. Full piloting results are available on the GBA website.[1]

Participation in the 2024 piloting exercise allowed GBA member companies to gain invaluable practical experience of sustainability reporting in a digital product passport environment. Recognising the global trend toward digital supply chain transparency and enhanced sustainability reporting – pushed forward by both regulatory and stakeholder drivers of change – piloting participants chose to keep ahead of the curve. Participants collaborated to ensure that their operations, management systems and reporting structures will be ready for rapidly evolving stakeholder expectations and compliance requirements. First-mover benefits include improved supply chain resilience, built through transparency and risk awareness, an enhanced ability to assure stakeholders of sustainability performance, and a more efficient way to meet emerging compliance requirements.

Learnings gained from the piloting exercise are presented in this report. Sections 3, 4 and 5 offer context and overview for the GBA, the Battery Passport programme in general, and the piloting exercise specifically. Section 6 details lessons learned in seven key areas. These lessons learned are itemised at the end of each subsection, 6.1 to 6.7, and highlights are summarised as follows:

6.1. Supply chain coverage and process clusterisation: Separating the battery mineral supply chain into clusters, representing different phases of material transformation, allowed for a detailed breakdown of sustainability performance phase by phase, whilst retaining anonymity of individual companies at each

[1] 2024 Battery Passport Pilots, GBA website. https://www.globalbattery.org/battery-passport-mvp-pilots/

stage. Going forward, cluster boundaries will be more clearly defined. Battery Passport sustainability reporting will be structured to accommodate supply chains in which supplier data is only partially available, while incentivising continuous improvement in supplier discovery and data gathering.

6.2. Reporting on environmental, social and governance performance: Engaging in sustainability and due diligence reporting helped participating companies to prepare their supply chains to respond to supplier questionnaires, as required by many existing voluntary standards and by upcoming regulatory requirements. The reporting exercise showed that detailed sustainability criteria that were used can be further streamlined. By abstracting Battery Passport indicators to higher-level principles for sustainability performance, and maximising recognition of existing standards and certifications, significant efficiency gains can be realised. The result will be a lean framework for sustainability reporting, that offers an efficient route to compliance with the due diligence components of the EU Batteries Regulation, the fulfilment of stakeholder expectations, and the ability to differentiate site and product level performance using harmonised metrics. Further reporting efficiencies will be realised through the development of a robust, risk-based 'opt out' mechanism for reporting against sustainability issues that not material for participating sites.

6.3. Greenhouse gas reporting: The GBA's Greenhouse Gas (GHG) Rulebook[2] represents the only global methodology for battery carbon footprint calculation and aggregation from production site to product level. Rules for carbon footprinting contained in the GHG Rulebook were generally found to be robust. Differences in interpretation of the rules highlighted the need for clarification of some ambiguous elements, and the need to develop guidance materials for companies in the supply chain to apply Battery Passport carbon calculation rules effectively and consistently. The piloting exercise tested two approaches to calculating the carbon costs of electricity consumption (the Physically Modelled Approach and the Harmonised Market Approach, both defined in the GHG Rulebook), yielding valuable lessons on the complexity of dual reporting and assisting regulators to define clear guidance to allow transparent and comparable reporting against emissions reduction targets. Aggregation of carbon footprint data along the supply chain requires further elaboration, due to the innovative nature of the approach – gathering assured data from sites at each stage of material production and processing, rather than modelling the supply chain as a whole in a Life Cycle Assessment exercise run by the battery manufacturer.

6.4. Sustainability indicator score averaging, and aggregation through the supply chain: Converting reported data into numerical scores is crucial for ensuring that Battery Passport data is robustly comparable. Decisions on scoring methodology have major impacts on the incentive mechanisms that the Battery Passport creates. The relationship between score weightings and the physical weight of materials supplied, and the handling of scoring in the case of incomplete data or missing reports, are key elements to be determined in the finalised Battery Passport. Moreover, in order to adequately recognise high performers, final scores in the Battery Passport must be relative rather than absolute. Participating companies will be benchmarked in relation to their peers, rather than in relation to the maximum scores that are theoretically available.

6.5. Data disclosure and data governance: Increasing transparency and traceability of battery supply chains is vital for establishing supply resilience and assuring stakeholders of strong sustainability performance. The GBA did not mandate a minimum disclosure level for the piloting exercise, and the voluntary nature of disclosures made it possible to gauge participants' current appetites for data sharing. Some piloting participants appeared reticent to disclose data against the full Battery Passport reporting structure, and this reticence can be partially attributed to uncertainty over how data would be shared, and with whom, as these parameters were not specified in detail in the pilot framing. The GBA will elaborate a concrete data sharing framework for the finalised Battery Passport, with an accompanying theory of change for incentivising progressively greater data disclosures.

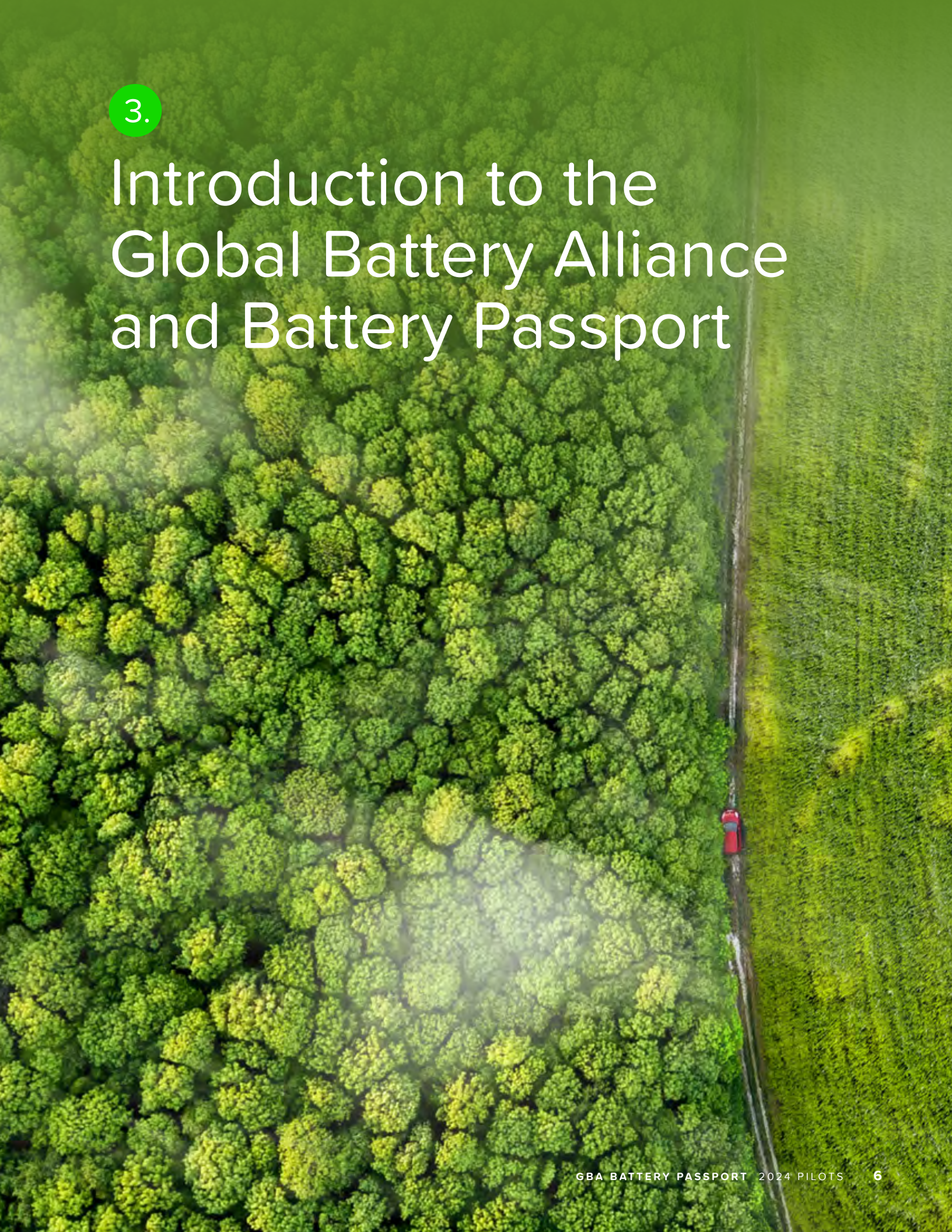
[2] GBA Battery Passport Greenhouse Gas Rulebook V.2.0, https://www.globalbattery.org/media/publications/gba-rulebook-v2.0-master.pdf

6.6. Supply chain data gathering and data aggregation: Good data governance is key for ensuring the efficiency of external reporting. The 2024 piloting exercise demonstrated the need for a decentralised data model, in which supply chain companies are responsible for the custodianship of their own data, to avoid potential bottlenecks arising from reliance on 3rd parties. Digital report signing, data exchange and the assurance of data integrity by external verifiers will be key focus areas in future trials of the Battery Passport. A specialist category of carbon footprint calculation providers will be considered within the Battery Passport ecosystem.

6.7. Verification of data: Data verification trials were conducted by 3rd-party verifiers, as a first step toward building a highly trusted data ecosystem for the Battery Passport. Little guidance was given by the GBA on verification protocols, allowing verifiers to innovate and report back on lessons learned. Based on this exercise, detailed data verification protocols will be elaborated, aligned with relevant ISO guidance. Digital streamlining of verification processes will be explored. A benchmarking exercise will be undertaken for the resource cost of verification, to determine an appropriate frequency for data verification spot checks in the operational Battery Passport.

The Global Battery Alliance is humbled by the dedication of participants to the piloting exercise. A great range of organisations, of many types and sizes, contributed time and resources, pro bono, to the success of this groundbreaking endeavour. The insights gained through the piloting exercise will serve participating GBA members well, in their onward journeys to efficiently meet the sustainability performance and reporting expectations of their stakeholders and of regulators, and to achieve their strategic sustainability goals. Pilot learnings, like other content created through GBA activities, are presented transparently in this document as a public resource. Our hope is that they inform not only the further development of the GBA Battery Passport, but also other initiatives, frameworks and regulations under development in the digital product passport and sustainability assurance spaces. Our shared understanding is the doorway to our shared progress.

The GBA is currently preparing to launch a 'beta release' of the Battery Passport indicator framework, and accompanying guidance for data exchange and assurance, in September 2025. This release will be followed by a round of operational trials, set to launch in the 4th quarter of 2025. Relevant organisations are invited to express their interest in participating by contacting secretariat@globalbattery.org



3.

Introduction to the Global Battery Alliance and Battery Passport

Founded in 2017 at the World Economic Forum, the Global Battery Alliance (GBA) is an independent non-profit organisation committed to establishing a sustainable, responsible and circular battery value chain by 2030. The GBA brings together the ambition and expertise of over 150 leading businesses and NGOs, academic institutions, governmental and international organisations. We stand for multi-stakeholder collaboration, and collective action that spans the entire value chain, from battery mineral mining, refining, manufacturing and battery pack assembly, through the service lives of a battery to its end-of-life and recycling. The former German Chancellor Olaf Scholz described the GBA as the "most important global partnership" to scale sustainable, responsible value chains for batteries.[3]

GBA's member organisations commit to its 10 Guiding Principles, which lay the foundation for a circular, sustainable and low-carbon battery value chain – one that creates economic impact and drives the clean energy transition, while safeguarding human rights and the environment. The GBA's work programmes are steered by multi-stakeholder governance bodies, with equal representation from corporate and non-corporate members. We also routinely consult with non-member civil society organisations, standard-setting organisations, subject-matter experts and the general public.

The GBA makes its materials publicly available, to help organisations of all types to drive forward battery supply chain sustainability. Through our flagship Battery Passport programme and the Circularity and Critical Minerals Advisory Group, we are providing tools, frameworks and thought leadership, for corporate entities to take confident new strides in their sustainability journeys, and for civil society organisations, regulators and others to play empowered roles in the promotion of progressively increasing sustainability performance.

Representatives of the GBA's multistakeholder membership at the 2024 Annual General Meeting in Shanghai, during which the results of the piloting exercise were launched.

[3] Scholz, O. (2024, October 7). Rede bei der Hamburg Sustainability Conference. Die Bundesregierung. Retrieved from: https://www.bundesregierung.de/breg-de/service/newsletter-und-abos/bulletin/rede-von-bundeskanzler-olaf-scholz-2313702

The GBA Battery Passport is an emerging product sustainability certification for batteries, consisting of a set of frameworks to allow data on site-level sustainability performance in the battery supply chain to be gathered, verified, scored, aggregated and compared. It is built on emerging Digital Product Passport protocols and technologies, to enable the establishment of supply chain transparency, materials flow visibility, and the mapping of trustable data on supply chain sustainability performance, more efficiently and more collaboratively than ever before.

The supply chain scope of the GBA Battery Passport is from raw material creation (through mining or recycling) to the point of battery manufacture. Throughout the supply chain, Battery Passport reporting measures the strength of sites' and facilities' sustainability policies, evidence of their sustainability practices, and their attainment of voluntary sustainability standard certifications. By translating these proxy metrics for sustainability performance into numerical scores, and aggregating them at the battery level in a way that allows straightforward comparison between products, we incentivize progressive improvement in sustainability performance across the battery supply chain. The Battery Passport gives companies a new and powerful way to showcase their sustainability performance to their stakeholders, differentiate their products and earn recognition for their efforts toward sustainability excellence.

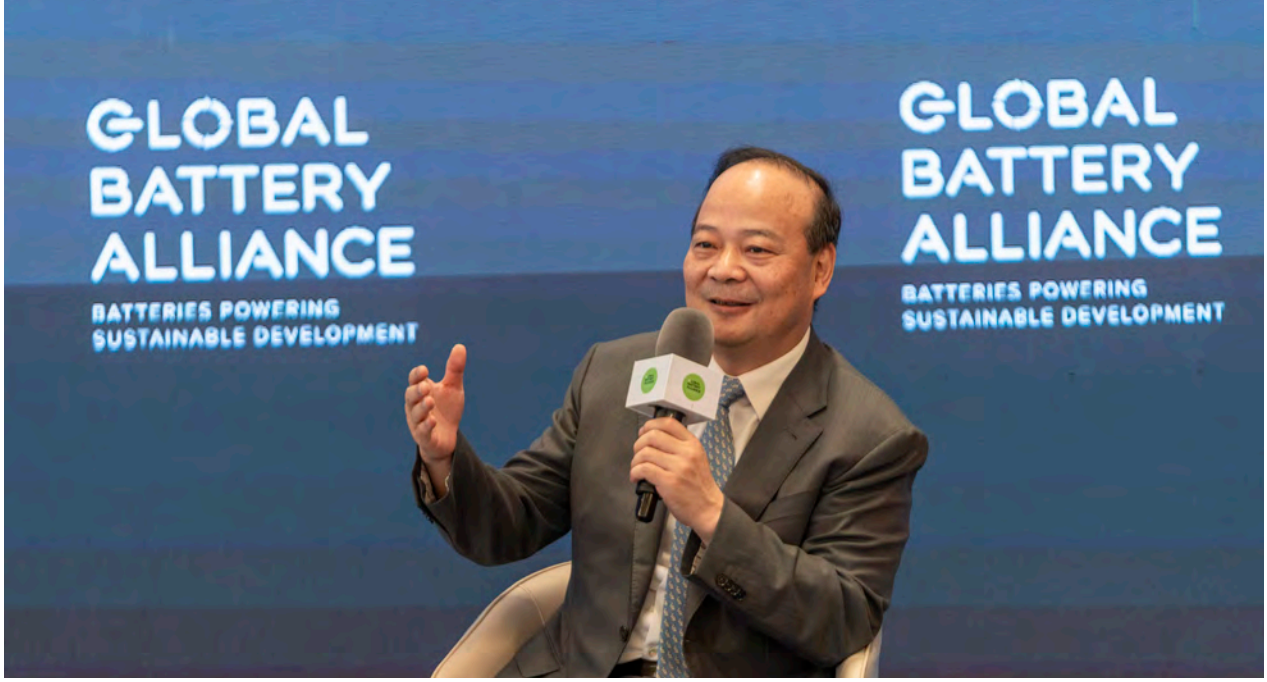
By providing a way to consistently measure and compare sustainability performance across the battery material supply chain, the Battery Passport acts as a key tool for sustainability reporting. Battery Passport data can be used to demonstrate a company's compliance with supply chain due diligence regulations, including elements of the EU Batteries Regulation. It can also help stakeholders to make informed choices and to build sustainability criteria into their operations. For example, by requiring GBA Battery Passport certification on batteries, as part of a sourcing or procurement strategy, a set of investment criteria, or a sustainable finance taxonomy, and to underpin the trustworthiness green claims.[4]

The GBA Battery Passport will break new ground in battery supply chain sustainability, bringing together concepts from the worlds of responsible sourcing, due diligence, digital technology, product carbon footprinting and multi-stakeholder consensus building. The 2024 piloting round was the world's largest pre-competitive exercise to establish an interoperable and commonly agreed battery passport framework. This report details the wealth of lessons learned from the exercise, which will inform the continued development of the GBA Battery Passport towards operationalisation.

[4] For more information and context on the Battery Passport, see *GBA Battery Passport: an overview.* https://www.globalbattery.org/media/publications/gba-batterypassport-2024-v1-web.pdf

4.

GBA Battery Passport Development Timeline and the 2024 Piloting Round



Robin Zeng, Founder and Chairperson of CATL, speaking at the launch of the 2024 piloting exercise (7th November 2024).

The GBA is working to a 2027 timeline for a fully operational Battery Passport. It has conducted two piloting rounds to date, to trial key aspects of the Battery Passport and drive its development. In January 2023, the GBA launched the world's first battery passport proof-of-concept (PoC) pilot[6]. Three piloting consortia participated, each comprising a vehicle OEM and their upstream supply chain partners and a track and trace solution provider (T&T provider). Using simulated sustainability data, the consortia demonstrated the integration of material flow information with sustainability performance indicators, along the supply chain from mineral mining to vehicle production.

The 2024 piloting round built on the achievements of the PoC piloting round, with a significant uplift in ambition. It was the world's largest pre-competitive effort to establish comparable battery passports, with 10 pilot consortia involved throughout, including cell makers representing over 80% of global electric vehicle battery market share.

The 2024 piloting round was designed to:

- Evolve the developmental Battery Passport from simulated data reporting to the reporting and scoring of real sustainability data.
- Expand the scope of sustainability reporting to include Biodiversity, Indigenous Peoples' Rights, Forced Labour, Environmental Due Diligence and Circular Design in addition to the rulebooks tested in the PoC pilots, on Human Rights Due Diligence, Child Labour and Greenhouse Gas Emissions
- Introduce elements of data verification to the battery passport
- Demonstrate the viability of driving supply chain sustainability performance through a Battery Passport structure. Prepare participants for incoming Battery Passport requirements, and create learnings to allow the GBA to take the Battery Passport to scale and issue a sustainability certification in the future.

[6] https://www.globalbattery.org/press-releases/global-battery-alliance-launches-world%E2%80%99s-first-battery-passport-proof-of-concept/

5.

Overview to the GBA Battery Passport 2024 Pilots

5.1. History and context for piloting activities

The GBA successfully conducted its initial "proof-of-concept" (PoC) round of piloting in 2022-2023. The results and lessons learned from this piloting round were published by the GBA, in the report *Proof of Concept Pilots: Setup. Learning. Next steps.*

Subsequently, the GBA continued to develop the Battery Passport programme in two principal ways:

1. **Development of sustainability measurement framework:** Refinement of PoC draft rulebooks on Greenhouse Gas, Child Labour and Human Rights, and development of new draft rulebooks on Forced Labour, Biodiversity, Indigenous Peoples Rights and Circular Design.[7]
2. **Development of technical implementation framework:** Development of processes, interfaces and tools necessary to ensure technical implementation of the passport. Including, but not limited to, scoring mechanism, data collection, verification, and aggregation.

In addition to building on previous achievements (e.g. full supply chain traceability, and aggregation of ESG data along the traced supply chain, into product level metrics) the 2024 pilots involved significantly more supply chain companies, move from reporting realistic data to reporting real data on sustainability performance, and introduced elements of data verification.

5.2. Roles of participants and associated expectations

The following roles were defined for participants in the 2024 piloting round:

Role	Major expectations
Regular battery supply chain participants (from miner to OEMs)	• reporting against the GBA rulebooks • collecting and sharing the data with T&T and 3rd party verifiers (if applicable) • collecting and sharing organisational feedback with the GBA (e.g. on experiences reporting against the Rulebooks and exchanging data)
Consortium-leading battery producer	In addition to the role of a regular battery supply chain participant: • mapping the organisation's upstream supply chain • mobilisation of the supply chain for reporting and exchanging data • managing the process of data collection, aggregation and verification (if applicable) • collecting and sharing non-ESG data on the supply chain • validation of Battery Passport data before submission to the GBA • managing Battery Passport data disclosure
Regular T&T solution providers	• mapping the supply chain (together with the leading battery producer), including collection of material flow data. • ensuring the exchange of data between the battery supply chain and the GBA • ensuring timely collection of data from the supply chain • basic data verification (e.g. completeness, consistency, etc.) • collecting and sharing organisational feedback with the GBA
Leading T&T solution providers	In addition to the role of a regular T&T solution provider: • managing the process of data collection, aggregation and verification (if applicable)
3rd-party verifiers	• verification of ESG data from battery supply chain participants • collecting and sharing organisational feedback with the GBA
Other supporters	The roles of auxiliary supporters were varied: from integration services (an additional entity managing both a leading battery producer, a leading T&T solution provider and a 3rd-party verifier) to specialised consulting services (e.g. LCA modelling, and calculation of GHG data on top of regular T&T services)
The GBA itself	• developing content for implementation (rulebooks, guidelines, presentation materials, etc.) • overall governance, communication and coordination among pilots and (to the extent possible) ensuring consistency of outputs

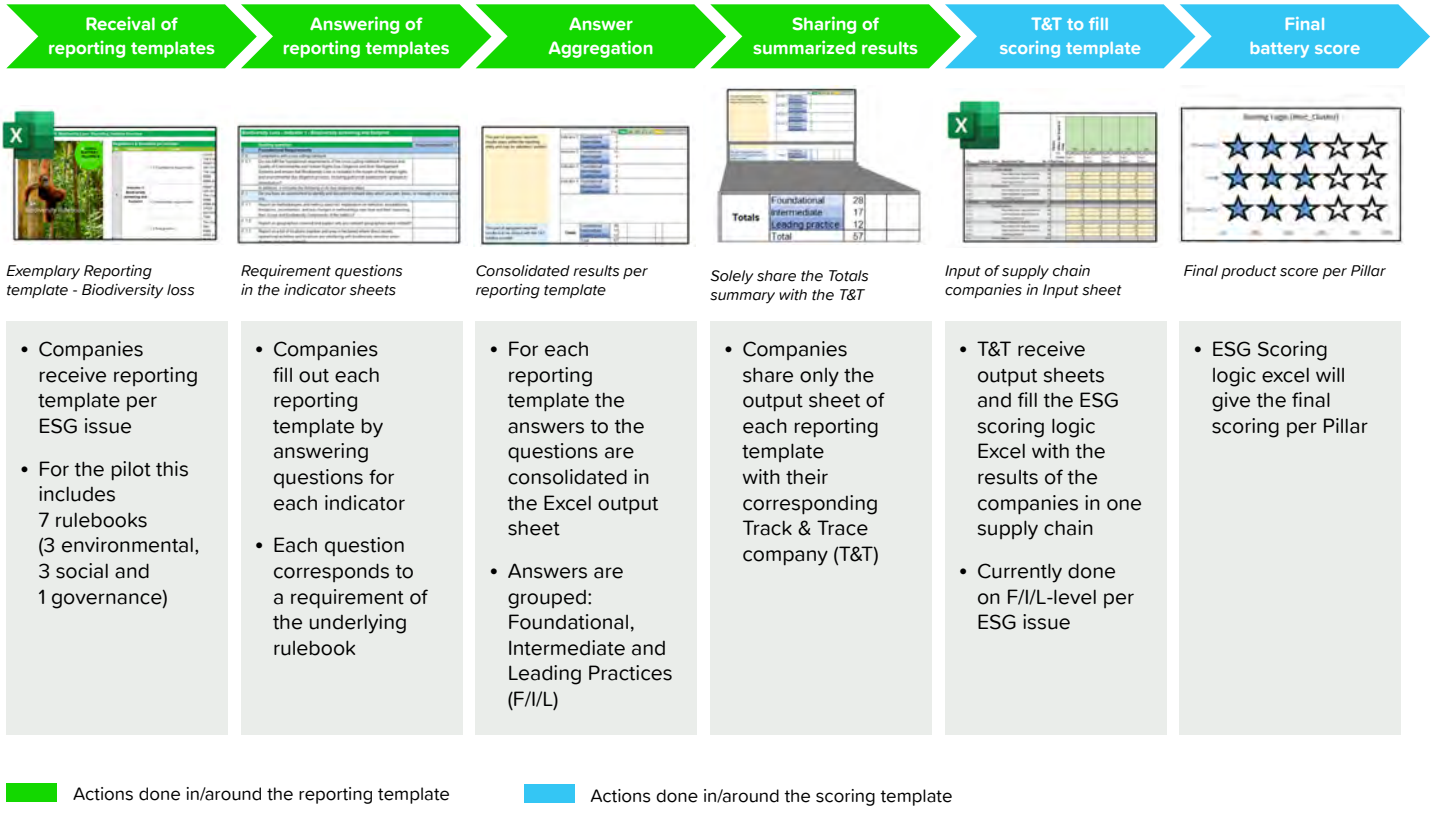
[7] Sustainability reporting rulebooks used for the 2024 pilots are available here: https://www.globalbattery.org/publications/

The roles defined for participants in the 2024 piloting round differed from those used in the PoC piloting round, in several ways. These included:

- **De-prioritisation of the role of automotive OEMs in consortium management.** The GBA considers OEMs to play a crucial role in the Battery Passport ecosystem. However, over 95% of GBA Battery Passport data is collected before a battery is installed into an EV. This leads the GBA to consider OEMs primarily as data consumers, rather than managers of data collection processes.
- **Temporary removal of the requirement for interoperability in technological solutions.** The 2024 pilots focused on increased scope and scale of ESG reporting, rather than technical implementation of data collection, exchange and integration. Interoperability requirements for technological solutions will be further elaborated and tested in subsequent piloting rounds, and the GBA remains as a pre-competitive and technology agnostic initiative.
- **Acceptance of both internal and external T&T.** Some participating battery manufacturers requested to trial in-house T&T systems. The GBA allowed this practice, on the condition that the battery manufacturer ran two pilots in parallel – one with internal T&T, and one with an independent third-party providing the T&T solution.
- **A prominent role for 3rd-party data verifiers.** The GBA considered the testing of data verification to be a critical component of the 2024 piloting value proposition, although resource constraints meant that it was not made a mandatory criterion for all the participants.

Figure 1, below, illustrates the process for reporting and consolidating data from site-level reports in the pilots, and the division of data handling responsibilities between reporting companies in the supply chain and T&T partners.

FIGURE 1: Process and Responsibilities for Data Handling and Aggregation

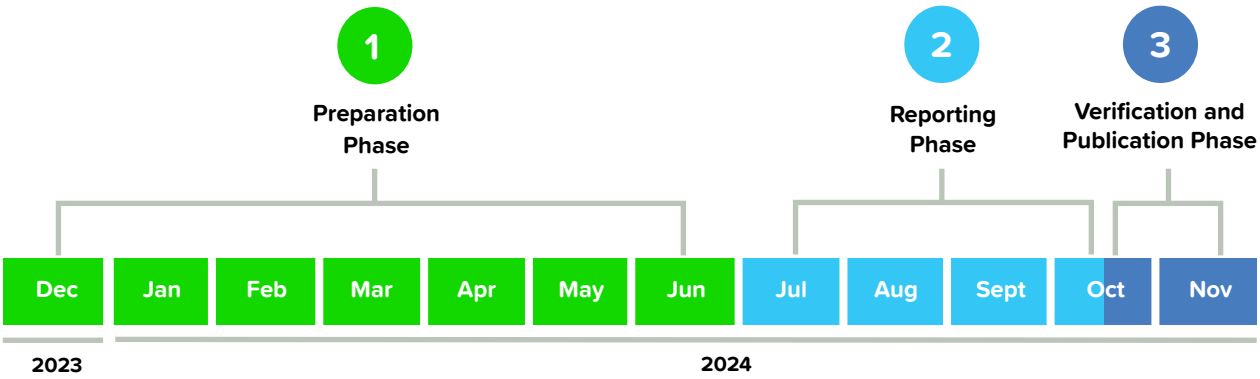


5.3. Conduct of the 2024 pilots

The 2024 piloting exercise was overseen by the GBA's Battery Passport Steering Committee and supported day-to-day by the Piloting Working Group of GBA members. Both are multistakeholder bodies, which operate through consensus-based decision making. The pilots were conducted on a pre-competitive and technology agnostic basis, which did not seek to compare the relative strengths and merits of piloting consortia's technical solutions or the sustainability performance of companies in the battery supply chain.

In total, 249 site-level sustainability reports were generated during the 2024 piloting exercise. 10 consortia successfully completed the exercise, five of which engaged in elements of data verification, conducted by three independent 3rd party verifiers. Reporting was conducted on the supply chains of aluminium, cobalt, copper, artificial graphite, iron phosphate, lithium and nickel, and the geographic scope of reporting encompassed all five major continents: Africa, the Americas, Asia, Australasia and Europe.

The piloting exercise was split into 3 major phases:



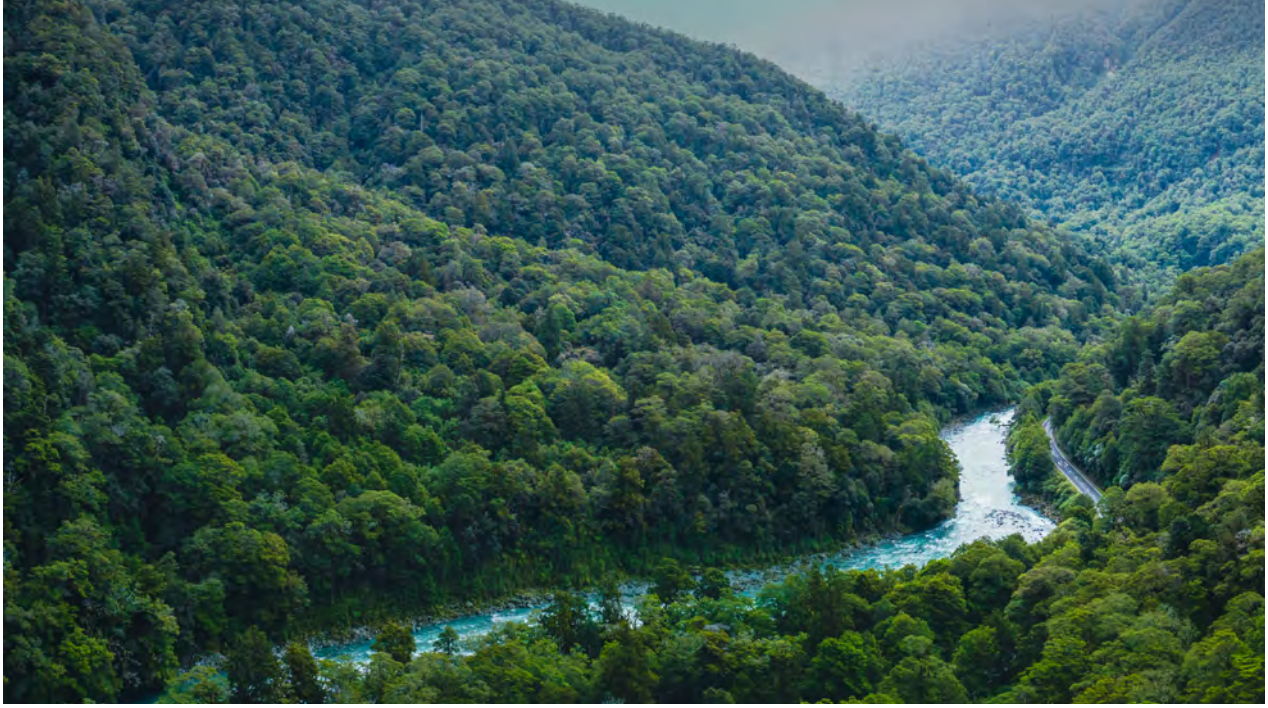
The announcement of 2024 pilots generated great interest from the GBA membership and externally, which led to the formation of multiple piloting consortia. Of these:

- Ten consortia completed the full scope of the piloting exercise.
- Two consortia started the piloting exercise but discontinued before the Reporting Phase commenced. Two further consortia discontinued during the Reporting Phase.
- One consortium joined the piloting exercise at the beginning of the Reporting Phase but was not successful in meeting the reporting deadline.
- One consortium joined the piloting exercise in the middle of the Reporting Phase and successfully made the deadline, with a reduced reporting scope.

All the piloting consortia demonstrated strong willingness to mobilise the supply chain. However, their success rates varied significantly, from full traceability of complex supply chains from mining sites to automotive OEMs, to piloting consortia with just one supply chain company.

Launch of the 2024 piloting exercise results in Ningde, China (7th November 2024).

Given the pre-competitive structure of the GBA, and our commitment not to promote comparison of individual Battery Passports at the piloting stage, this report will refer to consortia in an anonymised fashion (Pilot A, Pilot B, ..., Pilot J). We remind readers that the piloting exercise trialled prototype methodologies and reporting frameworks, and that no sound overarching conclusions can be drawn about the relative sustainability performance of consortia's supply chains, from the data presented.



5.4. Objectives of the 2024 pilots and status at launch

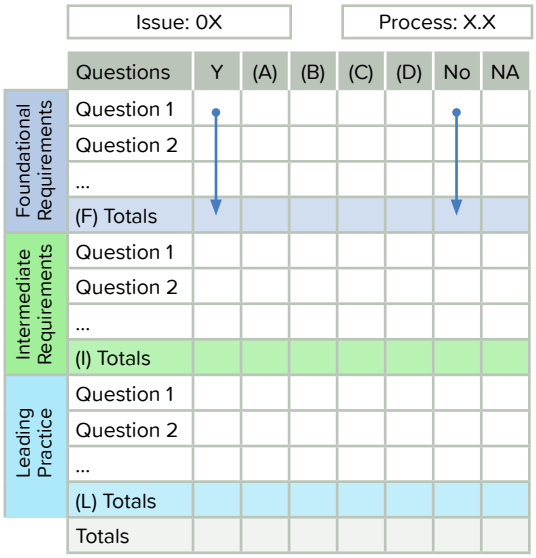
Objective	Status
1. Deliver multiple passports ready for comparison	**Partially achieved.** Only partial comparability was achieved (see Section 6.1)
2. Pilot reporting against GBA rulebooks for sustainability performance measurement (checking usability of reporting frameworks and resource intensity of reporting), including: • Pilot GHG Rulebook 2.0 and GHG Aggregation Guidelines • Pilot restructured Human Rights and Child Labour rulebooks • Piloting of four new rulebooks on Forced Labour, Biodiversity, Indigenous Peoples Rights and Circular Design. • Pilot ESG Scoring system.	**Mainly achieved,** excluding full scale test of GHG Aggregation Guidelines due to limited coverage of the supply chain and insufficient data for generalization, on resource intensity of reporting process (see Sections 6.2-6.4).
3. Develop and pilot elements of data verification processes.	**Partially achieved:** verification process was tested in a limited manner (see Section 6.7).
4. Identify legal barriers to handling real data	**Not achieved:** A minimalist approach to mandatory data disclosure, and a reliance on voluntary disclosure, meant that no legal barriers were encountered.
5. Assess resistance levels to disclose granular data and compare passports	**Mainly achieved:** broad spectrum of opinions collected (see Section 6.5).
6. Assess resistance levels to disclose granular data and compare passports	**Partially achieved:** the interface between GBA, T&T and verifiers was tested but requires further elaboration and testing (see Section 6.6).
7. Identify and assess challenges on the path to scale the Battery Passport ecosystem	**Partially achieved:** overall viability of the Battery Passport concept was affirmed, but questions of cost and efficiency of implementation remain (see Section 7).

5.5. Mechanism of data collection and score calculation

The 2024 round of pilots used the same data collection mechanism as the PoC pilots. Individual sites reported against GBA rulebooks using Excel files[8], and reports were aggregated by consortia T&T solution providers into custom data collectors and submitted to the GBA Secretariat. Figure 2 shows key aspects of the templates used for data collection and aggregation.

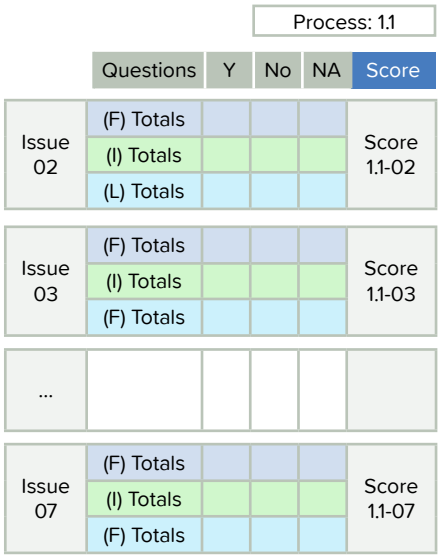
FIGURE 2. Steps of data collections

Step 1: Individual process/issue report(s)



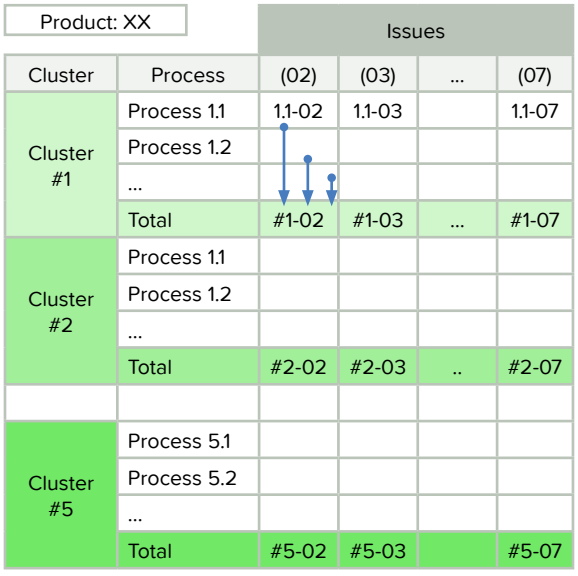
Shows individual questions on sites' sustainability performance, grouped into Foundational Requirements, Intermediate Requirements and Leading Practice.

Step 2: Complete process report(s)



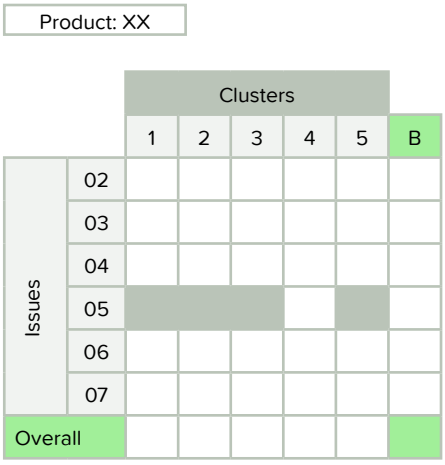
Shows the data collected in Step 1 aggregated into totals and subtotals for each ESG issue covered, for an individual process in the supply chain, and translated into scores.

Step 3: Value Chain Scoring



Shows these scores aggregated from processes into supply chain clusters.

Step 4: Final Product Passport



Shows the overall aggregation of scores for sustainability performance in the battery supply chain, by ESG issue and by supply chain cluster.

[8] The Excel format of data collection and exchange was used to ensure technology agnosticism and simplify the process of adjustments, which was critical for the piloting exercise. The GBA recognizes that future data exchange should utilized more technologically advanced means if they do not constrain content adjustments and equal possibility for reporting entities to handle their data

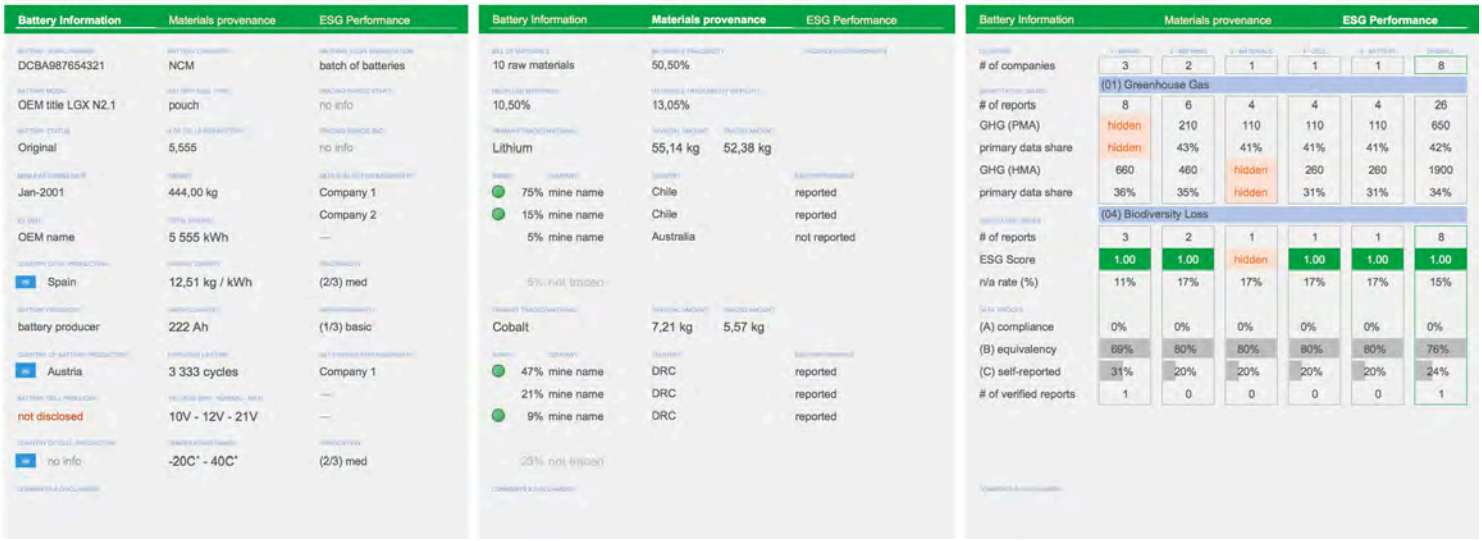
The following notes should be observed on the 2024 piloting exercise data collection and score calculations[9]:

1. Each reporting entity populated reporting templates with relevant data, either by answering questions manually or utilising a semi-automated method. The latter method required reporting entities to disclose the certifications they had achieved against voluntary sustainability standards, which were pre-mapped to performance criteria in the reporting templates. The templates returned the number of questions answered “yes”, “no”, or marked as not applicable.
2. T&T solution providers ensured a coherent collection of individual reports for all the applicable issues and all the participating reporting entities.
3. The score calculation per individual pair or “process / issue” was calculated in the data collector, provided and controlled by the GBA. This means the GBA had access to “consolidated” versions of individual reports (step 2) but had no access to the full underlying reports (on step 1). The data collector also ensured comprehensive score calculation along the supply chain (step 3) and mapping of individual metrics into an easily consumable matrix (step 4).
4. Each consortium validated its score calculation and chose which part of the results the consortium members wanted to disclose or withhold, without access to results of peers.

5.6. Visual appearance

The main purpose of the visual structure of the “ESG Performance” tab, shown below in Figure 3, was to show completeness, correctness and breakdown by sources of collected data across the supply chain and integrated ESG indicators. Figure 3 demonstrates the look of the passports after aggregation and before uploading to the GBA website, in the Excel data aggregator. This preview was then almost completely replicated on the website (notwithstanding minor adjustments to outline and design).

FIGURE 3. Passport preview before publication *(mockup data for illustration purposes only)*



The GBA supports the use of more advanced and accessible formats for data representation, which some pilot participants and GBA members already use for external purposes. The GBA Battery Passport programme, meanwhile focuses on content and underlying methodology, recognising that other organisations are best placed to represent this content visually for their stakeholders.

[9] Quantitative ESG data (GHG) and non-ESG data (technical / provenance of materials) were calculated in the same manner but without additional scoring or processing

6.

Lessons learnt and identified next steps

6.1. Supply chain coverage and processes clusterisation

A key supporting component to the GBA vision is a progressive increase in battery supply chain transparency and comparability of sustainability performance, over time.

In both the PoC and 2024 piloting rounds, data was reported at the level of physical transformation processes within the supply chain. In the PoC piloting round, data from these processes was aggregated directly at the product (battery) level. This approach created challenges in achieving meaningful transparency, because the unstructured aggregated datasets were not readily analysable for sustainability performance stage by stage along the supply chain.

The 2024 pilots introduced cluster-level aggregation, as an interim step between process and product. Each cluster combines relatively similar processes (for which the performance metrics may be averaged without significant losses in quality). A specially assembled focus group of the GBA membership developed a working model comprising five clusters: mining; refining; advanced materials; battery components ("cell"); and battery assembly. The cluster approach confers the following advantages, some of which were implemented in the 2024 pilots and some of which remain theoretical:

1. **Enhanced transparency.** Each passport in the 2024 pilots provided sustainability indicators in five ESG risk areas, at five cluster levels (making 25 indicators in total) plus indicators at two cluster levels for fulfilment of Circular Design criteria[10]. This gave a significantly more granular picture of supply chain sustainability performance than in the PoC pilots.
2. **Manageable complexity.** The more granular data presented in the 2024 pilot passport was nonetheless easily readable, providing clear indicators of sustainability performance at each stage of the supply chain.
3. **Comparability.** Batteries supply chain sustainability performances can be compared at the cluster level, as well as the ESG issue level and the overall battery level (provided that sufficient data has been collected for this, in a manner that is consistent between participants, which was partially the case in the 2024 pilots).
4. **Flexibility of scoring.** Weighting can be applied to scores achieved in each cluster, by 3rd parties analysing Battery Passport data, in order to increase focus on their priority areas of the supply chain (not trialled in the 2024 pilots).
5. **Data protection.** The GBA aims to collect summaries of ESG data only. Cluster-level aggregation allows companies to aggregate data before sharing, so that commercially sensitive raw data points can be safeguarded, and shared only between the company and 3rd-party verifiers.

The 2024 piloting round led to the production of **249 sustainability reports** against GBA rulebooks, by sites in the supply chain. This represents a dramatic increase over the three reports produced in the PoC piloting round. The choice of ESG issues and clusters to report upon was left to the discretion of reporting companies, meaning that some issues and some clusters were not reported on by pilot consortia, as shown in the blue boxes, in Figure 4.

[10] For a visual representation of these indicators, see Figure 10

FIGURE 4. Number of submitted and processed reports

Pilot	Number of collected reports per issue[11]							Number of reports per cluster						Verified reports[12]	Unique reports[13]
	(02)	(03)	(04)	(05)	(06)	(07)	Total	1	2	3	4	5	Total		
Pilot A	10	10	9	1	10	9	49	5	15	15	6	8	49	16 (33%)	35 (71%)
Pilot B	8	8	8	1	8	8	41	10	5	15	6	5	41	11 (27%)	31 (76%)
Pilot C	8	8	8	2	8	8	42	10	10	10	6	6	42	3 (7%)	24 (57%)
Pilot D	5	5	5	2	5	5	27	6		7	14		27		24 (89%)
Pilot E		12			12		24	4	4	12	2	2	24	12 (50%)	10 (42%)
Pilot F	3	3	3	2	3	2	16				11	5	16		16 (100%)
Pilot G	3	3	2	2	3	2	15			3	6	6	15	2 (13%)	9 (60%)
Pilot H	2	2	2	2	2	2	12			6	6		12		12 (100%)
Pilot I	3	3	3	1	3	3	16			5	6	5	16		16 (100%)
Pilot J	2	2		1	2		7					7	7		7 (100%)
Total	44	56	40	14	56	39	249	35	34	73	63	44	249	44 (18%)	184 (74%)

Major learnings and conclusions

1. **Clusterisation helped to improve transparency.** As intended, clusterisation of data by supply chain phase enabled a significant elevation in meaningful transparency, as well as facilitating partial comparability of results.
2. **Gaps in supply chain coverage led to comparability challenges.** As shown in Table 3, several consortia did not report on all clusters within the supply chain. This highlighted the fact that, for comparability of Passports, either participation in the programme must be restricted to battery manufacturers with fully mapped supply chains (which would exclude a large proportion of the industry), or a system must be established to calculate overall product level scores even in cases where data from some clusters is absent.
3. **Data volume is not yet sufficient to extract trends**[14]. Piloting consortia adopted a range of setups, with varying numbers of participating companies (from 1 company to 10) and generally with high geographic concentration. Greater supply chain coverage and geographic breadth, and significant upscaling in the numbers of passports created, will allow global trends to be extracted from gathered data.
4. **The current framework of five clusters will be refined.** Cluster boundaries were found by participants to be unclear in some cases, and will be more precisely defined. Due to uncertainties over interpretation, participating companies sometimes classified largely similar processes into different clusters. Boundaries would also benefit from greater alignment with other typologies of supply chain phases, such as the typology used in the EU Batteries Regulation.
5. **Challenges exist related to inclusion of medium- and small-scale companies.** Piloting consortia generally did not involve medium- and small-scale companies in the reporting exercise. Therefore, limited data was gathered on the implementability of Battery Passport frameworks by such companies.

[11] The table includes reports on qualitative issues only.
[12] Number of reports declared as verified at the time of the 2024 pilots' publication (including some work-in-progress verification). In brackets is the proportion of verified reports expressed as a percentage of the pilot consortium's total number of reports.
[13] "Unique reports" are those that remain once duplicates have been removed, since a company will sometimes submit identical reports for different clusters. In brackets is the proportion of unique reports expressed as a percentage of the pilot consortium's total number of reports.
[14] As of now as many pilots decide to withhold some cluster / issue specific data the GBA cannot directly refer to pilots, where this hypothesis is proven and supported by data. However, the nature of cluster approach implies that cluster specific issues will reflect in relatively lower performance in a relative cluster

Additional considerations

6. **Handling vertical integration.** The cluster approach allows data to be aggregated at key stages in the supply chain. In the case of vertically integrated companies, where several supply chain stages are located at a single site, this approach can lead to duplication of reported data. A site that covers the clusters of 'advanced materials', 'battery components' and 'battery assembly', for example, would be required under the reporting framework to submit one report for each cluster. But, since GBA rulebooks largely measure site-level sustainability management systems, the three reports would be mostly identical. The main exception to this is in GHG reporting, for which different figures would be recorded at each cluster. Future iterations of Battery Passport frameworks will be designed to minimise duplication of effort in reporting, for vertically integrated sites.
7. **Scope and boundaries of reporting.** Alongside refining the boundaries between established clusters, it will be necessary to extend the cluster model to incorporate additional entity types in the supply chain. These include transportation and logistics companies, traders and material aggregators or blenders, and recyclers. It will also be necessary to define clear boundaries for which materials are in scope of reporting. In both the PoC and 2024 piloting rounds, reporting focused on the most prominent 'critical minerals' for battery cathode and anode chemistry. It must be determined whether to limit the finished Battery Passport to these materials, or to include others, such as steel or aluminium for battery casing, or even plastics and other non-mineral materials. If the Battery Passport scope is not restricted by material type, it will be necessary to set materiality thresholds, so that only the materials present in significant volumes must be reported on, and companies are not compelled to put disproportionate levels of resources into reporting on minor materials that represent very small percentages of battery composition. Lastly, the extent of supply chain coverage remains to be concretely defined in some cases, including for recycled material, where there is no clear 'start point' in the chain as there is for mined material.

6.2. Reporting on environmental, social and governance performance (excluding greenhouse gas)

Development path for scoring structure

The GBA develops and publishes reporting rulebooks for sustainability performance for sites in battery mineral supply chains, through a multi-stakeholder process. The rulebooks each contain a series of questions on the management systems and practices for sustainability performance that are implemented by the reporting site. Three draft rulebooks were developed and subsequently used for the PoC piloting round, and four more draft rulebooks were added for the 2024 pilots. In future, the GBA will produce finalised rulebooks for reporting on the full range of salient sustainability issues in battery mineral supply chains, through a comprehensive indicator framework.

One of the objectives of the 2024 piloting round was to trial restructured versions of the three rulebooks used in the PoC round (Environmental and Human Rights Due Diligence, Child Labour and Greenhouse Gas Emissions) and four additional rulebooks (Biodiversity, Indigenous Peoples' Rights, Forced Labour and Circular Design).

Unlike in the PoC piloting round, the GBA did not specify a subset of questions to answer. All rulebook content was in scope of the reporting exercise.

For the 2024 piloting round, the GBA restructured rulebook questions and grouped them into three blocks of sustainability indicators:

(F) – Foundational

(I) – Intermediate

(L) – Leading practice

The purpose of this split was to distinguish between **baseline performance** (in line with regulators' requirements), **more advanced achievements** (in line with recognized external standards), and finally the most **proactive performers,** whose sustainability management systems might feature important innovations not yet covered by voluntary standards. This grouping was accompanied by a scoring mechanism that assigned 50% of the score to (F) requirements, 30% to (I) requirements and 20% to (L) requirements. The score weighting was developed through Working Group deliberations, based on factors including the number of indicators in each grouping and the relative importance of site-level performance at the three levels.

Each positively answered question scored 1 point. The overall process-level score was calculated as the sum of positively answered questions each block, divided by the maximum possible score, multiplied by the weight of block:

$$\textit{Process score} = \frac{\textit{Yes (F)}}{\textit{Max (F)}} \times 50\% + \frac{\textit{Yes (I)}}{\textit{Max (I)}} \times 30\% + \frac{\textit{Yes (L)}}{\textit{Max (L)}} \times 20\%$$

In general, this scheme fulfilled the goal of combining question groupings into a unified scoring structure. However, some unintended consequences were identified in the weighting given questions, due to the uneven distribution of (F), (I) and (L) questions, as shown in Figure 5.

FIGURE 5. Number of questions per issue, grouped by their (F), (I) and (L) categorisation

Issues	Number of questions			
	Foundational	Intermediate	Leading Practice	Total
(02) Child Labour Due Diligence (CL)	30	29	126	185
(03) Environmental and Human Rights Due Diligence (EHRDD)	117	15	90	222
(04) Biodiversity Due Diligence (BDL)	28	17	12	57
(05) Circular design (CD)	16	52	7	75
(06) Forced Labour Due Diligence (FL)	48	33	4	85
(07) Indigenous Peoples' Rights Due Diligence (IPR)	37	30	19	86
Total	276	176	258	710

Since (F), (I) and (L) questions were unevenly distributed in the prototype rulebooks trialled in the piloting round, some questions were significantly more important for scoring than others were. For example, Foundational questions for Child Labour Due Diligence (CL) each represented 1.7% of the overall CL score (50% allocation divided by 30 questions equals 1.67% per question). Whereas Leading Practice questions for CL each represented just 0.16% of the overall CL score (20% allocation divided by 126 questions equals 0.16% per question). In the case of Forced Labour Due Diligence, the uneven weighting between Foundational and Leading Practice questions was just as significant, but in the opposite direction.

In future iterations of the reporting and scoring systems, novel approaches will be considered to address the issue of uneven weighting. Possible remedies are to redistribute Foundational, Intermediate and Leading Practice questions so that they are more consistently proportioned in each rulebook, to adopt different weightings for each question category in each rulebook, or to dispense with this aggregation step and simply score each question individually, giving a total score in each ESG issue area.

Uncertainty over "not applicable" questions

During the 2024 piloting round, participating companies often had questions on the applicability of certain reporting requirements to their operations. These questions pertained to entire ESG issues and rulebooks, and to individual performance expectations within rulebooks.

ESG issue applicability. A hypothetical example to illustrate rulebook applicability questions is a manufacturing facility in a longstanding industrial area, surrounded by an urbanised population. For such a site, issues of Indigenous Peoples' rights or biodiversity were perceived by some participants to be of little salience. Another example pertains to jurisdictions where Child Labour or Forced Labour are prohibited by law, where some supply chain companies considered, as a function of abiding by local laws, that any further reporting on child labour or forced labour avoidance was unnecessary.

Individual performance expectation applicability. An example of this type of applicability question is a reporting company without small or medium enterprises (SMEs) in its supply chain, that considers questions in the Environmental and Human Rights Due Diligence rulebook specific to SMEs to be inapplicable.

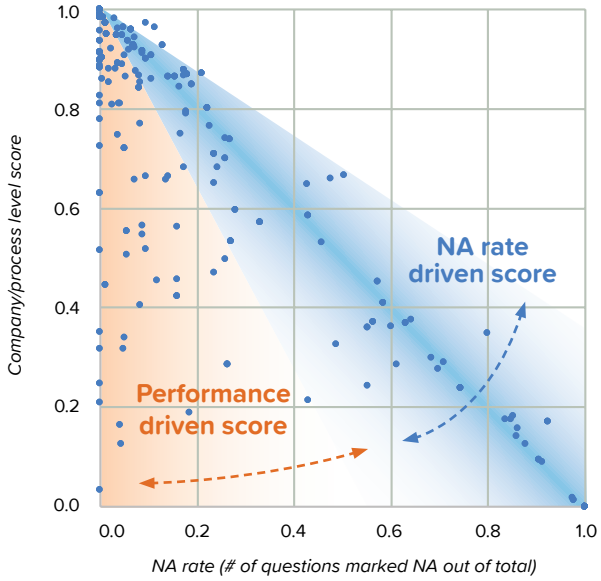
Another example is a company responding to initial questions in the Biodiversity rulebook, determining through its responses that its biodiversity impacts are not significant, and consequently considering latter questions on mitigation and remediation to be inapplicable.

As shown in these examples, interpretations of the non-applicability of questions could vary significantly between participants. The GBA ran several Q&A sessions to clarify and establish common interpretations of the rulebooks among pilot participants. Regardless, in the absence of formalised rules and mechanisms to assess issue and question saliency, or 3rd party verification to assure correct interpretations, the GBA allowed pilot participants to self-determine the non-applicability of questions to their operations, by simply marking question as not applicable ("N/A") in reporting templates.

We anticipated an N/A response rate of less than 10%, which would have allowed for score renormalisation excluding N/A responses, without significantly affecting overall scores. However, in practice some pilots had significantly higher N/A response rates (in some cases up to 45% of questions in an individual rulebook marked N/A, and in other cases companies determining that entire rulebooks were not applicable to their operations). Under these circumstances, renormalisation of scores after excluding N/A responses became impractical. A company answering 55% of questions positively and 45% of questions negatively would achieve a score of 55%, whereas a company answering 55% of questions positively and 45% of questions N/A would achieve a score of 100% after renormalisation, without any verification mechanism to determine whether the questions marked N/A were genuinely inapplicable to its operations. For this reason, the GBA determined to score N/A responses as zero for this piloting round.

In order to investigate the impact of N/A self-reporting, the GBA used the full reported dataset[15] to plot scores against N/A rates, as shown in Figure 6. The plotted results may be split into two clusters: **performance driven score** (where the N/A rate is relatively low and the score is determined to be high or low based mainly on reported sustainability performance) and **N/A rate driven score** (where the N/A rate is relatively high and the score is roughly inversely proportional to the rate of N/A responses, which are zero-scored).

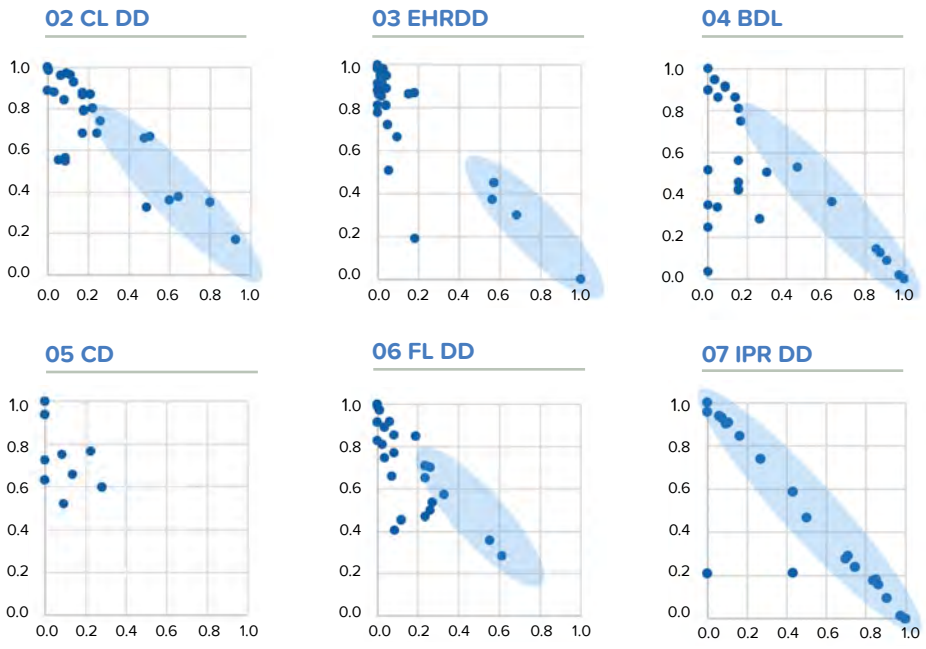
FIGURE 6: Process scores vs NA rates



[15] These data points includes those contained in reports that pilots chose to withhold from publication.

The distorting effect of N/A responses varied significantly by ESG issue. As shown in Figure 7, it was most pronounced for Indigenous Peoples' Rights reporting. It was also present in reporting on Child Labour Due Diligence, Environmental and Human Rights Due Diligence, Biodiversity Due Diligence and Forced Labour Due Diligence, but to a lesser extent.

FIGURE 7: Process scores vs NA rates issue by issue



Reporting efforts

At the outset of piloting, some participating companies had questions regarding the anticipated level of efforts to complete the required sustainability reporting. Many chose to report against a subset of ESG rulebooks, or report for a subset of supply chain clusters, as a result.

Having been given the flexibility to self-limit their reporting scope, the majority of participating companies were able to mobilise resources to report substantively on multiple ESG areas. Only one of the consortia that dropped out of the pilots before completion cited the reporting burden as their main reason for withdrawal. Nonetheless, feedback was received from multiple piloting participants that the trialled ESG rulebooks required too much granular detail on the "how" of meeting sustainability performance expectations, and that the same level of sustainability assurance could be achieved by reporting against higher-level sustainability principles.

One innovation that improved reporting efficiency, from the PoC pilots to the 2024 pilots, was the introduction of the concept of standards equivalency. Sites were given the option to declare any voluntary sustainability standard certifications they may have achieved, and to have these certifications automatically translated into scores against relevant ESG criteria in the piloting reporting template. Use of this mechanism was somewhat limited overall (accounting for 19% of total scoring) but was used extensively by certain sites, in some cases accounting for 100% of their reporting.

A more streamlined sustainability reporting framework, greater forefronting of standards equivalency, and the possible development of a mechanism for automated digital recognition of sites' voluntary standards certifications, could lead to significant gains in the efficiency of future reporting.

Because sites were able to self-limit their reporting scope, insufficient data was obtained to benchmark the overall resource cost for sites of reporting against all six qualitative ESG rulebooks. The resource cost of reporting, and its implications for the scalability of the Battery Passport, are crucial to determine, going forward. However, since the Battery Passport draft ESG rulebooks will be significantly streamlined in future iterations, the lack of usable data on the resource cost of reporting in the 2024 pilots is not a critical issue.

In any future consideration of the resource cost of reporting, the GBA will pay special attention to the costs incurred for small and medium enterprises, with the aim of avoiding a barrier for participation in the Battery Passport programme for such organisations. Options could include requiring only a subset of reporting by SMEs, directing them to Foundational criteria only, or acknowledging company size and resources in their scoring, through weighting.

Major learnings and conclusions

1. **Rulebooks for sustainability reporting will be streamlined.** Much of the granular detail in the piloting drafts of the ESG rulebooks can be distilled into higher-level principles, and the role of standards equivalency made more prominent, in order to significantly reduce reporting burden for participating companies. Automated recognition of sites' digital credentials for voluntary standard certification can also be explored.
2. **Foundational indicators will be aligned more closely with the EU Batteries Regulation and underlying guidance frameworks from the OECD and United Nations.** This will allow greater clarity for participating companies, on the areas of the Battery Passport reporting framework that are of greatest priority for their stakeholders.
3. **Score aggregation for Foundational (F), Intermediate (I) and Leading Practices (L) will be refined.** The aggregation method used in the 2024 pilots, combined with the uneven distribution of questions between F, I and L categories, led unintentionally to some questions having significantly higher scoring weight than others. This will be remedied in future iterations of the scoring framework.
4. **An opt-out mechanism will be applied for reporting against GBA rulebooks.** In order not to place an unduly onerous reporting burden on participating companies, a mechanism will be developed to allow reporting sites to elect not to report against certain rulebooks, or sections of rulebooks, if they are deemed not to be 'salient'. I.E. the case of hypothetical sustainability impacts that are shown to be negligible in practice, through an initial analysis of the site's operations and circumstances. Such a filter could only be applied in cases of genuinely low salience for site-level operations, and would require rigorous external scrutiny of sites' saliency determinations either through site-level assurance of reported non-applicability, or public disclosure of justifications, to allow for stakeholder scrutiny.
5. **Rules for determining whether rulebook questions are 'not applicable' for reporting sites will be clarified.** A range of different interpretations of non-applicability were identified in the 2024 pilots, leading to variations in scoring between sites that will be addressed.
6. **Further benchmarking is required to assess the overall reporting burden of participation in the Battery Passport programme.** Insufficient data was obtained on the resource cost of reporting against all piloted rulebooks, since most consortia reported against a subset of these rulebooks and/or for a subset of the supply chain. Additional benchmarking of resource costs will be required in subsequent piloting, using streamlined ESG rulebooks.
7. **Reporting, including self-reporting, against GBA rulebooks significantly increased supply chain companies' familiarity with sustainability performance expectations.** This was particularly the case for manufacturing companies, which have historically experienced less sustainability scrutiny from stakeholders than miners and refiners have. Participation enabled them to benchmark internal systems and readiness against regulatory requirements, and beyond, and to prepare for future expectations placed on them by downstream clients, financiers, civil society, organised labour, affected peoples, national regulatory authorities, and other stakeholders.

6.3. Greenhouse gas reporting

The Greenhouse Gas (GHG) workstream is at a more advanced stage of development than other Battery Passport workstreams. Work on the Greenhouse Gas Rulebook[16] began early on in the Battery Passport programme, and the rulebook has undergone extensive review by the GBA membership as well as a round of public consultation. The Rulebook was a 'first of its kind', since no other published approaches to battery carbon footprinting were available prior to the development of the rulebook, from which to draw.

One unique feature of the GHG Rulebook, compared to the draft qualitative ESG rulebooks discussed in Section 6.2, is the possibility to employ 'secondary', or approximated, data. In cases where primary data on carbon footprints, which are calculated from a site's own operations, is not available, it is legitimate to use industry averages or recognised benchmark figures from external sources. Clearly, the same approach does not hold when assessing a site's management systems for eliminating child labour, mitigating biodiversity loss, or similar. The use of both primary and secondary data in sites' reporting for the Battery Passport is therefore unique to the GHG Rulebook.

Accompanying the GHG Rulebook, the GBA developed the document *Guidelines for Track & Trace Service Providers on ESG Data Declaration, Exchange, and Aggregation*[17], ("Guidelines for T&T"), which was published in April 2024. This document focused primarily on GHG data, and described a model for how this data could be exchanged and aggregated step by step along the supply chain, culminating in a total carbon footprint at the battery level.

This stepwise approach to calculation along the supply chain follows the logic of a digital product passport, but diverges from the logic typically used in GHG life-cycle assessments (LCAs). In an LCA approach, the carbon footprint of a product is calculated by a single entity, using data from the product's supply chain and industry averages, rather than calculated at each step of the supply chain and aggregated.

This novel approach to carbon footprinting, and the commercial sensitivity of GHG data, were two factors that led to the reporting of GHG data being less comprehensive than hoped for. On average, reporting rates for GHG data were approximately half the rates for qualitative ESG data. Utilisation of the Guidelines for T&T was also uneven, with some consortia opting to use LCA-type approaches instead, although this was not

[16] https://www.globalbattery.org/media/publications/gba-rulebook-v2.0-master.pdf
[17] https://www.globalbattery.org/media/publications/the-tt-guidelines-on-ghg-data-exchange-v1-0.pdf

strictly permitted within the scope of the pilots. Specific obstacles to fuller GHG reporting that were reported by piloting participants or conjectured by organisers include:

- Concern among some participating companies that disclosure of GHG data within the Battery Passport framework could have negative regulatory implications. Many companies have mandated emissions reductions targets, and data generated through the novel and developmental Battery Passport GHG reporting framework could be misinterpreted in this context.
- Concern among some participating companies regarding the commercial sensitivity of GHG disclosures, and the potential for competitors to 'reverse engineer' insights on production models and supply chains, from granular GHG data disclosed by supply chain cluster.
- Lack of compatibility between the Battery Passport supply chain model and available secondary data on carbon footprints. The pilot exercise subdivided the battery supply chain into five clusters (see Section 6.1) and required separated reporting for the supply chains of each mineral. Available secondary data often did not disaggregate to this extent. For example, available overall figures for the carbon footprint of metallic nickel may not separate out the contribution from mining, refining, transportation, etc., and overall figures for carbon footprint of mining may not differentiate by mineral type.
- Ambiguity and requirement for interpretation for some calculation rules in the GHG Rulebook. For example, aluminium foil and copper wire are introduced into the battery supply chain at the cell production stage, and it was not clear to participants whether the entire carbon footprint of these two products should be attributed to cluster 4 (cell manufacturing) or whether the carbon footprint should be distributed between clusters 1 (mining), 2 (refining) and 4 (cell manufacturing).
- Ambiguity in the definitions of primary and secondary data, leading some pilot participants to reach markedly different designations of the same scenarios. In one extremal example, a piloting participant designated its data 100% primary, while another participant designated its equivalent data as 100% secondary.

Major learnings and conclusions

1. **Ambiguity in some GHG calculation rules will be addressed.** Rulebook revisions will ensure that there is less requirement for interpretation of the rules, in any of the typical scenarios that occur in battery production and battery mineral supply chains. Guidance and examples will be provided to assist companies in implementing the GHG Rulebook (in particular for small and medium sized companies).
2. **Clarification of the definitions of primary and secondary data.** Either the definitions of primary and secondary data will be amended to remove room for interpretation, or guidance and examples will be given, to ensure that interpretation is consistent between participants, or both.
3. **Harmonise GHG data collection model with Battery Passport data exchange model.** We will enable the smooth collection and aggregation of GHG data along the supply chain, within the general framework of data exchange in the Battery Passport. Rulebooks will prohibit more explicitly the use of divergent carbon footprinting approaches that employ LCA-type practices, in which supply chain carbon footprint is calculated solely at the battery producer level. Rules will be developed for the use of industry averages, in instances where site-level data from the supply chain is missing due to non-reporting by sites upstream.
4. **Resolve incompatibilities between Battery Passport supply chain model and available secondary data.** Ensure that cluster boundaries are as harmonised as possible with available sources of secondary data, and provide further guidance on the usage of secondary data that does not align with clusterisation or other boundaries (e.g. how to apportion carbon emissions to supply chain clusters, from a single aggregate figure for the carbon footprint of refined nickel or lithium).

6.4. Sustainability indicator score averaging and aggregation through the supply chain

The scoring of a product's sustainability indicators, as reported against GBA rulebooks, is a key component of the Battery Passport value proposition. While the indicators themselves allow sustainability performance to be assessed, the scoring framework allows data aggregation down the supply chain, meaningful comparison between products and benchmarking of sustainability performance, at a glance. The multi-stakeholder governance environment in which the Battery Passport scoring framework is developed helps to establish a widely globally accepted method for measurement of battery supply chain sustainability performance.

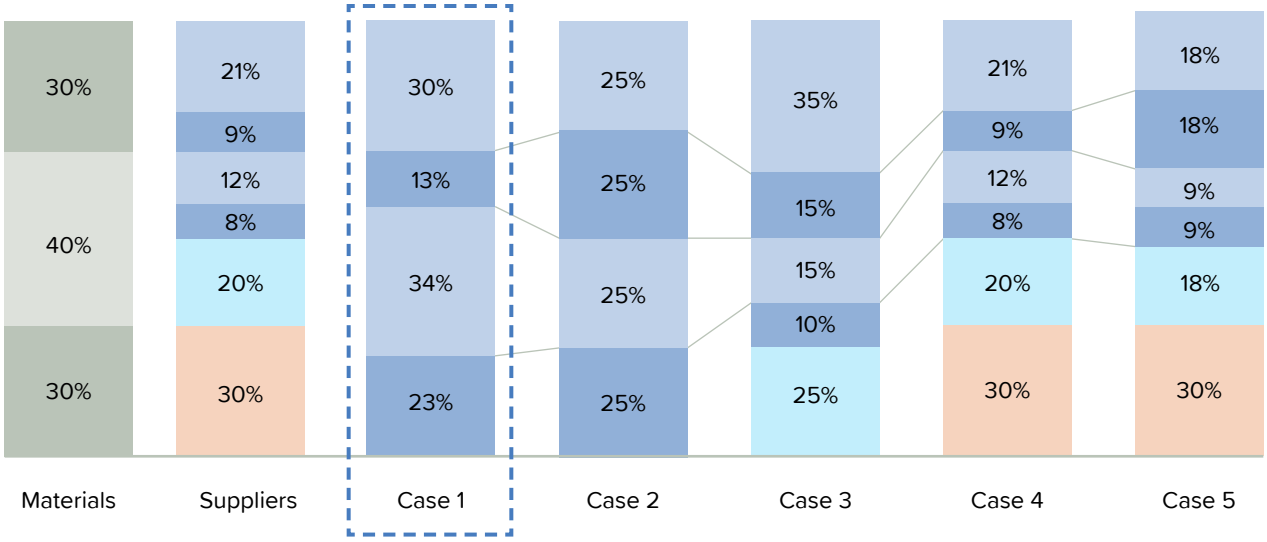
In the 2024 pilots, scores were calculated and displayed in Battery Passports broken down by sustainability topic (child labour, biodiversity, etc), and by supply chain cluster (mining, refining, etc). To arrive at these scores, scoring rules were decided upon in a number of areas. The most important of these areas were as follows:

1. Combining scores from different mineral supply chains, in a single composite product (e.g. score averaging for lithium, graphite, cobalt and nickel combined in a single battery).
2. Combining scores from different suppliers when calculating overall supply chain sustainability scores.
3. Handling of missing data from the supply chain

Figure 9, below, illustrates some of the potential scoring scenarios that were discussed during planning for the piloting. It is based on a simplified model of a battery supply chain, that features three minerals: Mineral 1, Mineral 2 and Mineral 3. As shown in the left-hand column, these minerals comprise 30%, 40% and 30% of the battery, respectively. As shown in the column second from the left, the supply mix for these minerals is as follows:

- Mineral 1: provided by company A1 (70% by weight) and company A2 (30% by weight)
- Mineral 2: provided by company A3 (30% by weight), company A4 (20% by weight) and unknown suppliers (50% by weight)
- Mineral 3: not tracing information

FIGURE 9. A subset of possible scenarios of scoring calculation



The rightmost five columns show five different scoring combinations, or cases, and the percentage contributed to the overall score by each supplier, in the five cases. The five cases illustrate the 'real world' significance of choices regarding scoring rules, which can lead to markedly different scoring results in the Battery Passport.

In the five cases, scoring rules are applied as follows:

Case 1: Scores are averaged in proportion to the weight of product supplied. When supplier data is unknown, scores are renormalised (i.e. as though the known suppliers accounted for 100% of material).

Case 2: Each supplier, across all minerals, contributes an equal share of the overall score. When supplier data is unknown, scores are renormalised (i.e. as though the known suppliers accounted for 100% of material).

Case 3: Each mineral contributes an equal share of the overall score, but minerals with completely unmapped supply chains are ignored. For each mineral, supplier scores are averaged in proportion to the weight of product supplied.

Case 4: Scores are averaged in proportion to the weight of product supplied, with no renormalisation for missing data.

Case 5: Scores are weighted equally for all suppliers and all materials, where data is available. No renormalisation for missing data.

Case 1 depicts the scoring system used for the 2024 Battery Passport pilots. It was determined during the planning of the piloting round that each supplier, and each mineral, should contribute to the overall score in proportion to the associated weight of material supplied. This was assessed to be the fairest way to reflect supply chain sustainability performance, for the purpose of the piloting exercise, and the option least prone to negative unintended consequences. In an alternative scenario where each supplier is given equal scoring weight, a potential unintended consequence is battery manufacturers disengaging from minor suppliers with poor sustainability scores instead of working with them to improve performance, because of the disproportionate effect that such suppliers would have on the overall score. Similarly, in the scenario where all minerals in the battery are given equal weighting for scoring, minor minerals in the battery could disproportionately affect the overall sustainability score.

As shown in Case 1, the GBA chose to renormalise scores in instances of unknown suppliers or missing data from the supply chain. This decision was taken in light of the developmental nature of the piloting exercise. Supply chain companies participated in the piloting exercise pro bono, and no preconditions were set for a minimum expected level of supply chain visibility. In the piloting context, it would have been unfair to penalise participating companies with poor scores due to a low level of supplier knowledge.

If the same scoring principle was applied to a fully-operational 'live' version of the Battery Passport, however, it could lead to significant negative unintended consequences. Supply chain companies could be incentivised to report only the data associated with their best-performing suppliers, and declare the remainder of their supply chain "unknown", even if this was not the case. The overall effect would be detrimental to the goals of improving supply chain transparency and meaningful comparability of supply chain sustainability performance. The scoring logic depicted in Case 4, of purely weight-based averaging, with no renormalisation in the case of missing data, may be a more appropriate fit for a final, operational Battery Passport.

It should be noted that the above discussion of scoring options is primarily relevant for reporting against the qualitative (non-GHG) sustainability indicator rulebooks. In the case of GHG, carbon footprint data aggregation must be averaged by weight of material, with secondary data used when primary data is missing, in order to produce meaningful results.

Carbon footprint data was not translated to scores in the 2024 pilots, since insufficient data was collected to benchmark carbon footprint scores from high to low. This benchmarking will be done following subsequent piloting rounds, once sufficient data is available.

Major learnings and conclusions

1. **Scoring proportionate to material weight, without renormalisation for missing data, is generally preferable.** Going forward, the Battery Passport will implement a scoring system that employs score averaging by weight, for each material, as depicted in Case 4 in Figure 9.
2. **Scoring bands will be calibrated to global scoring performance.** If missing data is scored as zero in the Battery Passport, as depicted in Case 4, it is reasonable to anticipate that most battery manufacturers will score well below the maximum number of points available, at least in the first few years. This is because the vast majority of battery manufacturers have incomplete knowledge of their mineral supply chains. Scoring bands for the Battery Passport will be set such that top performers, relative to their peers, attain recognition irrespective of their numerical scores. Scoring bands will be reviewed periodically, in order to ensure they remain calibrated to overall global scoring performance, year on year.
3. **Thresholds will be considered for materiality.** In a weight-based scoring system, reporting companies are faced with a choice: either spending significant resources mapping and collecting data from minor suppliers with minimal effect on overall scores, or declaring such suppliers "unknown" and accepting that a small proportion of their supply chain will be scored zero. A materiality cut-off, in which only suppliers that contribute a certain percentage of a metal, or only metals that contribute a certain percentage to the battery, need be considered for scoring purposes, could eliminate this dilemma.
4. **The responsibility for validation of scoring will change.** In the 2024 pilots, the GBA was responsible for collating battery supply chain data and checking scores for the Battery Passport. In order to ensure scalability of the Battery Passport, in which the capacity of the GBA Secretariat is not a determinant of scaling speed, the responsibility for validating score calculations will be shifted to third party verifier organisations.
5. **Further data will be gathered to benchmark carbon footprint performance.** Although data on GHG emissions associated with battery production was gathered in the 2024 pilots, the dataset was not sufficiently complete to be representative of general battery GHG emissions, and high and low performers could not be benchmarked. This deficiency will be addressed in subsequent piloting activities.

6.5. Data disclosure and data governance

Resistance to disclose

The 2024 pilots made use of real sustainability data reported and gathered from battery supply chains, unlike the PoC round of piloting which relied on simulated data. The fact that real data was used for the 2024 pilots introduced disclosure challenges, since many companies considered this data to be commercially sensitive. The involvement of multiple piloting consortia heightened the challenge. Companies were reticent to publish scores if they anticipated that their scores would be lower than those of their peers. Since companies could elect which mineral supply chains and which supply chain clusters to report on, some were also reticent to publish when they anticipated that they might be alone in publishing scores in a particular area, which could lead to them being singled out for heightened scrutiny of their performance.

In order to address these challenges, the GBA adopted a simple mechanism for the management of disclosures. Each piloting consortium agreed to share sufficient data with the GBA to calculate scores, but had the option to withhold scores from publication on the GBA website, at will. A key requirement was that all data submitted by piloting consortia was considered 'final' at a designated cut-off point. Data, and decisions on whether to disclose data, could not be subsequently revised by consortia once the results of the piloting exercise were published. This requirement was introduced to prevent companies from revising their data or disclosure decisions, if they felt that their scores compared poorly to the scores of their peers. Consortia's willingness to publish data varied significantly according to data type, as shown below.

Data type	Publication rate	Comments
Technical data	Relatively high (almost 100% of reported data)	Technical battery data is frequently shared by manufacturers, outside the GBA battery passport framework, so few sensitivity challenges were encountered. A few consortia requested for technical metrics to be rounded (e.g. 50 kg of physical weight instead of 49,32 kg), or withheld from publication.
Provenance data	Relatively low (variable rate between data types)	All consortia publicly disclosed the origin countries of materials. Less than 50% of consortia shared the names of companies that supply materials. None of the consortia chose to publicly disclose those names.
Quantitative data (GHG)	Relatively low (36% of reported data)	Factors underlying the relatively low levels of public disclosure for GHG data are discussed in Section 6.3
Qualitative sustainability scores	Relatively high (68% of reported data)	In some cases, consortia opted to withhold sustainability scores from publication, in particular when this data was perceived as commercially sensitive or likely to compare unfavourably with the scores of peers.

The GBA defined the technical data to be included in the 2024 pilots via a survey of the piloting consortia (see Annex 2). The piloting consortia rated the data points contained in the Battery Pass consortium's data attribute list[18], for their importance, the ease of data sharing, and their readiness to share the data. The Battery Pass consortium's list is based on the data disclosures required under the EU Batteries Regulation.

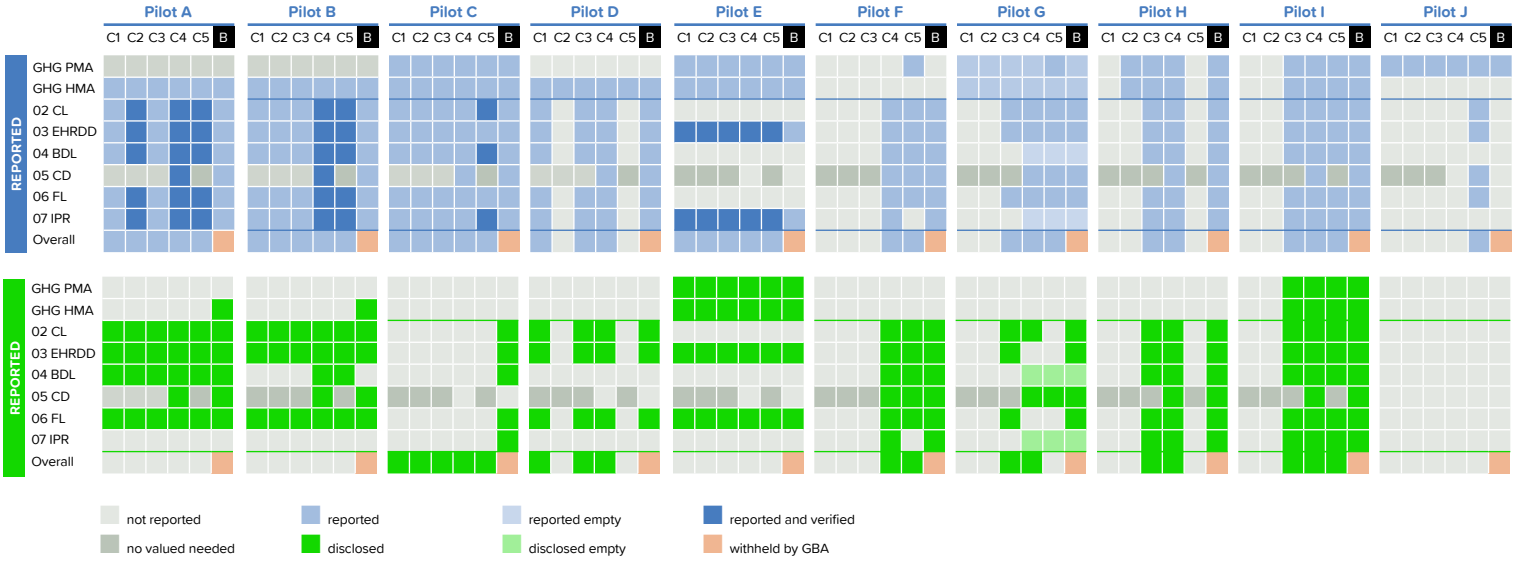
This preparatory step partially explains the high level of disclosure of technical data. Going forward, the GBA will assess what technical and performance data will be required in the final version of the Battery Passport, and how best to align with regulatory and other requirements. Depending on member interest, the GBA may

[18] The full list is available here: https://thebatterypass.eu/assets/images/content-guidance/pdf/2023_Battery_Passport_Content_Guidance.pdf

also play a role in developing additional guidance for companies on reporting technical data required by the EU Batteries Regulation, in instances where data points are currently perceived to be insufficiently defined or too sensitive to disclose.

A detailed breakdown of the data reported to the GBA, and the data publicly disclosed by each piloting consortium is given in Figure 10, below (with the consortia anonymised using the labels A to J). In this figure, and in Figure 11, the five supply chain clusters are denoted C1 to C5 (see Section 6.1 for an explanation of the clusterisation methodology used in the 2024 pilots). The acronyms in the left-hand columns correspond to the Battery Passport rulebooks against which data was reported. In descending order, these were: Greenhouse Gas (Physically Modelled Approach), Greenhouse Gas (Harmonised Market Approach), Child Labour, Environmental and Human Rights Due Diligence, Biodiversity Loss, Circular Design, Forced Labour and Indigenous Peoples Rights.

FIGURE 10: Graphical representation of ESG data coverage and data publicly disclosed (including both qualitative and quantitative data)

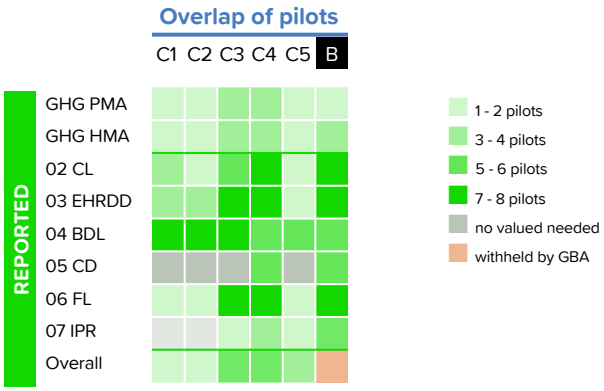


The figure illustrates the significant variation between piloting consortia, in terms of data reported to the GBA and data publicly disclosed. Some notable aspects of the data landscape include:

- Pilot C achieved a 100% reporting rate to the GBA (every tile is blue in the upper half of the matrix), but had the lowest rate of public disclosure of any consortium (very sparse green tiling in the lower half of the matrix).
- Pilot I chose to publicly disclose all data that was reported to the GBA, though it's supply chain coverage did not extend to the refining or mining clusters.
- The average rate of data reporting to the GBA (the proportion of blue tiles to the maximum value of 49) was 66%.
- The average rate of public disclosure of reported data (the proportion of green tiles to blue tiles) was 61%

The overall level of public disclosure of data was significantly improved in the 2024 pilots, compared to the earlier PoC pilots. Collectively, the piloting consortia disclosed scores for every supply chain cluster and for each ESG Rulebook, with the exception of Indigenous Peoples Rights reporting at the mining and refining stages of the supply chain. Figure 11, below, superimposes the disclosure data for all ten pilots, showing where public disclosures were most frequent for piloting consortia, and where disclosures were sparser.

FIGURE 11: A heatmap of the frequency of public disclosures, for piloting consortia.



Governance of data disclosures

The GBA did not elaborate a full governance system for data disclosures in the 2024 pilots, allowing consortia to 'opt in' to different levels of voluntary data disclosure. Each consortium made its data disclosure choices individually, without knowledge of other consortia's planned disclosure levels, as all disclosed data sets were published online simultaneously.

Without a full governance system for data disclosures in place, some piloting consortia expressed uncertainty over how their data would be shared, and with which stakeholders. These concerns may have reduced overall data disclosure rates for the piloting exercise.

As the Battery Passport continues to be developed, experience from the piloting exercise shows that significant work must be done to socialise and agree a governance structure for data disclosures. The structure should provide surety for participating companies on how their data will be shared, a clearly-articulated minimum level of data disclosure, and the flexibility for companies to disclose data beyond the minimum, at will.

Some aspects to consider for a governance structure for data disclosures include:

- **The granularity of sustainability data that is visible in the Battery Passport.** In the 2024 pilots, sustainability indicators were displayed as a numerical score in the 0 to 1 range, for each sustainability issue and each supply chain cluster (as shown in Figure 12). GHG data was displayed in kg of CO2e, under both the physically-modelled approach (PMA) and harmonised market approach (HMA) to carbon footprinting. The GBA must determine whether this is the appropriate level of granularity for the final Battery Passport or whether, for example, the Battery Passport should mandate disclosure of scores for subcategories within sustainability topics (e.g. scoring for the presence of community grievance mechanisms, within the overall topic of Environmental and Human Rights Due Diligence), or even mandate disclosure of responses to individual questions in the Battery Passport rulebooks.

Figure 12: An example of how numerical data is displayed in the 2024 piloting results.

CLUSTERS	MINING	REFINING	MATERIALS	CELL	BATTERY	OVERALL
# of companies	3	3	6	1	1	14
QUANTITATIVE ISSUE:	(01) GREENHOUSE GAS					
# of reports	2	2	4	2	2	12
GHG (PMA)	17	7	59	17	1	102
primary data share	0%	0%	67%	100%	100%	57%
GHG (HMA)	18	7	52	9	0.41	86
primary data share	0%	0%	62%	100%	100%	49%
QUALITATIVE ISSUES	(03) ENVIRONMENTAL AND HUMAN RIGHTS DUE DILIGENCE					
# of reports	2	2	6	1	1	12
ESG Score	0.87	0.87	0.92	1.00	1.00	0.93
n/a rate (%)	17%	17%	7%	0%	0%	9%

- **The granularity of proof and provenance data that is visible in the Battery Passport.** The 2024 piloting version of the Battery Passport disclosed the percentage of data that was verified by a 3rd party verifier, and disclosed the countries of origin of traced minerals. The GBA must determine what level of transparency to mandate in the final Battery Passport. For example, a requirement could be to disclose the types of proof that were presented to verifiers (policy documents, certifications, etc). For provenance, the final Battery Passport could display the name of the countries in which production and processing takes place at each stage of the supply chain, as well as the mineral countries of origin.
- **How disclosures beyond the minimum are facilitated and incentivised.** The Battery Passport will contain a minimum set of indicators that must be publicly disclosed, accompanying the physical battery. In addition, the Battery Passport framework will be structured such that companies in the supply chain can elect to make disclosures beyond the minimum. Stakeholders including regulators, customers, end consumers, civil society and investors have varying expectations on supply chain transparency, and on companies' accountability for their sustainability performance. By facilitating voluntary and flexible disclosures to these groups, the Battery Passport allows companies to differentiate themselves to their stakeholders on sustainability grounds. This in turn drives a general uplift in supply chain sustainability performance. An additional score could be presented in the Battery Passport, to recognise companies going beyond minimum disclosure requirements, or disclosures could be incentivised more organically, by stakeholders encouraging supply chain companies toward voluntary disclosures for transparency and due diligence purposes. Conceivably, the final Battery Passport could allow companies to create different "views" of their data for different audiences, e.g. a view with minimal disclosures, for public consumption; a view that provides transparency elements such as the names and locations of companies in the supply chain that volunteer to share this information; and a full and granular view of sustainability performance for trusted stakeholders.

Major learnings and conclusions

- **A full governance structure for data disclosures will be elaborated by the GBA.** This structure will provide surety for participating companies on how their data will be shared. It will define a minimum level of data disclosure, specifying the level of disaggregation of sustainability indicators, and the transparency requirements for data proofs and material provenance information. It will present a clear pathway for the facilitation and incentivisation of progressively greater data disclosures, beyond the mandated minimum.

6.6. Supply chain data gathering and data aggregation

In most consortia in the 2024 piloting exercise, commercial track and trace solution providers ("T&T providers") played a crucial role in the centralised collection and aggregation of supply chain data.

T&T providers were assigned equal prominence to the cell manufacturers leading the consortia. Each consortium included one coordinating T&T provider, so interoperability between different T&T providers' systems was not tested during the 2024 pilots. All T&T providers were independent commercial entities, except in the case of one piloting consortium where the cell manufacturer chose to trial an in-house traceability solution. This was permitted by the GBA, under the condition that the same cell manufacturer ran a second piloting consortium in parallel, with an independent T&T provider.

While each consortium had one designated coordinating T&T provider (external or in-house), some piloting consortia also chose to collaborate with a second T&T provider specialised in greenhouse gas calculations, in order to fulfil this component of the Battery Passport. This modularisation of the T&T provider role proved useful in the case of greenhouse gas reporting, which relies on specialised technical expertise, and the delineation of responsibilities is instructive for the future evolution of the Battery Passport ecosystem.

The centralised approach to data collection and aggregation was a good fit for the piloting exercise. However, it highlighted some structural considerations that suggest a decentralised solution would be better suited to the global scaling of the Battery Passport. One such consideration was around trust between organisations. Some supply chain companies relayed reservations about sharing detailed and commercially sensitive data with commercial T&T providers, who might also handle data from clients, suppliers, peer companies and competitors. Many participating companies employed non-disclosure agreements (NDAs) to manage these sensitivities, which in turn led T&T providers into the formidable task of deconflicting the provisions of multiple NDAs between multiple participants. Some T&T providers expressed disappointment at the level of administrative burden this entailed, and also at their centralised coordination role which, in the absence of a technical data exchange framework, limited them to reliance on a data storage and exchange system built on MS Excel and email attachments. Few opportunities were available to trial T&T providers' custom technological solutions, and the T&T providers are to be commended for the significant resources they devoted to the piloting exercise, nonetheless.

For companies in the scope of the EU Batteries Regulation, the exercise provided an opportunity to trial the feasibility of utilising "neutral third parties" to carry out supply chain mapping and data collection for due diligence. While some cell manufacturers that participated in the 2024 pilots preferred to retain control of data by relying on in-house solutions, not all economic operators will have the resources or willingness to construct in-house digital product passport solutions. Elaborating clear conditions and credibility criteria for third party T&T providers, with regard to independence, data ownership and safeguarding, and disclosure of data on an "need to know basis", and related sanctions for breaching these conditions, are critical for implementing the EU Batteries Regulation requirements. The GBA Battery Passport piloting exercise, and GBA rulesets for T&T providers that will be developed based on piloting lessons learned, can provide a valuable model from which to develop regulator requirements.

Major learnings and conclusions

1. **The Battery Passport will explore a decentralised model, in order to scale.** The centralised coordination of data exchange and aggregation worked well for the 2024 pilots, but came with challenges around the disclosure of sensitive data to third parties, and the administrative burden of centralisation. With an elaborated decentralised digital data exchange framework, it will be possible to mitigate these challenges, with T&T companies transitioning to bilateral solution-provider roles with supply chain companies, based on their custom technological solutions.
2. **Trialling a digital data exchange framework is a priority for the Battery Passport programme.** Data exchange and interoperation protocols, between supply chain companies and T&T providers, will require comprehensive real-world testing and refinement, in order to ensure their suitability for the global scaling of the Battery Passport.
3. **A separate designation of 'GHG calculation partner' will be considered.** Within a decentralised system for Battery Passport data exchange and aggregation, supply chain companies would have the flexibility to choose the components of T&T provision for which they involve external service providers. Given the specialised technical nature of GHG calculation and aggregation down the supply chain, this is a component for which many companies might seek external support, and for which a standalone category of service provider could be designated.

6.7. Verification of data

Data verification is an essential component of the GBA Battery Passport since, in order for data to have value for stakeholders, it must be trustworthy. In the finished version of the Battery Passport a comprehensive data assurance framework will be elaborated, detailing roles, responsibilities and procedures for the verification of data inputted into the Battery Passport ecosystem, and the verification of data aggregation and exchange processes.

At the time of the 2024 pilots, a draft data assurance framework had not yet been developed. 3rd party data verifiers were invited to assure reported data based on their existing templates for data verification, and to provide feedback to the GBA Secretariat on lessons learned, in order to inform the development of a Battery Passport data assurance framework. Data assurance trials were limited to verification of reported data only. 3rd party verifiers did not scrutinise T&T Providers' processes for data aggregation or data exchange in the 2024 pilots, though these processes will need to be assured in the final version of the Battery Passport.

Five consortia decided to participate in data verification. Most underwent data verification for ESG reporting against multiple GBA rulebooks. Some consortia limited the verification scope to individual supply chain companies, while others aimed for verification of multiple companies' data.

Because of the free-form methodology employed, and the varying approaches of 3rd party verifiers, it was not possible to benchmark the level of effort required to undertake verification, by the verifier organisation and the site being verified. Such benchmarking is an essential future step in the development of the Battery Passport, as the resource cost of verification will be a crucial factor in determining appropriate verification frequency.

Although a benchmarking of level of effort could not be established, the piloting of verification functions generated other invaluable insights for the development of the Battery Passport. One of the challenges identified centred on the timely verification of data, in the somewhat complex piloting setup with the GBA and T&T providers playing coordinating roles, alongside the bilateral relationship between verifiers and supply chain companies. In particular, some verifiers experienced delays in receiving supply chain data that was being aggregated by T&T providers, which led to challenges completing verification on time for pilot launches.

Another challenge identified through piloting related to the management of potential conflicts of interest. Of the 3rd party verifiers that participated in the piloting, two out of three were major global audit firms. Such audit firms generally provide a complex range of services to companies throughout the minerals supply chain, and must carefully navigate conflict of interest requirements. It is imperative to avoid situations where a firm supports the generation of data or the conduct of a process, and also assures the veracity of the data or correct conduct of the process.

Major learnings and conclusions

1. **Detailed guidance will be developed for 3rd party verifiers.** In order to ensure clarity and consistency within the verification process, 3rd party verifiers will be provided with detailed verification guidance, covering the scope and stringency of checks, and relevant roles, responsibilities and reporting requirements.
2. **Benchmarking will be conducted on the resource cost of verification, in subsequent pilots.** Through such benchmarking, with a guidance document for verifiers in place, it will be possible to project the cost associated with verification for supply chain companies – both in terms of verifier fees and staff time. With this cost data, it will in turn be possible to set an appropriate frequency for verification checks, providing assurance to stakeholders without unduly burdening participating companies.
3. **The relationship between verifiers and supply chain companies will be streamlined.** As the Battery Passport moves toward an operational, scalable version, a more efficient interrelationship between verifiers and supply chain companies will be established. In particular, the Battery Passport data exchange framework will be designed such that by default verifiers receive data directly from supply chain companies, rather than from T&T Providers functioning in an intermediary role.
4. **A robust and diverse verifier ecosystem is necessary to avoid challenges related to conflict of interest.** Given the clear potential for conflict-of-interest issues to arise, from verifiers' existing relationships with supply chain companies participating in the Battery Passport programme, the GBA will foster a diverse verifier ecosystem involving a wide range of verification firms, to give companies sufficient choice over which verifiers they appoint. 3rd party verifiers will be recognised, or accredited, by the GBA as legitimate providers of verification services. An appropriate recognition framework for verifiers will be developed by the GBA Secretariat and member organisations.

7.

The Road Ahead for the GBA Battery Passport

The 2024 piloting exercise for the GBA Battery Passport represented a very significant investment of time and resources by companies in the battery supply chain, T&T providers, 3rd-party verifiers, and other organisations from across the globe. Companies representing 80% of the world's cell manufacturing capacity participated, making these pilots the single largest effort to date to uplift sustainability performance in the battery supply chain. In turn, the piloting exercise supported the transition to a global economic model that is not only low carbon, but also just, equitable and beneficial for people and planet.

As this report attests, the investment of time and resources by piloting participants has led a wealth of lessons learned, to help shape the future development of the GBA Battery Passport. These lessons learned have fed directly into the 2025 workplan for the Battery Passport, and have guided longer-term planning, as we look toward full public operationalisation of the framework in 2027.

Lessons learned on the streamlining and refining of Battery Passport rulebooks for sustainability reporting, on developing the associated scoring framework, on elaborating the GHG calculation rules, and on the need for a decentralised system for data exchange, will be taken up directly by relevant multistakeholder working groups within the GBA. These lessons learned will inform the development of revised frameworks, rulebooks and guidance, for the implementation of the Battery Passport.

Some aspects of the Battery Passport will benefit from further testing. In particular, substantive rules for data exchange and assurance were not in place during the 2024 piloting round, and must be developed and trialled. The rules developed in these areas, through the corresponding GBA working group, and informed by the lessons learned documented in this report, will be a pioneering framework with few existing analogues in raw material supply chains. Trials will ensure that these rules are practically implementable by supply chain companies, scalable for the global roll-out of the battery passport, and capable of delivering a data landscape that is reliable and trustable.

To meet this need for real-world testing, the GBA is preparing to launch a 'beta release' of the Battery Passport sustainability reporting framework and accompanying data exchange and assurance rules, followed by the commencement of operational trials focused on practical scaling of the Battery Passport. The beta release and operational trials are scheduled for the 4th quarter of 2025, and throughout 2026. Participation will allow supply chain companies and digital solution providers to collaborate on the continued development of the Battery Passport, and to gain first-mover advantage in meeting the rapidly evolving expectations of regulators and stakeholders for the use of Digital Product Passport technology in battery supply chains. Organisations that wish to participate are invited to express their interest by contacting secretariat@globalbattery.org

In a time of great global uncertainty, the 2024 Battery Passport pilots represent a light-shaft of optimism. Not only does the Battery Passport hold significant potential for uplifting transparency, facilitating circularity, sustainability and resilience in battery value chains, it also demonstrates the power of cooperation. Companies from across the supply chain, service providers, civil society, national governments and others have come together, building consensus in a multistakeholder environment and devoting time and resources toward common sustainability goals. The piloting results, learnings and conclusions presented in this report are a testament to the level of global goodwill that persists, to meet our collective challenges together as one.

8.

Acknowledgements

The implementation of the Global Battery Alliance's 2024 piloting exercise relied on pro bono contributions of time and resources from companies throughout the battery supply chain, providers of supply chain tracking and traceability solutions, and professional services firms conducting data verification. The preparation of underlying frameworks, such as the pilot versions of ESG rulebooks, involved many more stakeholders on top – from industry, civil society, academia, governments and beyond.

It would not be possible to adequately acknowledge each organisation's contribution to making the GBA 2024 pilots a success. It would be still less possible to adequately acknowledge each individual contributor, many of whom worked long hours, took late night or early morning calls across multiple time zones, and in some cases even sacrificed holiday periods to ensure their contributions were delivered on time and to a high standard. We will not name individuals from contributing organisations who made these commendable efforts, since naming some could take recognition away from others, but special thanks must go to Alex Sorokin, a longstanding contributor to the Battery Passport programme and the leader of the piloting exercise. Special thanks must also go to the piloting teams from the following organisations:

Battery and automotive supply chain companies:

BYD
CALB
CATL
EVE Energy
FinDreams Battery
Gotion
LG Energy Solution
Li Auto
NIO
PTL
Samsung SDI
SAIC Maxus
Smart
Sunwoda

Track and trace solution providers:

Circularise
Circulor
Glassdome
Minviro
Nanjing Fuchuang
RCS Global
Shenzhen Dianlian Technology

3rd Party verifiers:

EY
TuV Rheinland
Botree