International Organization for Standardization
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Международная организация по стандартизации

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ISO/TMB/SAG CRMI

Strategic Advisory Group on Critical Minerals

PHASE 2 - Final Report

[For consideration at the June 2023 TMB meeting]

Finalized 28 April 2023

Contents

Convenor's report to TMB concerning ISO/TMB/SAG CRMI

The ISO Strategic Advisory Group on Critical Minerals was pleased to collaborate for a second phase of work to further explore priorities for critical minerals standardization and testing these potential areas of work with stakeholders. The discussion and collaboration has allowed members to make a series of recommendations about structures to undertake the work, priority areas for standardization and additional opportunities for collaboration with external parties, which will bring coherence to the critical minerals standards landscape.

In this second phase of the Strategic Advisory Group's (SAG) work members held eight meetings from August 2022 – April 2023. Seven meetings held in virtual mode and the final meeting was held in hybrid mode. Over the course of their work, the Strategic Advisory Group also benefited from inputs from the Consultative Group who joined several meetings of the SAG and were invited to the final meeting of the group.

The major pieces of work in this second phase included:

- Summary of chemical analysis techniques used for critical minerals.
- Stocktake of ICP and XRF methods, with reference to existing standards.
- Review of chemical analysis techniques to identify best-practice examples.
- Stocktake of sustainability tools/guides/standards external to ISO.
- Survey of stakeholders which helped to clarify the way forward with many aspects of the SAG's mandate.

We would like to acknowledge the contributions of all members of the SAG to the work.

Particular thanks goes to John Bonevich and Jeff Koyanagi for the significant work analyzing existing chemical analysis techniques on ICP and XRF methods. And also to Rafael Toledo-Bell for his work in developing an extensive summary of chemical analysis techniques used for each critical mineral (contained in Appendix E).

The group was able to finalize outputs requested as part of the June 2022 TMB Resolution and have made seven recommendations for consideration by the ISO Technical Management Board (TMB) members. (see Item 7 *Recommendations* in this report).

The Co-convenors sincerely thank members for their participation in the work, noting the challenges in working virtually particularly considering the demands on experts across the critical minerals industry and their many conflicting priorities. We look forward to working with our colleagues to take the recommendations forward.

Karen Batt and Dr Stephen Collocott

1. Background on the SAG on Critical Minerals

As we rely increasingly on technology to improve our lives and solve problems, there has been a focus on technologically important minerals, their extraction and processing. It is recognized that many current and emerging technologies necessary for a net-zero carbon future rely on critical minerals. A discontinuity anywhere in the supply chain can cause a major impact on high technology products and services.

Whilst there is much innovation in the extraction, processing and recycling of critical minerals, economic and societal benefits have not accrued uniformly across all countries. Standards provide a suite of agreed principles and behaviours, that when applied to the extraction, processing and recycling of critical minerals should help ensure that economic and societal benefits are shared in a fair and sustainable manner.

There are many challenges for various industries involved in the critical mineral supply chain, which extends from mine to high-value added product. The environmental and societal goals include carbon neutral emission targets, sustainable practices in processing, recycling and waste management and social attitudes towards mining.

ISO has expertise across a broad scope of topics that impact on critical minerals and supply chains in other industries; therefore, ISO is well placed to undertake strategic work to consider how standards could address the challenges and issues facing us today as well as help us move towards new ways of supporting critical mineral supply chains.

ISO has been developing standards for critical minerals since its inception in 1947, when ISO/TC 26, *Copper and copper alloys*, was created. Many committees on critical minerals have been formed in the decades since; such as ISO/TC 79, *Light metals and their alloys*, in 1953; ISO/TC 132, *Ferroalloys*, in 1969; ISO/TC 298, *Rare earth,* in 2015; and ISO/TC 333, *Lithium*, in 2020. Like the formation of the majority of other technical committees at ISO, this has been an organic, 'bottom-up' process with little coordination between the committees established on critical minerals.

As identified in the first phase of work, ISO has a large range of Standards supporting the critical minerals industry in the extraction and processing end of the supply chain. However there is a gap further along the supply chain. For example there is currently no coherent or coordinated approach to recycling of critical minerals. Activity is occurring in ISO/TC 298, *Rare earth,* WG 2, *Elements recycling*, and in ISO/TC 207/SC 5, *Life cycle assessment*.

Many of ISO's more generic standards, used across a range of industries, are also important to critical minerals supply chains such as ISO/TC 207, *Environmental management*, and ISO/TC 308, *Chain of custody.*

The Strategic Advisory Group has considered the activities across these mineral specific committees and more general committees as part of their work.

2. ISO Strategic Advisory Group Mandate

2.1 Phase 1: March 2021 – April 2022

In March 2021, following the circulation of the new standardization area proposal in October 2020, ISO/TMB and ISO Council approved the establishment of the Strategic Advisory Group on Critical Minerals. The group's mandate was agreed as follows:

Undertake an analysis of existing and potential standardization work in the area of critical minerals from the point of initial extraction (mining and production of raw materials), and processing steps through to pre-cursor materials; and make recommendations to the TMB in this regard.

A copy of the TMB resolution 26/2021 (80th meeting) is provided as Appendix A for reference.

2.2 Phase 2: June 2022 – April 2023

In April 2022, the SAG completed its mandate and submitted its final report and recommendations to the TMB. At the TMB June 2022 meeting, the TMB accepted the report of the SAG and resolved to extend its mandate, essentially to:

- further provide strategic advice related to the organization of the ISO work on critical minerals, including the development of overarching guidance on common chemical analysis techniques,
- investigate the market need for focused standards on sustainability issues related to critical minerals, and the possibility to develop a general guidance for critical mineral supply chain participants.

And the TMB resolution 50/2022 (84th meeting) for phase 2 of the work is provided as Appendix B for reference, where the TMB extends the work of the SAG on Critical minerals for an additional period of 1 year, with the specified mandate, expected outcomes and membership.

2.3 Expected outputs of the second mandate

- A **priority list of any new standardization work**, that has received market support, to be undertaken in the short term that should be progressed as an immediate priority and suggested **existing or new ISO Committee** to undertake the work.
- Outcome paper from **survey of existing requirements and guidelines** (outside ISO) on sustainability standards related to critical minerals. (Noting this work would also be shared with the ISO/SAG/ESG.)
- Semiannual reports on **potential duplicate standards/projects/committees** with suggested consolidation/collaboration options

3. Evaluation of chemical analysis techniques

3.1 Review of chemical analysis techniques to identify a model

A finding in Phase 1 of the SAG's work was that harmonization of test methods was not to the benefit of industry and in fact had tried and failed in the past. However it was agreed that providing a good practice model test method to use for common chemical analysis techniques would be beneficial. Providing a model template would increase efficiencies in developing new methods, particularly for new critical minerals standardization.

In order to identify the most commonly used chemical analysis techniques across a large range of critical minerals, a summary of all chemical and mineral analysis techniques was prepared (see Appendix E).

The most commonly used chemical analysis methods for critical minerals, and related materials, were found to be ICP-spectroscopies and X-ray fluorescence techniques.

Across the ISO portfolio these techniques cover a range of particle analysis from soil testing, minerals testing to dairy testing. A stocktake was undertaken to identify test methods across the ISO catalogue that used ICP and XRF techniques. There were 221 ISO Standards that used ICP techniques and 132 ISO Standards that used Xray florescence (see Table 1).

Table 1: ISO Standards using ICP and XRF Techniques

Inductively Coupled Plasma (ICP)	X-Ray Florescence (XRF)
221 ISO Standards	132 ISO Standards
43% in area of minerals testing	65% in area of minerals testing

An analysis was then conducted of the Standards using these techniques, to see if any could serve as a template to follow a "best practice" to minimize duplication effort and achieve a level of harmonization.

A member of the SAG and an expert delegated from the CG looked at the list of existing Standards using ICP-spectroscopies and X-ray fluorescence techniques, in order to identify commonalities and to see if a template method could be derived.

The Standards were reviewed against a series of criteria, including:

- the adherence to ISO 78-2, *Chemistry — Layouts for standards — Part 2: Methods of chemical analysis*, which provides guidance to prepare Standards dealing with chemical analyses,
- the referenced Standards as normative references (and Bibliography), in order to identify which other Standards were followed,
- the structure and level of detail of the Standards regarding e.g. the methods description, the sample preparation, the instrumentation and instruments performance, etc..

The focus of the analyses was on the standards' approach, not on their achieved results, to find commonalities and identify the most exemplar documents that could help craft a template. Such a model Standards would capture the best parts of existing standards for the benefit of future standards.

3.2 Findings and recommendations for future drafting of chemical analysis techniques

Six Standards were identified as model Standards for ICP techniques, which were noted for their quality and level of detail and could be used as a starting point for further development of similar standards; these are:

- ISO 13899-2:2005, *Steel — Determination of Mo, Nb and W contents in alloyed steel — Inductively coupled plasma atomic emission spectrometric method — Part 2: Determination of Nb content*
- ISO 15202-1:2020, -2:2020, -3:2004, *Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry — Part 1: Sampling; Part 2, Sample preparation; Part 3, Analysis*
- ISO 17925:2004, *Zinc and/or aluminium based coatings on steel — Determination of coating mass per unit area and chemical composition — Gravimetry, inductively coupled plasma atomic emission spectrometry and flame atomic absorption spectrometry*
- ISO 22682:2017, *Iron ores — Determination of trace elements — Plasma spectrometric method*
- ISO 22033:2011, *Nickel alloys — Determination of niobium — Inductively coupled plasma/atomic emission spectrometric method*
- ISO 23166:2018, *Nickel alloys — Determination of tantalum — Inductively coupled plasma optical emission spectrometric method*

Similarly, four documents were identified as model Standard for WD/ED-XRF techniques, which were identified as comprehensive documents reflecting good practice (some use software code to help analyze the results); these are:

- ISO 9516-1:2003, *Iron ores — Determination of various elements by X-ray fluorescence spectrometry — Part 1: Comprehensive procedure*
- ISO/TS 9516-4:2021, *Iron ores — Determination of various elements by X-ray fluorescence spectrometry — Part 4: Performance-based method using fusion preparation method*
- ISO/TR 18336:2016, *Guidelines for good XRF laboratory practice for the iron ore industry*
- ISO 13605:2018, *Solid mineral fuels — Major and minor elements in coal ash and coke ash — Wavelength dispersive x-ray fluorescence spectrometric method*

Although these model templates have been identified for use in drafting critical minerals chemical analysis techniques it does not prevent other raw material committees from using these as models.

See Recommendations 2 and 3 of the report regarding the use of model chemical analysis standards.

4. Analysis of existing ESG standards/guides/tools

During Phase 1 of the SAG's work a gap in ISO's catalogue of standards and work programme related to standards supporting sustainability, traceability and recycling was acknowledged. However, it was noted that there was a significant number of standards/guides/tools available outside ISO that have gained acceptance and are used and implemented by the critical minerals industry, and the minerals industry more broadly.

A stocktake of existing ESG standards/guides/tools was undertaken and is provided at Appendix D. The BGR (German Federal Institute for Geosciences and Natural Resources) Report[1] and the report from the ISO/TMBG/SAG ESG provided input to establish a matrix of a 19 standards and tools compared against a series of parameters. These standards and tools are generally material-agnostic; address general sustainability issues; and extend across a variety of sections of the supply chain, though rarely the full supply chain.

The SAG reviewed the stocktake to see if there was a role for a more universal ISO contribution and agreed that the potential future ISO work would have to:

- be material-agnostic, but also consider specificities applicable to different contexts,
- envisage some kind of cooperation with partners such as those organisations developing the tools identified in Appendix D.

Members of the SAG are also aware that amongst the organisations that have developed these standards/guides/tools there is a current effort underway by some to draw equivalence and consolidate.

In order to collect further insights from the market on the identified ESG standards/ guides/tools, the SAG included those in a comprehensive Survey of Market Needs and Priorities to find out stakeholders' familiarity and exposure to the tools (see Item 5.3, Section 2).

Results of the survey are summarized in the following section.

5. Survey of Market Needs and Priorities

In December 2022, the SAG conducted a Survey to identify global market needs and priorities in the critical minerals sector.

5.1 Components to the survey

The Survey provided a short introduction to collect basic personal data from the respondents to the Survey, with some background information on the work of the SAG and the purpose of the Survey. The Survey was then structured in 4 Sections:

1. **Areas of focus**: to collect feedback on the minerals that should be considered for new Standards, and the most widely used chemical analysis techniques for critical minerals. The Survey provided the list of minerals that the SAG had identified as "critical" during its first mandate, and requested respondents to rank them. This should disclose patterns in terms of priorities.

2. **Current sustainability tools**: to find out stakeholders' familiarity and exposure to the ESG standards/guides/tools identified by the SAG.

[1] BGR - Mineralische Rohstoffe - Sustainability Standard Systems for Mineral Resources. A Comparative Overview (2022) (bund.de)

3. **Overarching guidance document**: to find out stakeholders' interest in an overarching guidance in the critical minerals supply chain.

4. An open question for final comments.

Members of the SAG and ISO/CS promoted the Survey within their networks and the ISO technical community.

Responses represented an interesting geographical spread, the top participating countries being Canada (68 responders), France (29 responders), Japan (19 responders), Australia (16 responders) and the US and China (both had 15 responders).

5.2 Responses to the survey

A total of 267 responses were collected.

Sector classification of responders: Most responders were from the mining sector (31 %) and industry/manufacturing (26 %), reflecting that the survey targeted well the expected audience. These sectors were closely followed by academia (24 %).

Source of knowledge of the Survey: 50% of the responders knew about the survey from their NSBs. The remaining 50% heard about the Survey from an industry association, a colleague, or other sources, in roughly similar proportions. None were from social media.

5.3 General findings

Section 1 – Areas of focus

Mineral ranking by priority: cobalt, followed by antimony, chromium and graphite, showed the highest average rankings amongst the 17 listed minerals. Almost a half of the responders classified cobalt in rank 1 (34 %) or rank 2 (13 %). This could reflect the electrification trend supporting the energy transition. Through the lens of particular regions or industries, Cobalt was confirmed as the first priority mineral for every region and sector (except for the consumers sector). Compared to the previous report of the SAG to the TMB (June 2022), there was overall consistency in the ranking of minerals.

Other minerals: 45 % of responders considered that other minerals should be prioritized. lithium (24 votes), nickel (20 votes), rare earth elements (18 votes) and copper (10 votes) were the top four identified minerals, for which there is already an ISO Committee and thus were excluded on purpose from the initial given list. Silicon (6 votes) unexpectedly came in the 5th position.

Chemical analysis techniques: 87 % of the responders agreed with the SAG observation that the most commonly used methods of chemical analysis for critical minerals are ICP and XRF. Other techniques listed as most widely used included a variety of absorptiometric and spectrometric methods, amongst others.

Section 2 – Tools for critical minerals to assist with sustainability

More than one half of responders did not use any of the listed tools in the past 12 months. The most widely used tools were ICMM Standard (22 % of responders), IRMA Standard (17 %), GRI Standards (15 %) and TSM Protocols and Frameworks (14 %)[2].

[2] ICMM: International Council on Mining and Metals. IRMA: Initiative for Responsible Mining Assurance. GRI: Global Reporting Initiative. TSM: Towards Sustainable Mining.

Between 47 % and 78 % of the responders said they were not familiar at all with the different tools. The tools that responders were most familiar with were GRI Standards (17 % of responders), ICMM Standard (15 %) and IRMA Standard (14 %).

The responders identified other tools that they use, including JORC code, Copper Mark, and UNRMS[3]. (Other suggested tools were actually chemical analyses tools.)

As detailed at Item 4 of this report, there are many existing ESG standards/guides/tools. However, results from the survey show that there is a lack of knowledge of the existence of the standards/guides/tools. And for most tools more than half of respondents were "not familiar at all" with the standard/guide/tool.

Section 3 – Overarching Guidance on Critical Minerals Supply Chain

Almost two thirds of the responders said they would definitely (26%) and probably (47%) see value in an overarching guidance document for stakeholders in the critical mineral supply chain. They felt such document would mostly benefit multinationals and large to medium size companies.

There was strong support for developing overarching guidance on the critical minerals supply chain – including information on chemical analysis and sampling approaches; traceability frameworks, for service providers and users; matters relating to sustainability; fair operating practices, consumer issues, community involvement and development. Other identified areas of interest that the document could cover included certification schemes, chain of custody, traceability frameworks and ESG, amongst others.

See Recommendation 7.

Section 4 – Additional business

A variety of additional comments were provided by the responders.

A Summary of the Survey Results is given in Appendix G.

5.4 Priority list of critical minerals from survey

The findings from Section 1 of the survey helped determine a priority list of new critical minerals to be introduced in ISO. Along with considerations of demand and volume for these minerals being used in various applications.

The overall ranking from the survey was as follows:

1. Cobalt
2. Antimony
3. Chromium
4. Graphite
5. Beryllium
6. PGMs
7. Manganese
8. Vanadium
9. Niobium
10. Tantalum

[3] JORC: Joint Ore Reserves Committee. UNRMS: United Nations Resource Management System.

When comparing the matrix of countries' critical minerals list, completed in Phase 1 with the top five (5) from the survey, four critical minerals emerge as priorities see Table 2 below.

Table 2: Critical mineral priorities from Phase 1 and Phase 2

June 2022 Final report top CMs	December 2022 – Survey to stakeholders
1. Rare earths 2. Cobalt Graphite Niobium Tungsten	1. Cobalt 2. Antimony 3. Chromium 4. Graphite 5. Beryllium
3. Antimony Chromium Germanium Lithium PGMs Tantalum	

Cobalt, which ranked first in the survey, is ranked second in the volume increase required between 2020 and 2050 for clean energy transition[4]. Graphite which ranked fourth in the survey is ranked third in the volume increase required between 2020 and 2050 for clean energy transition.

Although Antimony ranked high in the survey and occurs on 8 of the 10 critical minerals lists studied in Phase 1, its importance to current and future volumes required for energy transition and other applications are not as significant as other critical minerals. Therefore it has been ranked behind cobalt, chromium and graphite on the priority list of minerals for new standardization work.

Recommendation 1 sets out a priority list for critical minerals standardization at ISO.

An ISO Committee, ISO/TC 65, *Manganese and chromium ores*, developed 15 standards on chromium in the 1980s. This committee has since been disbanded. These Standards have been transferred to ISO/TC 132, *Ferroalloys*, where activity should be centered to revise/update these standards.

It is recognized that criticality varies with region, sector and time, so that a mechanism should be put in place to allow periodic reviews and adjustment of the priorities list. See further discussion and recommendations under "6. ISO structure to undertake the work on Critical Minerals".

6. ISO structure to undertake the work on Critical Minerals

The SAG considered the following elements as input material to discuss options on the structure for future work in ISO on Critical Minerals:

- The result of the analysis of chemical analysis techniques.
- The result of the Survey on Market Needs and Priorities.

[4] Charted: The Raw Material Needs of Energy Technologies (visualcapitalist.com)

- The existing committees working on Critical Minerals. Some have been active for decades (ISO/TC 79, *Light metals and their alloys*, established in 1953) and have a focus on chemical analyses. Others are very recent (e.g. ISO/TC 333, *Lithium*, established in 2020), and cover also traceability and/or sustainability.

- The current efforts in ISO/TC 82, *Mining*, to expand the Scope of SC 7 from "Mine closure and reclamation management" to "Sustainable mining and mine closure".

- The recently submitted proposals for new work:

    - AFNOR proposal for a new TC "Specialty minerals and metals", circulated for approval by the ISO NSBs until 2023-06-03.

    - DIN initiative for a "Sustainable Raw Material Criteria", not yet circulated.

6.1 Options for future work – Emphasis on chemical analyses and basic issues

The options in Table 3 to address chemical analyses were considered by the SAG, discussing the advantages and disadvantages.

Table 3: Advantages and disadvantages for chemical analyses options

Option	Advantages	Disadvantages
1. Use existing TCs and SCs and **amend/expand scopes** to include priority minerals where expertise exists (e.g. Expand ISO/TC 155, *Nickel and nickel alloys*, to include cobalt)	Consolidation - Use existing structures and reduce growing number of TCs/SCs - Leverage existing base of experts	Not supported by leadership of committees and therefore unlikely to succeed.
2. Continue with **Ad hoc formation** of new TCs as needed	none	Status quo not acceptable
3. **Consolidate** all TCs and SCs related to critical minerals under one Technical Committee or a small number of TCs grouped into specific issues (either by application, by mineral characteristics, by market size etc)	- Assist with consolidation - May assist with ensuring experts are allocated to one TC/SC rather than multiple	- Disruptive (and would take some time to achieve) - Unlikely to receive support
4. **Create a new committee(s)** to develop standards for Critical Minerals not yet covered	- New TC can be used as an incubator for new areas of standardisation for new minerals - Assists with material agnostic issues where standards can be addressed	No consolidation of existing efforts so potential for duplication of effort & standards remains. (Good coordination could assist)

The SAG resolved that the best option for ISO to work on chemical analyses techniques was

Option 4. The existing longstanding structures remain without disruption, while establishing a new TC to cover the new critical minerals as identified in the Priorities list (see Recommendation 1). New specialized WGs would be established under this TC to cover new critical minerals not yet dealt with in ISO. This new TC should also be able to address general material-agnostic issues, such as terminology, packaging, labelling, in dedicated WGs.

The new TC would have to establish a mechanism to develop model chemical analysis techniques (templates/guidance) for use by the new Working Groups in the TC and by other Committees developing chemical analysis Standards for critical minerals. It is thus expected that ISO chemical analyses for critical minerals be more comparable, and efficiencies could be realized from their development and in their use by practitioners. As derived from the review of the chemical analysis techniques, such potential model standards could be derived from ISO 13899-2, ISO 15202-1,-2,-3, ISO 17925, ISO 22682, ISO 22033 and ISO 23166 for ICP methods, and ISO 9516-1, ISO/TS 9516-4, ISO/TR 18336 and ISO 13605 for XRF methods (see Item 3.2).

See Recommendation 2 to establish a new technical Committee for basic and chemical analysis standards for Critical Minerals not yet covered in ISO.

Noting the ISO structure would therefore consist of several committees dealing with critical minerals, i.e. those established so far, and the new proposed TC to address critical minerals not yet covered in ISO, it is important to provide them with a coordination mechanism. In addition to coordination, a mechanism to allow periodic reviews and adjustment of the priorities list of critical minerals should be put in place.

See Recommendation 3 to establish a Critical Minerals Coordination Committee (CMCC).

6.2 Options for future work – Emphasis on traceability

Members of the SAG discussed whether the new TC to address critical minerals not yet covered in ISO (see Item 6.1) should deal with traceability as a general topic, or not.

The options considered included the following:

1. Establish a working group under ISO/TC 308, *Chain of custody*, to address traceability issues related to critical minerals.

2. Form a Working Group on Traceability across each TC on Critical Minerals risking duplication.
   (NOTE: ISO/TC 298, *Rare earth*, current standard addresses traceability from extraction to pre-cursor but new work potentially will address through to high-value product.)

3. Create a new committee to address traceability issues across Critical Minerals Supply Chain.
   (Note: This will require consideration of incorporating future ISO/TC 298/WG 3 into this new committee.)

The options above were considered along with other initiatives currently underway in the sector, including a recent report from the Geological Survey of Finland[5]. SAG members agreed that it was worthwhile for the new TC to consider traceability as part of its work programme, providing a model traceability framework following the methodology used by ISO/TC 298/WG 3 to develop

[5] Geological Survey of Finland 2022, *Traceability methods for cobalt, lithium, and graphite production in battery supply chains Assessing geo-based fingerprinting as a method for battery raw materials' traceability* https://tupa.gtk.fi/raportti/arkisto/20_2022.pdf

ISO 23664:2021, *Traceability of rare earths in the supply chain from mine to separated products*, based on principles from ISO/TC 308, *Chain of custody*. This model traceability framework would be generic and therefore applicable to a number of critical minerals (including other minerals which are currently viewed as not being a critical mineral, covered by other TCs). The new TC should monitor outcomes of other initiatives in the area including the new UNECE initiative on Critical Minerals Traceability and Sustainability[6]. See Recommendation 4.

6.3 Options for future work – Coherence on sustainability/ESG

The SAG identified two major issues related to sustainability matters in critical minerals standardization.

1. **Duplication of work in ISO**

ISO/TC 298/WG 5 and ISO/TC 333/WG 5 are both addressing sustainability issues for, respectively, rare earth elements and lithium. The working groups have initiated discussions on forming a joint working group (JWG), which the SAG fully supports.

See Recommendation 5 on the harmonization of existing ISO work on sustainability for critical minerals.

2. **Proliferation of ESG standards/guides/tools outside of ISO**

The Survey on market needs and priorities shows that stakeholders do not seem familiar with the existing ESG standards/guides/tools related to minerals.

As shown in the matrix in Appendix D, those ESG standards/guides/tools cover a range of criteria and extend along differing parts of the supply chain.

It is suggested that ISO offer its platform to bring together, in an international workshop, the stakeholders and organizations (including regional and international institutions) that have developed existing ESG standards/guides/tools and sets of principles, with the view to produce an International Workshop Agreement (IWA) detailing the principles used in the Sustainability tools across the full supply chain.

The IWA mechanism was identified as having several benefits in this circumstance as organizations which have developed the identified sustainability tools are able to participate directly in the IWA development. And in addition full-consensus on a Standard will be difficult to achieve initially in an area where solutions have been developed by a range of organizations.

See Recommendation 6 on collaboration on sustainability with organizations outside of ISO.

6.4 Overarching guidance for those in critical minerals supply chains

The Survey on market needs and priorities returned an interest from stakeholders on an overarching guidance document in the critical minerals supply chain with over two-thirds of respondents saying it would definitely or probably be a valuable document. This offers an opportunity for ISO to undertake the development of such guidance, which would include information on:

- the role of standards and conformance for the industry,
- chemical analysis and advantages and disadvantages of using standard test methods as opposed to in-house test methods,
- traceability frameworks, for service providers and users,
- matters relating to sustainability through the supply chain,

[6] Critical Minerals Traceability and Sustainability (unece.org)

- other topics such as fair operating practices, consumer issues, community involvement and development.

Such a document should be informative in nature and of low level of consensus, with an important bibliographic component. It is suggested that it be developed by an NSB seeking global input from interested stakeholders.

See Recommendation 7 to develop an overarching guidance on Critical Minerals supply chain.

7. Recommendations to ISO/TMB

The SAG recommends the following actions for future work:

Recommendation 1: Priority list for Critical Minerals

Priority be given to developing standards for the following critical minerals:

1. Cobalt.
2. Chromium.
3. Graphite.
4. Antimony.

NOTE: Standards addressing chromium are covered by ISO/TC 132, *Ferroalloys*.

See Recommendation 3 for a mechanism to review the priorities.

Recommendation 2: New technical Committee for Critical Minerals basic and chemical analysis standards

A new Technical Committee be established to cover basic and chemical analysis standards for critical minerals identified in Recommendation 1 (not covered by existing committees). New Working Groups would be established for each mineral to ensure expertise input to these standards.

The new TC would establish a mechanism to develop model chemical analysis techniques (templates/guidance) for use by the new Working Groups and other Committees developing chemical analysis Standards for critical minerals.

See list of potential model standards (see Item 3.2).

Recommendation 3: Establish a Critical Minerals Coordination Committee (CMCC)

Establish a Coordination Committee to provide a coordination mechanism for committees developing standards in the area of critical minerals.

See Appendix F for the detailed Terms of Reference.

Recommendation 4: Traceability

The new TC, as described in Recommendation 2, should consider the potential to include traceability as part of their work programme, providing a model traceability framework that is generic and therefore applicable to a number of critical minerals (including other minerals covered by other TCs). The methodology used by ISO/TC 298/WG 3 to develop ISO 23664:2021, *Traceability of rare earths in the supply chain from mine to separated products*, based on principles from ISO/TC 308, *Chain of custody*, should be considered.

Recommendation 5: Sustainability – Harmonization of existing ISO work

ISO/TC 298/WG 5 and ISO/TC 333/WG 5 formalize their work as a Joint working group.

Recommendation 6: Sustainability – Collaboration on sustainability with organizations outside of ISO

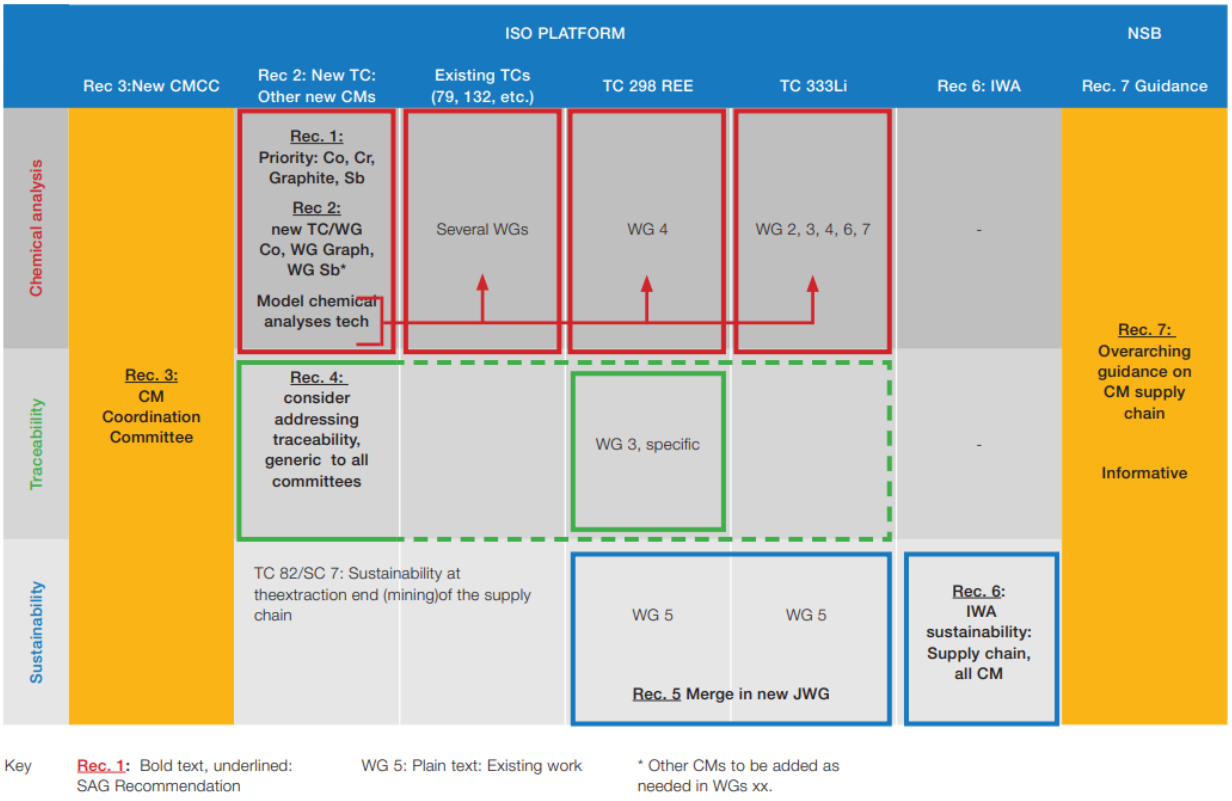
ISO to offer its platform to develop an International Workshop Agreement (IWA) to detail ESG principles in existing Sustainability tools and guides which have gained acceptance across various regions and jurisdictions. The participants in the IWA should include organizations who have developed existing standards and guidelines in this area.

This could then lead to a more defined standard/deliverable for future work.

Recommendation 7: Overarching guidance on Critical Minerals supply chain

Identify a National Standards Body to develop a lower-level consensus deliverable (informative) describing the role standards play across the critical minerals supply chain (including availability of chemical analysis techniques, existing sustainability tools identified by the SAG, traceability tools available, etc.).

Figure 1: Summary of Recommendations



Appendices

Appendix A

TMB Resolution 26/2021: 80th TMB Meeting (March 2021)

Adopted at the 80th meeting of the Technical Management Board, Virtual Meeting, 4-5 March and 8-9 March 2021

Creation of an ISO Strategic Advisory Group on Critical minerals

The Technical Management Board,

Noting the proposal from Standards Australia (SA) and the revised Terms of Reference presented;

Decides to create a new ISO Strategic Advisory Group (SAG) on Critical minerals for an exceptional initial period of 12 months,

Mandate:

- undertake an analysis of existing and potential standardisation work in the area of critical minerals from the point of initial extraction (mining and production of raw materials), and processing steps through to pre-cursor materials; and
- make recommendations to the TMB in this regard.

Expected outputs:

1. Set of parameters for the classification of critical minerals for the purposes of the SAG's work (while recognising that the definition of critical minerals varies between countries based on their own objectives, usage of minerals and resource endowments);

2. An analysis to identify:

- standards and other documents relevant to the critical minerals sector that are, or have been, developed by existing ISO Technical Committees.
- any synergies in the current work of existing ISO technical committees relevant to the critical minerals sector, and consideration of opportunities to coordinate or collaborate across ISO committees where overlaps exist.
- areas important for standardisation not currently addressed by an existing ISO committee.

3. Recommendation of a structure to undertake the development of standards relevant to the critical minerals sector, which includes consideration of existing ISO committees, new technical committees, and ongoing coordination mechanisms.

4. A priority list of any new work to be undertaken in the short term that should be progressed as an immediate priority.

Participation:

Co-Convenors: Karen Batt (SA) and Dr Stephen Collocott

Secretariat: ISO/CS

Members:

- 12 critical minerals experts, nominated by ISO member bodies:
    - 8 experts nominated by TMB members from ANSI, AFNOR, BSI, DIN, GOST R, SAC, SA, SCC;
    - 4 critical minerals experts nominated by non-TMB ISO members (selected via an Expression of Interest process to TMB)
- 2 critical minerals experts nominated by SMB members.

Supported by a consultative group of experts composed from:

- 1 x Representative from ISO/TC 298 *Rare Earth*
- 1 x Representative from ISO/TC 79 *Light Metals and their Alloys*
- 1 x Representative from ISO/TC 82 *Mining*
- 1 x Representative from ISO/TC 132 *Ferroalloys*
- 1 x Representative from ISO/TC 25 *Cast irons and pig irons*
- 1 x Representative from ISO/TC 79/SC 5 *Magnesium and alloys of cast wrought magnesium*
- 1 x Representative from ISO/TC 79/SC 11 Titanium
- 1 x Representative from ISO/TC 333 *Lithium*
- 1 x Representative from IEC/TC 21 *Secondary Cells and Batteries*
- 1 x Representative from ISO/TC 26 *Coper and copper alloys*
- 1 x Representative from ISO/TC 79/SC 12 *Aluminium ores*
- 1 x Representative from ISO/TC 207 *Environmental management*
- 1 x Representative from ISO/TC 323 *Circular economy*

Asks the SAG to consider the membership recommendations made by CS/SP, and where appropriate, invite them to join the consultative group (for approval by the TMB by correspondence);

Asks the SAG to report to each TMB meeting and deliver a final report with recommendations for June 2022.

Appendix B

TMB Resolution 50/2022: 84th TMB Meeting (June 2022)

Adopted at the 84th meeting of the Technical Management Board, Geneva, 13-14 June 2022

Report of the Strategic Advisory Group (SAG) on Critical minerals

The Technical Management Board,

Accepts the report of the SAG on Critical minerals,

Thanks the Co-Convenors and members of the SAG and its Consultative Group for their excellent work,

Decides to extend the work of the SAG on Critical minerals for an additional period of 1 year, with the following mandate, expected outcomes and membership

Mandate

1. Investigate whether new standards required for critical minerals could be developed by existing technical committees with or without scope expansion or whether new Committees should be formed.
2. Identification of the market need for focused standards on sustainability issues that relate to critical minerals (this would include a survey of existing requirements and guidelines beyond existing ISO standards).
3. Investigate the viability of a new Project Committee to develop a Standard 'Critical minerals, General guidance for supply chain participants'.
4. Identification of working groups/projects on cross cutting issues for critical minerals and list of chemical analysis techniques with the aim of developing overarching guidance on common chemical analysis practice, when developing or revising chemical test methods.
5. Make recommendations to the TMB in this regard.
6. Advisory functions to ISO/CS - Advising ISO/CS, when necessary, on technical issues related to critical minerals.

Outputs

- A priority list of any new standardization work, that has received market support, to be undertaken in the short term that should be progressed as an immediate priority and suggested existing or new ISO Committee to undertake the work.
- Outcome paper from survey of existing requirements and guidelines (outside ISO) on sustainability standards related to critical minerals. (Noting this work would also be shared with the ISO/SAG/ESG.)
- Semi-annual reports on potential duplicate standards/projects/committees with suggested consolidation/collaboration options

Leadership of group

Convenorship: SA

Term

- 12 months

Requests the SAG to report at each TMB meeting and to deliver its final report in June 2023.

SAG - Membership

- Co-Convenor: Dr Stephen Collocott (Australia) and Karen Batt (Standards Australia/TMB member)
- Secretariat: Mercè Ferrés Hernández (ISO/CS)
- 8 TMB members (or their appointed experts);
- 4 non-TMB members (or their appointed experts)
- 2 IEC members

Consultative group - Membership

- 1 x Representative from ISO/TC 298 *Rare earth*
- 1 x Representative from ISO/TC 79 *Light Metals and their Alloys*
- 1 x Representative from ISO/TC 82 *Mining*
- 1 x Representative from ISO/TC 132 *Ferroalloys*
- 1 x Representative from ISO/TC 25 *Cast irons and pig irons*
- 1 x Representative from ISO/TC 79/SC 5 *Magnesium and alloys of cast wrought magnesium*
- *1 x Representative from* ISO/TC 79/SC 11 *Titanium (declined invitation)*
- 1 x Representative from ISO/TC 333 *Lithium*
- 1 x Representative from IEC/TC 21 *Secondary Cells and Batteries*
- 1 x Representative from ISO/TC 26 *Coper and copper alloys*
- 1 x Representative from ISO/TC 79/SC 12 *Aluminium ores (declined invitation)*
- 1 x Representative from ISO/TC 207 *Environmental management*
- 1 x Representative from ISO/TC 323 *Circular economy*
- Additional representatives from ISO member bodies

Appendix C

Members of Critical Minerals Strategic Advisory Group and Consultative Group

ISO/TMBG/SAG_CRMI ***ISO Strategic Advisory Group on Critical minerals***			
Role	**Appointed by**	**Salutation**	**Last name, First name**
Convenor	ISO/TMBG	Ms.	Batt, Karen
Convenor	ISO/TMBG	Dr	Collocott, Stephen
Secretary	ISO	Mme	Ferrés Hernández, Mercè
Committee member	AFNOR	M.	Krupka, David
Committee member	ANSI	Dr	Bonevich, John
Committee member	BSI	Dr	Petavratzi, Evi
Committee member	DIN	Mr.	Haschke, Michael
Committee member	GOST R	Mr	Liske, Anton
Committee member	IEC	Mrs	Hou, Jie
Committee member	IEC	Mr	Shimizu, Kotaro
Committee member	INN	Mr	Souza, Carlos
Committee member	SA	Dr	O'Rourke, Angela
Committee member	SAC	Mr	Ma, Cunzhen
Committee member	SCC	Mrs	Zinck, Janice
Committee member	SIS	Mr	Larsson, Kristian
Committee member	TBS	Dr	Mshiu, Elisante
Committee member	UNI	Ms	Sbaffoni, Silvia

ISO/TMBG/SAG_CRMI_CG ***Consultative Group- ISO Strategic Advisory Group on Critical minerals***			
Role	**Appointed by**	**Salutation**	**Last name, First name**
Convenor	ISO/TMBG	Ms.	Batt, Karen
Convenor	ISO/TMBG	Dr	Collocott, Stephen
Secretary	ISO	Mme	Ferrés Hernández, Mercè
Committee member	AFNOR	M.	Krupka, David (ISO/TC 79, *Light metals and their alloys*)
Committee member	BSI	Dr	Murrell, Pam (ISO/TC 25, *Cast irons and pig irons*)
Committee member	CODINORM	Monsieur	Bakayoko, Oumar (ISO/TC 207, *Environmental management*)
Committee member	DIN	M.	Didier, Christophe (ISO/TC 82, *Mining*)
Committee member	DS	Dr	Veluri, Badrinath
Committee member	IEC	Mr	Giess, Herbert (IEC/TC 21, *Secondary Cells and Batteries*)
Committee member	ISO	Mrs	Chevauche, Catherine (ISO/TC 323, *Circular economy*)
Committee member	SAC	Ms	Han, Zhiwei (ISO/TC 26, *Copper and copper alloys*)
Committee member	SAC	Prof.	Xi, Huan (ISO/TC 79/SC 5, *Magnesium and alloys of cast wrought magnesium*)
Committee member	SAC	Mr	Zhang, Jiangfeng (ISO/TC 333, *Lithium*)
Committee member	SAC	Ms	ZHU, Rong (ISO/TC 132, *Ferroalloys*)
Committee member	SASO	Mr	Damanhori, Nabeel
Committee member	SCC	Mr	Goode, John (ISO/TC 298, *Rare earth*)
Committee member	SFS	Dr	Nilsén, Frans
Committee member	UNE	Dr	Gutiérrez Peinador, Vicente

Appendix D

Stocktake of ESG standards/guides/tools

Standard/Tool	Organisation	Governance structure	Frequency of update	Coverage (i.e. general or mineral specific)	Part of supply chain	Is there a reporting component to the tool?	Audience for report?	Usage/uptake (is it used, companies publicly noting they use it)	Referenced in any countries regulations?	Any ISO Standards referenced in standard / tool	Is level of certification referenced (1st, 3rd or not at all)	Inclusions in standard / tool
ICMM Standard Development (SD) Framework (including ICMM Mining Principles and Position Statements)	International Council on Mining and Metals (ICMM)	Industry led initiative (initial 10 principles), with the updated Mining Principles based on a global public consultation with 263 respondents from 30 countries (NGO's, non-member mining companies, public institutions).	Position Statements updated irregularly (latest 'Climate Change' in 2021), depending on developments of critical industry challenges. Frequency of updates not defined for principles, but noted that they "are neither static nor do they represent the ceiling of our ambition".	General	Mining and On-site Processing	Members are required to disclose, publicly, their Performance Expectation validation activities on an annual basis. Asset-by-asset disclosures apply to self assessments and third party validations from 2022 onwards. Disclosure can be made on a member's website or in a sustainability or corporate report,	Public or interested parties in a company's Performance Expectation validation.	All 26 mining and metals member companies have to comply with the full membership requirements. Market coverage of ~34% (in 2020).		ISO 14001	1st party assessment of all assets once every three years. 3rd party verification for prioritised assets within a three year validation cycle (selected assets are chosen by a member-driven prioritisation process)	Mining Principles: 1. Ethical Business 2. Decision-Making 3. Human Rights 4. Risk Management 5. Health and Safety 6. Environmental Performance 7. Conservation of Biodiversity 8. Responsible Production 9. Social Performance 10. Stakeholder Engagement Position Statements: Transparency of Mineral Revenues Climate Change Water Stewardship Tailings Governance Indigenous Peoples and Mining Mining Partnerships for Development Mercury Risk Management Mining and Protected Areas
IRMA Standard for Responsible Mining	Initiative for Responsible Mining Assurance (IRMA)	Multi-stakeholder collaboration -IRMA equitably governed by six sectors: directly affected communities, NGOs, organised labour, mining companies, purchasers and investors/financial sector.	The development of Standard v2.0 is underway. Expert input has been received and the first draft for public comment will be published in early 2023. The final Standard v2.0 will be published in late 2023.	General	Mining and On-site Processing	Following audit, mines have up to 12 months to release the audit report. Results about (relevant) single standard requirements are published publicly (optional for self assessment only).	Companies such as those in jewellery, electronics, building and autos. Civil society organizations and communities.	2018 standard in live application for independent auditing. As of August 2021, more than 40 mining companies were registered using the self assessment tool.		ISO 19011 ISO 17021 ISO 14001 ISO 45001	1st party assessment (no claims of IRMA verified achievement and option to share public). Independent 3rd party site specific verification and certification (every 3 years) - surveillance audit scheduled 12-18 months after initial audit. (Self assessment required before 3rd party verification).	Contents: Preamble Introduction to the IRMA Standard Business Integrity Requirements Social Responsibility Requirements Environmental Responsibility Requirements Glossary of Terms
TSM Protocols and Frameworks	Towards Sustainable Mining (TSM)/Mining Association of Canada (MAC)	Industry (mining association) led initiative with structured stakeholder engagement in national Community of Interest (COI) Advisory Panel (multi-stakeholder group comprised of about 12 to 15 individuals from Indigenous groups, communities where the industry is active, environmental and social NGOs, and labour and financial organizations)	The TSM Guiding Principles (basic values and targets), TSM Frameworks (issue specific commitments) and TSM Protocols (performance indicators) are developed and undergo regularly scheduled revisions with a rotating schedule during which one or two protocols are reviewed each year to determine whether amendments are needed.	General	Mining, On-site Processing and Processing/Smelting/Refining (entire upstream supply chain but no Chain of Custody (CoC) standard)	Rating results of single standard requirements are published - facilities must assess and publish their performance against the performance indicators outlined the TSM Protocols. Companies use the TSM online reporting portal to submit their results.	Mining sector's communities of interest; Aboriginal groups, communities where the industry is active, environmental and social NGOs, and labour and financial organizations.	TSM is mandatory for all companies that are members of implementing associations. In 2021, 25 MAC members published facility-level performance indicators, comprising 54 facilities. 11 MAC companies had their results externally verified. TSM implementation schedule: https://mining.ca/wp-content/uploads/dlm_uploads/2021/08/TSM-Company-Implementation-Schedule.pdf Outside of Canada, nine other national mining associations have adopted TSM (including Argentina, Australia, Botswana, Brazil, Colombia, Finalnd, Norway, the Philippines and Spain).		ISO 14001 ISO 45001 ISO 50001	1st party assessment (yearly). External 3rd party verification (every 3 years) by trained verifiers. All sites of a member in the corresponding country have to be audited.	Protocols: Biodiversity Conservation Management Climate Change Crisis Management and Communications Planning Indigenous and Community Relationships Preventing Child and Forced Labour Safety and Health Tailings Management Water Stewardship Mine Closure Framework
CERA 4in1 Performance Standard (CPS)	CERA 4in1/DMT Group	Initiative under development with structured stakeholder engagement in the advisory board (including civil society, private sector and public institutions).	Version 1.0 (December 2020); update expected in near future reflecting lessons learnt from the different pilot projects 2021-2022.	General	Mining, On-site Processing and Processing/Smelting/Refining (entire upstream supply chain but does not include Chain of Custody (CoC) standard)	Not defined yet - intention to publish the full or parts of the audit report.	Intention for detailed information about documents, processes, price and materials accessible only to certificate owners and business users via blockchain technology; whilst public access will be limited only to validate certificates.	Piloting of the CPS at four mines in DRC (Cobalt), China (REE), Portugal (Lithium) and Norway (Graphite) ongoing		ISO 19011 ISO 17011 ISO 17065	Independent 3rd party verification and certification (every 3 years) - CPS initial 50% certification (after 1 year), 75% certification (after 3 years), 100% certification (after 6 years). Yearly spontaneous surveillance audits are included. Site specific verification.	Contents: Introduction Scope Overview Structure Rules and requirements Implementation Details Hazards and Risks Rules and requirements for certification TOPIC 1 – Corporate Governance TOPIC 2 - Social Responsibility TOPIC 3 – Environmental Responsibility Glossary
IFC Performance Standards on Environmental and Social Sustainability	International Finance Corporation (IFC)/World Bank Group	Initiative led by the World bank governed by the 185 member countries + ad-hoc stakeholder consultation. Broad multistakeholder consultation in the revision process.	Current version (2012); No further revision scheduled	General	Mining, On-site Processing and Processing/Smelting/Refining (entire upstream supply chain but Chain of Custody (CoC) standard)	Annual Monitoring Report submitted to IFC. Results about single standard requirement are published on IFC project information portal.	IFC staff - monitoring of obligatory reports. IFC client's stakeholders - disclosure obligations in relation to project-level activities.	US $842 million mining portfolio (mainly copper and bauxite) including 12 mining projects in 11 countries 331 projects in the oil, gas and mining industry have been funded worldwide from 1994 until 2019		ISO 19011 (recommended) ISO 14001 ISO 45001	1st party audit - client reports fulfillment of the terms of the investment agreement. IFC staff as a 3rd party - monitoring of obligatory annual reports and conducts site visits at invariable frequency.	Performance Standards: 1: Assessment and Management of Environmental and Social Risks and Impacts 2: Labor and Working Conditions 3: Resource Efficiency and Pollution Prevention 4: Community Health, Safety, and Security 5: Land Acquisition and Involuntary Resettlement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources 7: Indigenous Peoples 8: Cultural Heritage

Standard/Tool	Organisation	Governance structure	Frequency of update	Coverage (i.e. general or mineral specific)	Part of supply chain	Is there a reporting component to the tool?	Audience for report?	Usage/uptake (is it used, companies publicly noting they use it)	Referenced in any countries regulations?	Any ISO Standards referenced in standard / tool	Is level of certification referenced (1st, 3rd or not at all)	Inclusions in standard / tool
RMAP Mineral Supply Chain Due Diligence (DD) Standards (voluntary) RMAP ESG Standard	Responsible Minerals Assurance Process (RMAP)/Responsible Minerals Initiative (RMI)	Industry led initiative by Responsible Business Alliance (RBA) with structured stakeholder engagement by a Steering Committee	Standard revision process in line with RMI Standards and Assessment Criteria Development Process (2021) The RMI shall review Standards on a 3-5 year cycle or as needed based on regulatory development, marketplace conditions or member priorities.	DD: tin, tantalum, tungsten, gold, cobalt, copper, nickel, lead, zinc and for all minerals ESG: general	Processing/Smelting/Refining	Publication of summarised results required - Supply Chain policies, the RMAP Audit Summary Report and the OECD Step 5 Due Diligence Report (annually).	Downstream companies	3TG and cobalt programs cover majority of global producers, for all minerals 262 conformant smelters/refiners certified. Programs for mica, Cu, Ni and Zn program just started with few producers. No information on ESG standard implementation available (implementation underway).		ISO 19011 ISO 17021 ISO 14001 ISO 45001	3rd party verification and certification. Frequency of audits is adjusted according to the risk profile of the facility audit - standard assessment is yearly but can be extended to max three years. Site specific verification.	List of standards: Responsible Minerals Assurance Process, Tin and Tantalum Standard Responsible Minerals Assurance Process, Tungsten Standard Responsible Minerals Assurance Process, Gold Standard Cobalt Refiner Due Diligence Standard Joint Due Diligence Standard for Copper, Lead, Nickel and Zinc Global Workplace Responsible Sourcing, Environmental, Health & Safety Due Diligence Standard for Mica Processors ITA-RMI Assessment Criteria for Tin Smelters (in pilot stage) Environmental, Social & Governance (ESG) Standard for Mineral Supply Chains Global Responsible Sourcing Due Diligence Standard for Mineral Supply Chains All Minerals
Global Reporting Initiative (GRI) Standards	Global Reporting Initiative (GRI)	Developed and approved by Global Sustainability Standards Board (GSSB) - 15 members represent diverse sectors, backgrounds and regions around the world, with range of technical expertise, diversity of experience, and multi-stakeholder perspective support	Revisions to the Universal Standards were developed according to a formally defined Due Process Protocol that provides a set of mandatory requirements for developing a standard. This process is overseen by the Due Process Oversight Committee and ensures that updates are developed following a transparent and multi-stakeholder process. https://www.globalreporting.org/media/mc0nylry/gssb-due-process-protocol-2018.pdf	General (currently developing a mining-and-mentals-specific standard)	Proposed Sector Standard for mining primary focus lies: Exploration and extraction of all types of minerals, metallic and non-metallic, including quarrying, (except for oil, gas, and coal); Primary processing of minerals; Support activities to mining, such as transport and storage; Supplying specialized goods and services to mining organizations includes engineering, procurement, and construction (EPC).	A report with relevant disclosures from Universal, Sector and Topic Standards and GRI content index is published	Investors, policymakers, consumers	GRI remains the most commonly used reporting standard globally with increased adoption across both the N100 (68 percent) and G250 (78 percent) - not industry specific. (G250=250 largest companies listed in the Fortune Global 500 N100= 100 largest companies in the countries included in the KPMG surveys) Source: https://assets.kpmg/content/dam/kpmg/xx/pdf/2022/10/ssr-small-steps-big-shifts.pdf	More than 160 policies in over 60 countries and regions reference or require GRI reporting - not industry specific. Source: https://sseinitiative.org/wp-content/uploads/2022/04/GRI-Slide-deck-.pdf		Designed to support independent 3rd party verification. Organisation can choose whether to seek external assurance unless policy within their jurisdiction states otherwise.	Universal Standards: GRI 1: Requirements and principles for using GRI Standards GRI 1: Disclosures about the reporting organisation GRI 3: Disclosures and guidance about organisation's material topics Sector and Topic Standards: https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/
Non-Financial Reporting Directive (NFRD)	European Union (EU)	European Commission	April 2021: proposal for a new Corporate Sustainability Reporting Directive (CSRD), which aims to strengthen and revise the existing rules introduced by NRFD (and act as a replacement).*	General	General dependent on the scope of the business	Companies must disclose a brief description of their business model, and non-financial key performance indicators relevant to the business. Information must be provided at the minimum for the Environment, Social and employee matters, Respect for human rights and Anti-corruption and bribery matters Source: https://www.accountancyeurope.eu/wp-content/uploads/NFR-Publication-3-May-revision.pdf	Regulators, potential investors, consumers and various stakeholders	EU rules on non-financial reporting currently apply to large public-interest companies with more than 500 employees. This covers approximately 11 700 large companies and groups across the EU, Source: https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en	In all 28 EU member states - some countries have adapted or omitted requirements of the directive Source: https://www.accountancyeurope.eu/wp-content/uploads/NFR-Publication-3-May-revision.pdf		Member states may require verification by an independent assurances services provider. (*CSRD proposal will require the audit of reported information)	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0095&from=EN
SASB Standards	International Financial Reporting Standards (IFRS) Foundation (August 2022, IFRS Foundation announced the completion of the consolidation of the Value Reporting Foundation (VRF) into the IFRS Foundation)	Developed by International Sustainability Standards Board (ISSB), with external consultation. (Previously SASB Standards Board - prior to consolidation)	Currently undergoing deliberations of Exposure Draft of IFRS (which will replace SASB Standards) (ISSB encourages companies and investors to continue to support and use the SASB Standards until they are replaced by IFRS Sustainability Disclosure Standards)	General	General dependent on the scope of the business	SASB Standards can be used to help disclose performance on industry level sustainability issues but there is no explicit disclosures of references to reporting on 'action taken' or a 'management approach' on ESG issues.	Investors	Across all industries: 317 institutional investors—representing $81T AUM and 27 markets—support SASB Standards and/or use SASB Standards to inform their investment decision-making. Many types of market participants, including companies, advisors, and others, support and use SASB Standards via becoming members of the IFRS Sustainability Alliance and/or licensing SASB Standards. 2424 companies since 2020 have publicly disclosed SASB metrics in their reports.			Support independent 3rd party verification, however do not have an explicit disclosure about assurance or external verification	SASB: Metals and Mining Sustainability Accounting Standard Contents: Introduction Sustainability Disclosure Topics and Accounting Metrics - Greenhouse Gas Emissions - Air Quality - Energy Management - Water Management - Waste and Hazardous Materials Management - Biodiversity Impacts - Security, Human Rights and Rights of Indigenous Peoples - Community Relations - Labor Relations - Workforce Health and Safety - Business Ethics and Transparency - Tailings Store Facilities Management IFRS Exposure draft (under development): https://www.ifrs.org/content/dam/ifrs/project/general-sustainability-related-disclosures/exposure-draft-ifrs-s1-general-requirements-for-disclosure-of-sustainability-related-financial-information.pdf
Task-Force on Climate Related Financial Disclosures (TCFD)	Financial Stability Board (FSB)	International body - broad range of stakeholders from different sectors/countries of the financial system. Included a public engagement and consultation period.	Frequency of update unknown but since the publication of the TCFD recommendations, the FSB has asked the Task Force to continue its work—promoting adoption of the TCFD framework, providing further guidance, supporting educational efforts, monitoring climate-related financial disclosure practices in terms of their alignment with the TCFD	General	General dependent on the scope of the business	The disclosure recommendations are structured around four thematic areas: governance, strategy, risk management and metrics and targets. The Task Force recommends that organizations provide climate-related financial disclosures in their mainstream (i.e., public) annual financial filings.	Investors, lenders and insurance underwriters	The percentage of companies disclosing TCFD-aligned information continues to grow, but more urgent progress is needed. For fiscal year 2021 reporting, 80% of companies disclosed in line with at least one of the 11 recommended disclosures; however, only 4% disclosed in line with all 11 recommended disclosures and only around 40% disclosed in line with at least five. More than 3,800 organisations have become supporters of the TCFD			No explicit mention of external assurance or audit within the TCFD disclosures but designed to support independent 3rd party verification.	Contents: Letter from Michael R Bloomberg Executive Summary A. Introduction B. Climate-Related Risks, Opportunities and Financial Impacts C. Recommendations and Guidance D. Scenario Analysis and Climate Related Issues E. Key Issues Considered and Areas for Further Work F. Conclusion Appendix 1: Task Force Members Appendix 2: Task Force Objectives and Approach

Standard/Tool	Organisation	Governance structure	Frequency of update	Coverage (i.e. general or mineral specific)	Part of supply chain	Is there a reporting component to the tool?	Audience for report?	Usage/uptake (is it used, companies publicly noting they use it)	Referenced in any countries regulations?	Any ISO Standards referenced in standard / tool	Is level of certification referenced (1st, 3rd or not at all)	Inclusions in standard / tool
			recommendations, and preparing annual status reports.					Recommendations, a number which has steadily increased since the Recommendations were first published.				Appendix 3: Fundamental Principles for Effective Disclosure Appendix 4: Select Disclosure Frameworks Appendix 5: Glossary and Abbreviations Appendix 6: References
Climate-related Disclosures Prototyp	International Financial Reporting Standards (IFRS) Foundation	Developed by International Sustainability Standards Board (ISSB), with external consultation.	Still under development	General	General dependent on the scope of the business	Reporting requirement for the disclosure of information that enables users of general purpose financial reporting to understand its assessment of the impact of sustainability-related risks and opportunities on management's strategy and decision making.	Investors, creditors and other lenders	Still under development.			Audit mentioned in terms of reporting about the assurance of the sustainability information. No further specification of certification,	IFRS Exposure Draft (under development): Objective Scope Governance Strategy Risk management Metrics and Targets Appendices A. Defined Terms B. Industry-based disclosure requirements (see separate booklet) C. Effective date
Blueprint for Responsible Sourcing of Critical Minerals (ESG Paper 2021) Breaking Down Barriers for Responsible Sourcing of Critical Minerals (ESG Paper 2022) (These reports form recommendations presented to the UK Government for consideration for measures it could take)	Critical Minerals Association (CMA)	2021: Industry led (mining association) initiative. ESG Working Group and consultation with industry members, organisations, consultants and analysts within the mining, processing, financial and technological industries and ESG fields. 2022: Multistakeholder workshops workshops attended by industry, academia, local governments, professional organisations, UK Government Departments including Business, Energy and Industrial Strategy (BEIS), and the Department for International Trade (DIT).	Updates based on changes in critical minerals landscapes and developments within UK policy.	General	General dependent on the scope of the business	CMA recommends the UK Government to consider implementing an ESG Policy and/or Principles and providing the private sector and civil society with the end goal, while allowing organisations to determine how to reach the end goal themselves (by using other standards). However they do not want to create new ESG standards, instead recommending to align with international partners (e.g.. Australia, Canada, EU, USA), on ESG standards for critical minerals, for maximum impact and to avoid duplication..	Currently not applicable but potential for investors, regulators, operators, insurers, customers and civil society (depending on implementation from UK Government)	The Blueprint successfully influenced the UK Government's Net Zero Strategy 2021, which featured a Critical Minerals Deep Dive outlining the UK Governments' commitment to publishing a Critical Minerals Strategy in 2022.			2022: CMA recommends the UK Government to develop a process of auditing and regulating the organisations and individuals that 'independently verify' ESG compliance. This could be developed by the ESG Expert Multi-stakeholder Forum and implemented by a government standards agency – UKAS, the national accreditation body.	2021 Paper Contents: Abbreviations and Acronyms Executive Summary Recommendations 1. Critical Minerals and UK' s Clean Growth Agenda 2. Importance of Sourcing Critical Minerals Responsibly 3. Blueprint 4. Case Studies 5. Appendix A: Proposed ESG Rating System Considerations & Example 6. Appendix B: Alignment of Blueprint with UN SDGs 7. Appendix C: Standards & Frameworks 8. References & Sources 2022 Paper Contents: About the Critical Minerals Association (CMA) Acknowledgements Purpose of Paper Abbreviations and Acronyms Executive Summary Recommendations Critical Minerals and the Path to Net Zero Access to Capital Talent Pipeline for the Energy Transition ESG Standards Creating an Enabling Domestic Environment Conclusion References Appendix A Appendix B
Chinese Due Diligence Guidelines for Responsible Mineral Supply Chains	China Chamber of Commerce of Metals, Minerals & Chemicals Importers & Exporters (CCCMC)	Industry led initiative (CCCMC operates under the guidance of the Ministry of Commerce of China and is registered with the Ministry of Civil Affairs of China) and cooperation with OECD and Global Witness. Reviewed by advisory group, international stakeholder consultation and public consultation.	Frequency of update known but the scope of CCCMC includes: (6) to carry out industry supervision, inspection, examination and other related work with the approval of relevant government departments; to undertake the formulation and revision of relevant standards in the industry and other work by the authorization of relevant government departments.	General	General dependent on the scope of the business	Companies should publicly report on their supply chain due diligence policies and practices, including on identified risks and steps taken to mitigate these risks, and may do so by expanding the scope of their sustainability, corporate social responsibility or annual reports to cover additional information on mineral resource supply chain due diligence.	External stakeholders and regulators in countries that require due diligence for responsible supply chains and/or to achieve conformance with industry initiative.	The implementation of the Guidelines will initially be voluntary. CCCMC will seek close cooperation with a number of pilot companies and Chinese companies that implement the OECD Due Diligence Guidance (May 2015).			Third party audit and optional certification (of third party audit by an independent oversight body).	Contents: I. Background and Challenges II. Objective III. Scope of Application IV. Introduction to Basic Steps of Risk-based Due Diligence V. Risk Categories for Due Diligence VI. Warning Signs VII. Framework and Processes for Due Diligence VIII. Audit, Certification and Oversight Annex: Model Supply Chain Policy
Cobalt Industry Responsible Assessment Framework (CIRAF)	Cobalt Institute	Industry led initiative (trade association of producers, users, recyclers and traders of cobalt).	Frequency of update unknown	Cobalt	General dependent on the scope of the business	Annual assessment of companies operations and, where applicable, supply chain. Following the assessment, they must make the following publicly available: A summary of the risk assessment and related activities; Documentation showing the presence of a policy and due diligence management system for managing the identified risks; Demonstration of how existing responsible production and sourcing standards are being applied.	Public and external stakeholders	2019: Initial implementation year with Cobalt Institute members			Self-assessment, based on the principles set out in the OECD Due Diligence Guidance for Responsible Sourcing from Conflict Affected and High-Risk Areas (OECD DDG). 3rd party verification by a credible mechanism.	Risk Categories (and equivalent risk areas): Environment: Air/water/soil environmental impacts Biodiversity Occupational Health and Safety (OHS): OHS and working conditions Human Rights: Conflict and financial crime Human rights abuses Worst forms of child labour Community: ASM Livelihoods Resettlement
Kimberley Process Certification Scheme (KPCS)	Kimberley Process (KP)	Multilateral trade regime, mandated by the UN. Dec 2000: United Nations General Assembly adopted a landmark resolution supporting the creation of an international certification scheme for rough diamonds. By November 2002, negotiations between governments, the international diamond industry and civil society organisations resulted in the creation of the Kimberley Process	Participants intend that the Certification Scheme should be subject to periodic review, to allow Participants to conduct a thorough analysis of all elements contained in the scheme. The review meeting should normally coincide with the annual Plenary meeting, unless otherwise agreed.	Diamonds	General dependent on the scope of the business	Certificates required. Participants of KP scheme required to report on how the requirements of the scheme are being implemented in respective jurisdictions.	KP, Domestic regulators, other participants of KP scheme.	The KP has 56 participants, representing 82 countries, with the European Union and its Member States counting as a single participant. KP members account for approximately 99.8% of the global production of rough diamonds.	82 governments have enshrined the Kimberley Process Certification Scheme (KPCS) into law.		Certification required but dependent on domestic legislation.	Contents: Preamble Section I: Definitions Section II: The Kimberley Process Certificate Section III: Undertakings in respect of the international trade in rough diamonds Section IV: Internal Controls Section V: Co-operation and Transparency Section VI: Administrative Matters Annex I: Certificates Annex II: Recommendations as provided for in Section IV, paragraph (f) Annex III: Statistics

Standard/Tool	Organisation	Governance structure	Frequency of update	Coverage (i.e. general or mineral specific)	Part of supply chain	Is there a reporting component to the tool?	Audience for report?	Usage/uptake (is it used, companies publicly noting they use it)	Referenced in any countries regulations?	Any ISO Standards referenced in standard / tool	Is level of certification referenced (1st, 3rd or not at all)	Inclusions in standard / tool
		Certification Scheme (KPCS) .										
ITSCI Joint Industry Traceability and Due Diligence Programme	The International Tin Supply Chain Initiative (ITSCI)	Industry led initiative; developed by International Tin Research Institute (ITRI), a UK based tin industry association.	Frequency of update unknown but aligned with OECD Due Diligence Guidance for Responsible Mineral Supply Chains	Coltan/tantalum and tin	Upstream supply chain	ITSCI generates and transparently publishes unique, extensive and credible information on progressive improvement in due diligence and risk mitigation in high risk areas (aligned with OECD Due Diligence Guidance for Responsible Mineral Supply Chains). TSCI companies publish annual due diligence reports which explain their approach to managing and mitigating risks.	Member companies, businesses, government authorities, advisors and civil society.	ITSCI is currently focused on enabling the supply chain supply and source responsible minerals from 4 countries (Burundi, DRC, Rwanda, Uganda). ITSCI monitors more than 1,800 mining sites, however, not all these are active at the same time. ITSCI follows minerals into the international market through the upstream supply chain in which incidents of fraud or other illegal activity remain a risk. Members are located in more than 40 countries, and includes more than 30 smelters of 3T minerals, more than half of which are in Asia.			Verification and audit by ITSCI Independent Evaluator	Contents: Large scale implementation iTSCi joint industry programme Foreword Multi-stakeholder participation How we work with stakeholders Identify the supply chain - iTSCi mine and company approval - step 2 Identify the supply chain - iTSCi traceability- step 2 Gallery Identify and manage risks - iTSCi incident management - step 3 Accessing and using iTSCi information Information available for companies - step 4 & 5 Moving beyond conflict; social & economic opportunity Working with others to bring benefits How iTSCi is funded and our expenses The first five years of iTSCi Plans for the future iTSCi information sources
LBMA Responsible Gold Guidance International Bullion Centre Recommendations	London Bullion Market Association (LBMA)	Independent precious metals authority - trade association	LBMA Responsible Gold Guidance: Last update 2019; . The concept of continuous improvement is an integral component of the LBMA Programme and underpins the spirit of LBMA's five-step framework and responsible business practices.	Gold	General dependent on the scope of the business	LBMA Responsible Gold Guidance: Annual reporting: Supply Chain Policy (Public) Refiner's Compliance Report (Public) Refiner's Country of Origin Annex (Confidential) Corrective Action Plan (Confidential) Sufficient detail of the Refiner's supply chain due diligence policies, management systems and risk assessment processes for users of the reporting to obtain a complete, accurate, timely and balanced view of the Refiner's activities over the reporting period. International Bullion Centre Recommendations: Require all counterparties operating through the International Bullion Centre to publicly report on their practices and policies.	Board, LBMA, external stakeholders (investors, consumers), public	Responsible Sourcing programme is mandatory for all Good Delivery refiners wishing to trade with the London Bullion market. LBMA has over 145 Member companies across more than 20 countries around the world.			LBMA Responsible Gold Guidance: Annual third party assurance (within 3 months of a companies financial year end) by LBMA approved Assurance Provider. Site specific verification. International Bullion Centre Recommendations: require all exchanges to only accept refiners who have undergone an OECD-recognised industry scheme audit	Contents: Definitions Acronyms Introduction Step 1: Establish Strong Company Management Systems Step 2: Identify and Assess Supply Chain Risks Step 3: Design and Implement a Management Strategy to Respond to Identified Risks Step 4: Obtain Independent Third-Party Assurance on Supply Chain Due Diligence Practices Step 5: Report Annually on Supply Chain Due Diligence International Bullion Centre Recommendations: 1. Effective scrutiny and verification of local and regional supply chains 2. Effective regulation of local and regional supply chains 3. Effective enforcement powers 4. Effective co-operation with local, regional and international organisations 5. Develop ASM specific guidance to support and further legitimate ASM supply
RJC Code of Practices (COP) **RJC Chain of Custody Standard (CoC)**	Responsible Jewellery Council (RJC)	Industry led initiative; 14 organisations from across the diamond and gold jewellery supply chain.	COP 2019; next revision is due in 2024. CoC 2017; next revision is due 2022.	Diamonds, gold, silver, PGE (platinum group elements)	Entire supply chain	No audit reports are published by RJC. Aggregated summarised superficial results only with general rule violations in Impacts Reports and Annual Progress Reports. Companies publish audit report template with main findings and status of certification on their homepages.	RJC members (audit reports) Public (Annual Progress Reports/company reports)	8092 certified facilities with 278,337 employees. 1379 Members, 993 certified after COP, of which 189 are additionally certified after CoC. 386 Members not yet certified (obligation to this within 2 years after membership has started).		ISO 19011 ISO 14001 ISO 45001	3rd party verification by RJC accredited auditor and certification. Re-certification every 3 years if no or minor non conformance is found. Surveillance audits also conducted. Site specific verification.	CoC Contents: Introduction RJC Chain of Custody (CoC) Standard - Due Diligence and know your counterparty for responsible sourcing - Chain of Custody Management - Systems to confirm eligibility of material - Issuing Chain of Custody documentation Glossary Glossary References Annex 1: CoC material transfer document template COP Contents: Introduction COP Standard - General Requirements - Responsible supply chains, human rights and due diligence - Labour rights and working conditions - Health, safety and environment - Gold, silver, PGM, diamond and coloured gemstone products - Responsible mining Definitions Key references
ASI Performance Standard **ASI Chain of Custody Standard**	Aluminium Stewardship Initiative (ASI)	Initiated by 14 companies from the aluminium value chain. Multi-stakeholder board (elected by ASI members) and multistakeholder Standards Committee (aimed at having 50% non-industry participation and balance between upstream and downstream supply chain members) . Three year multi-stakeholder public consultations process prior to revised standards being published.	Performance Standard V3 (2022) and Chain of Custody Standard V2 (2022); both set to be reviewed every 5 years. The non-normative supporting documents (such as the Performance Standard Guidance and Chain of Custody Standard Guidance) will undergo regular revision on a more frequent cycle, with a renewal every 6 months, in light of evolving frameworks and expectations.	Aluminium (and bauxite, alumina)	Entire supply chain	A Public Summary Audit Report is published on the ASI Website. ASI Audit Reports and Summary Audit Reports for all ASI Certifications are stored in elementAI, ASI's online assurance platform.	Public (Summary Audit Report) ASI members, auditors (Audit and Summary Audit Reports)	129 certificates issued against the Performance Standard. 51 certificates issued against the Chain of Custody Standard.		ISO 17011 ISO 17065 ISO 14001 ISO 45001	3rd party verification and certification (every 3 years). A member's certification status is determined based on the outcome of the Certification Audit: Certification (3 years), Provisional Certification (1 year), or not Certified. Surveillance Audits take place within 6-18 months as required. Site specific verification.	Performance Contents: Introduction ASI Performance Standard A. Governance B. Environment C. Social Glossary Chain of Custody Contents: Introduction ASI Chain of Custody (CoC) Standard A. General CoC Management B. Confirming Eligible Inputs of CoC and Non-CoC Material C. CoC Accounting , Documentation and Claims

Appendix E
Chemical analysis techniques – Summary of techniques used for each critical minerals

ISO Committee	Comodity Type	Grade	Chemical Analysis Technique														Mineral Analysis				
			XRF	pXRF	ICP-OES/AS	ICP-MS	LA-ICP-MS	LIBS	AAS	UV-Vis	ISE	IR-C	Titr	Grav	LOI	Moisture	PHA	FTIR	XRD	CORE Scan	QemScan/ Tima	SEM
ISO/TC 333	Li, Ta, Nb	Exploration	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×	✓	×	✓		✓		
		Ore Control	✓	×	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	×	✓		×		
		Concentrate	✓	×	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	×	✓		×		
ISO/TC 183		Exploration	✓	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	✓		✓		
		Ore Control	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	✓		×		
		Concentrate	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	✓		×		
ISO/TC 79/SC 12	Aluminum (HPA), Bauxite	Exploration	✓	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	✓		✓		
		Ore Control	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	✓	✓	×		
		Concentrate	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	✓		×		
ISO/TC 298	REE, Zr, Nb, Hf, Li, Ta, Ga.	Exploration	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		✓		
		Ore Control	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Concentrate	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
ISO/TC 102		Exploration	✓	×	✓	×	×		✓	✓	×	×	✓	✓	✓	✓	×	×		✓		
		Ore Control	✓	×	✓	×	×		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Concentrate	✓	×	✓	×	×		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
ISO/TC 183		Exploration	✓	✓	✓	✓	✓		✓	✓	×	×	✓	✓	×	✓	×	×		✓		
		Ore Control	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Concentrate	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
	Mn	Exploration	✓	×	✓	×	×		✓	×	×	✓	×	✓	✓	✓	×	✓		✓		
		Ore Control	✓	×	✓	×	×		✓	×	×	✓	×	✓	✓	✓	×	✓		×		
		Concentrate	✓	×	✓	×	×		✓	×	×	✓	×	✓	✓	✓	×	✓		×		
	W	Exploration	✓	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	×		✓		
		Ore Control	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	×		×		

ISO Committee	Comodity Type	Grade	Chemical Analysis Technique														Mineral Analysis				
			XRF	pXRF	ICP-OES/AS	ICP-MS	LA-ICP-MS	LIBS	AAS	UV-Vis	ISE	IR-C	Titr	Grav	LOI	Moisture	PHA	FTIR	XRD	CORE Scan	QemScan/ Tima	SEM
		Concentrate	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	×		×		
ISO/TC 183		Exploration	✓	✓	✓	✓	✓		✓	✓	×	×	✓	✓	×	✓	×	×		✓		
		Ore Control	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Concentrate	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
ISO/TC 183		Exploration	✓	✓	✓	✓	✓		✓	✓	×	×	✓	✓	×	✓	×	×		✓		
		Ore Control	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Concentrate	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Exploration	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓		
		Ore Control	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×	✓	×		
		Concentrate	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
ISO/TC 183		Exploration	×	✓	×	✓	×		✓	×	×	×	×	✓	×	✓	×	✓		✓		
		Ore Control	×	×	×	✓	×		✓	×	×	×	×	✓	×	✓	✓	✓		×		
		Exploration	×	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	×		✓		
	Bi, Co, In	Exploration	×	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	×		✓		
	Co, PGE	Exploration	×	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	×		✓		
		Exploration	×	✓	✓	✓	✓		✓	×	×	×	×	×	×	✓	×	×		✓		
	Pt, Pd, Rh , Co	Exploration	×	×	×	✓	✓		×	×	×	×	×	×	×	✓	×	×		✓		
	Co, PGE	Exploration	×	×	✓	✓	✓		×	×	×	×	×	×	×	✓	×	×		✓		
		Exploration	×	×	✓	✓	✓		×	×	×	×	×	×	×	✓	×	×		✓		
	Heavy Mineral sands (HMS), Ti, Zr, REE	Exploration	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	×		✓		
	Heavy Mineral sands (HMS), Ti, Zr, REE	Exploration	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	×		✓		
	Ti, V	Exploration	✓	×	✓	✓	✓		✓	×	✓	✓	✓	✓	✓	✓	×	×		✓		
	Limestones, Dolomites, Cements	Exploration	✓	×	✓	×	×		✓	✓	×	×	✓	✓	✓	✓	×	×		✓		

ISO Committee	Comodity Type	Grade	Chemical Analysis Technique														Mineral Analysis				
			XRF	pXRF	ICP-OES/AS	ICP-MS	LA-ICP-MS	LIBS	AAS	UV-Vis	ISE	IR-C	Titr	Grav	LOI	Moisture	PHA	FTIR	XRD	CORE Scan	QemScan/ Tima	SEM
		Ore Control	✓	×	✓	×	×		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Concentrate	✓	×	✓	×	×		✓	✓	✓	✓	✓	✓	✓	✓	×	×		×		
		Exploration	✓	×	✓	✓	✓		×	×	×	×	×	×	×	✓	×	×		✓		
		Exploration	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	×	×		✓		

Appendix F

Terms of Reference for a new Critical Minerals Coordination Committee (CMCC)

Overall Objective
To support ISO TMB, Central Secretariat and the technical community to provide a coordination mechanism for committees developing standards in the area of critical minerals.

Mandate

- Coordination across relevant ISO committees
- Undertake regular (annual) surveys of market needs for chemical analysis standards of critical minerals not yet covered by ISO
- Monitor countries/regions published lists of critical minerals
- Provide recommendations to TMB regarding development of standards to support critical minerals industry
- Facilitate communication, coordination and information sharing among ISO committees involved in standardization related to critical minerals
- Encourage the use of model chemical analysis techniques when new methods are being developed or revisions are approved
- Promote the use of ISO standards to the industry and highlighting ways for the industry to contribute to their development
- Support ISO's efforts to collaborate with other organizations

Membership

- Chairs of committees dealing with subject matters related to critical minerals. The CCCM may invite additional ISO committees Chairs to participate in its activities as needed, depending on the subject matter(s) under consideration
- IEC and ITU representatives
- Liaison with relevant ISO groups, including ISO/TMBG/ESG_CC, *ESG Coordination Committee* and ISO/TC 308, *Chain of custody.*

Note: Chairs, as members of the CCCM, may invite an expert from their committee with expertise on relevant issues to bring additional input when needed.

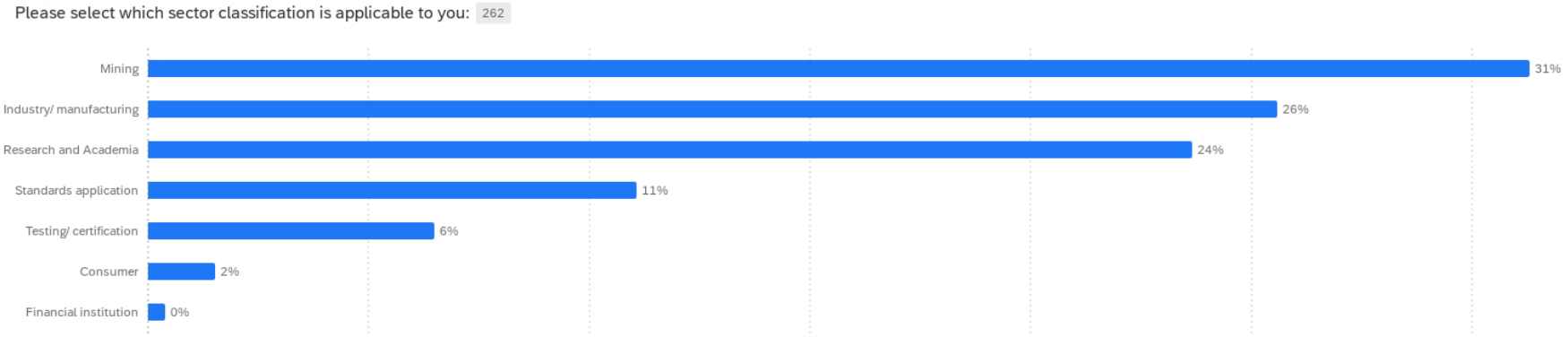
Reporting ·

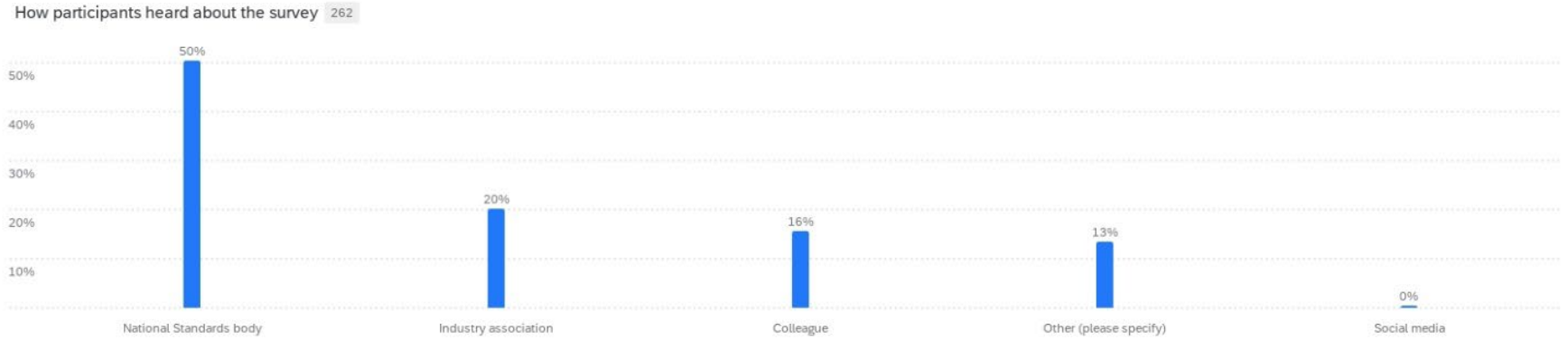
The coordination committee to provide a status update to the TMB on an annual basis.

Appendix G

Summary of Survey Results

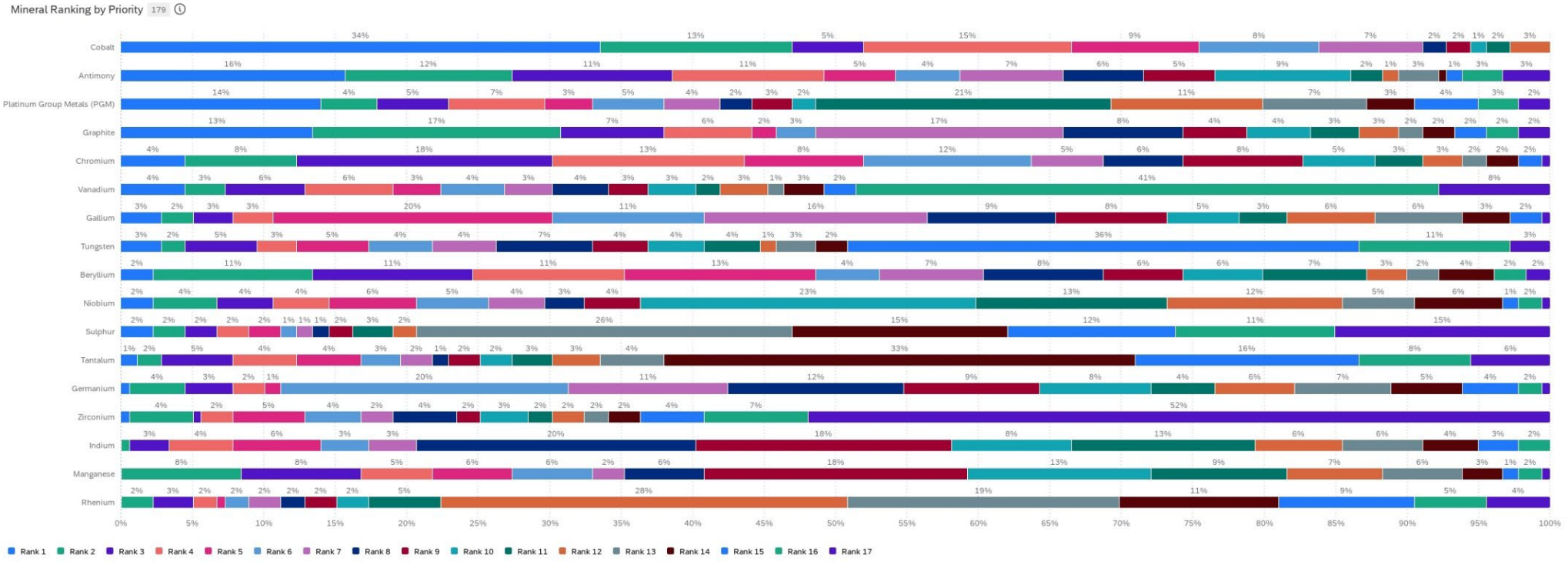
Participant Details

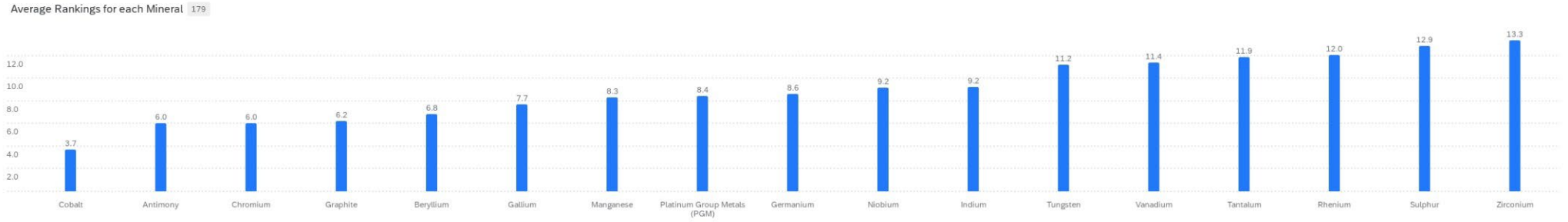




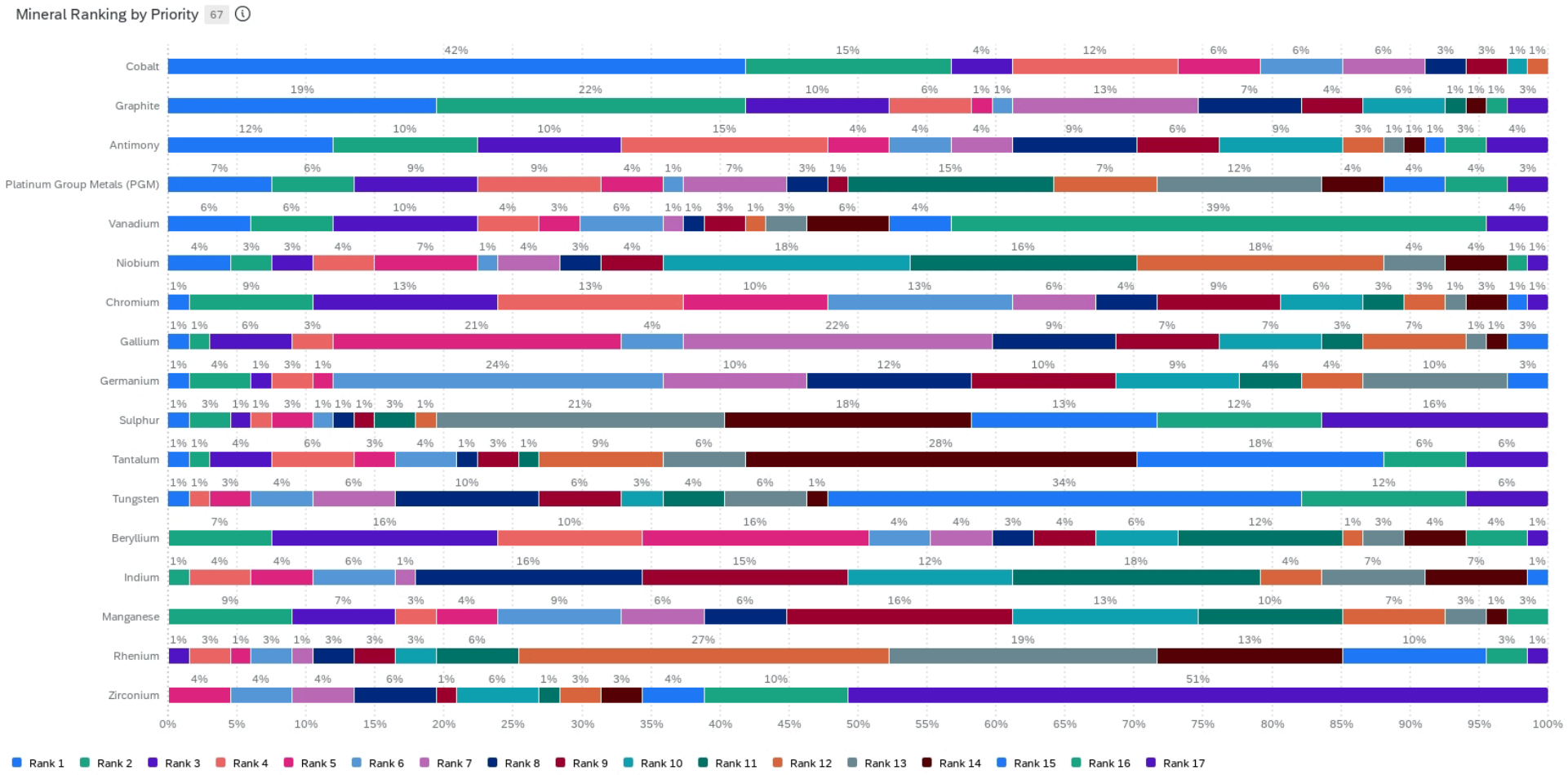
Section 1 – Mineral ranking priority

1.1 Overall

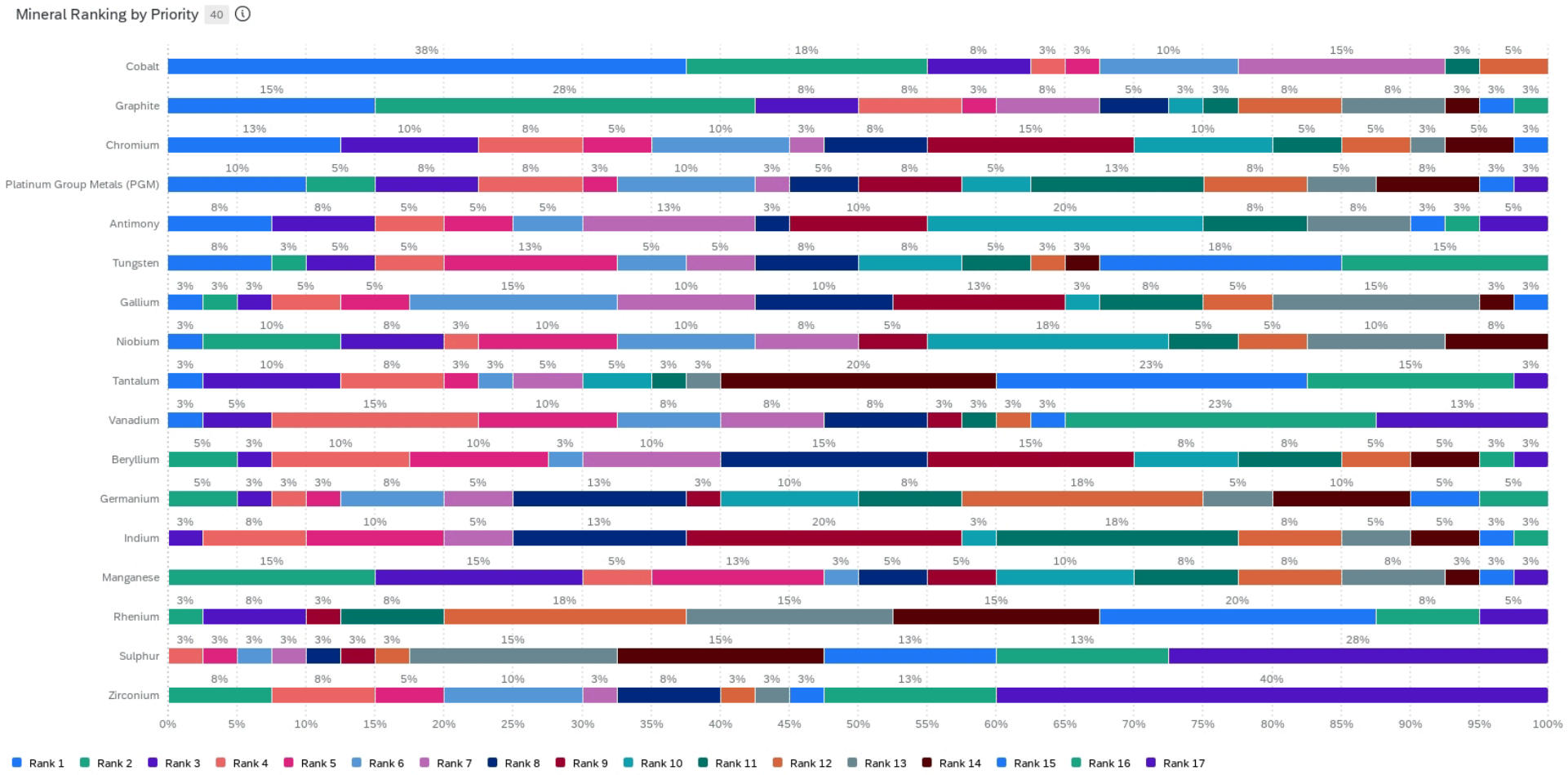




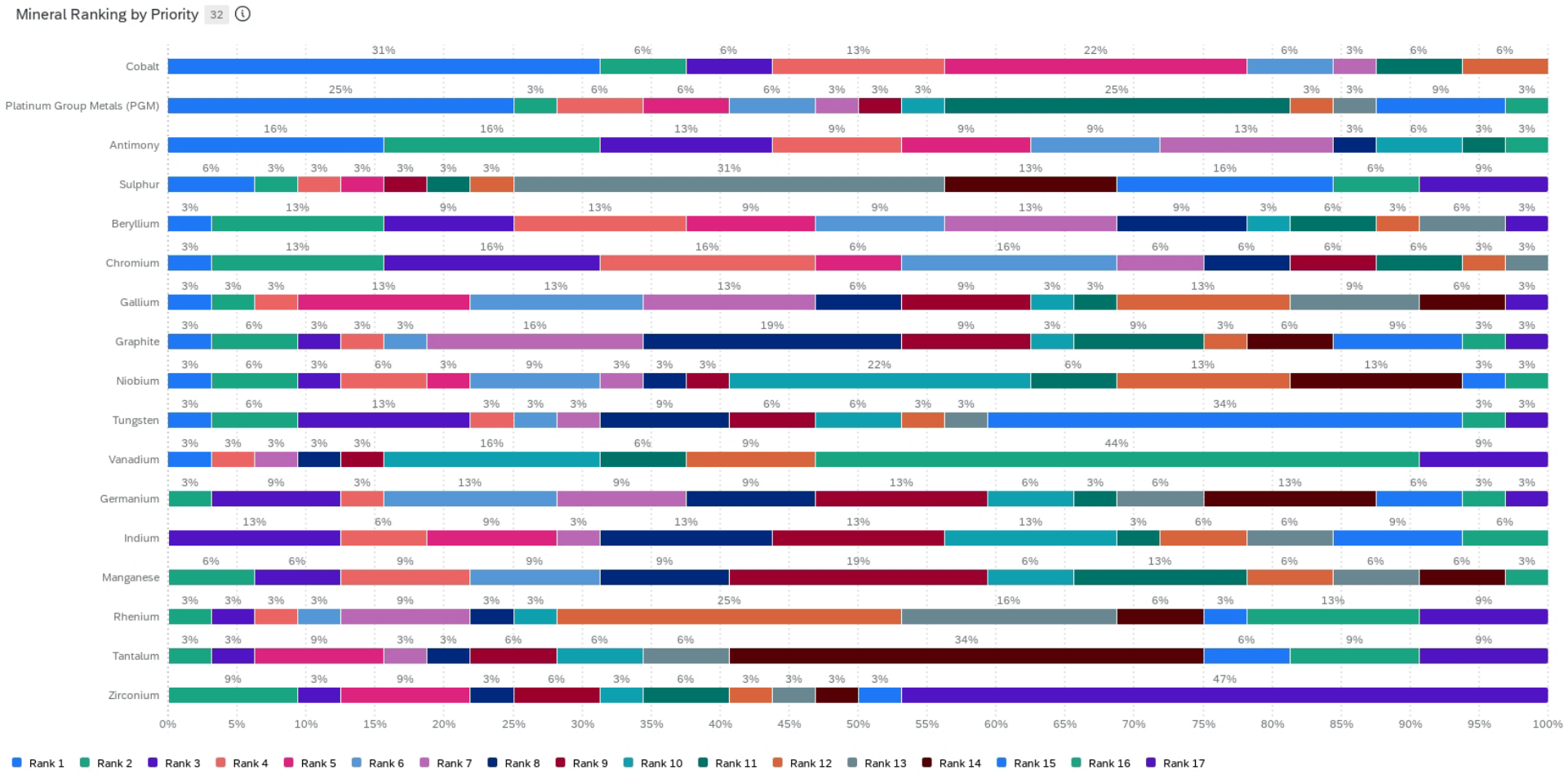
1.2 Mineral ranking by region: Americas



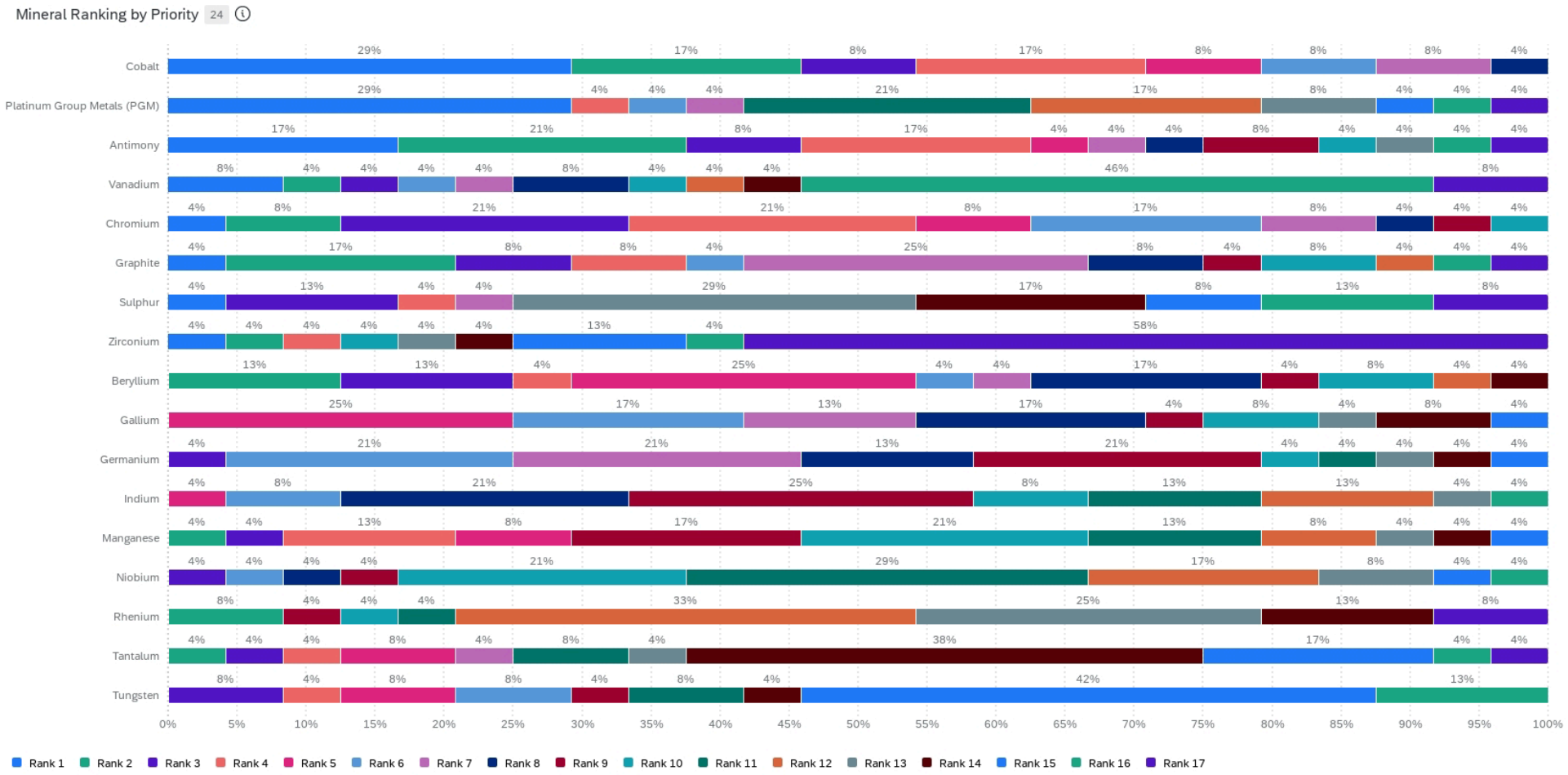
1.3 Mineral ranking by region: Europe



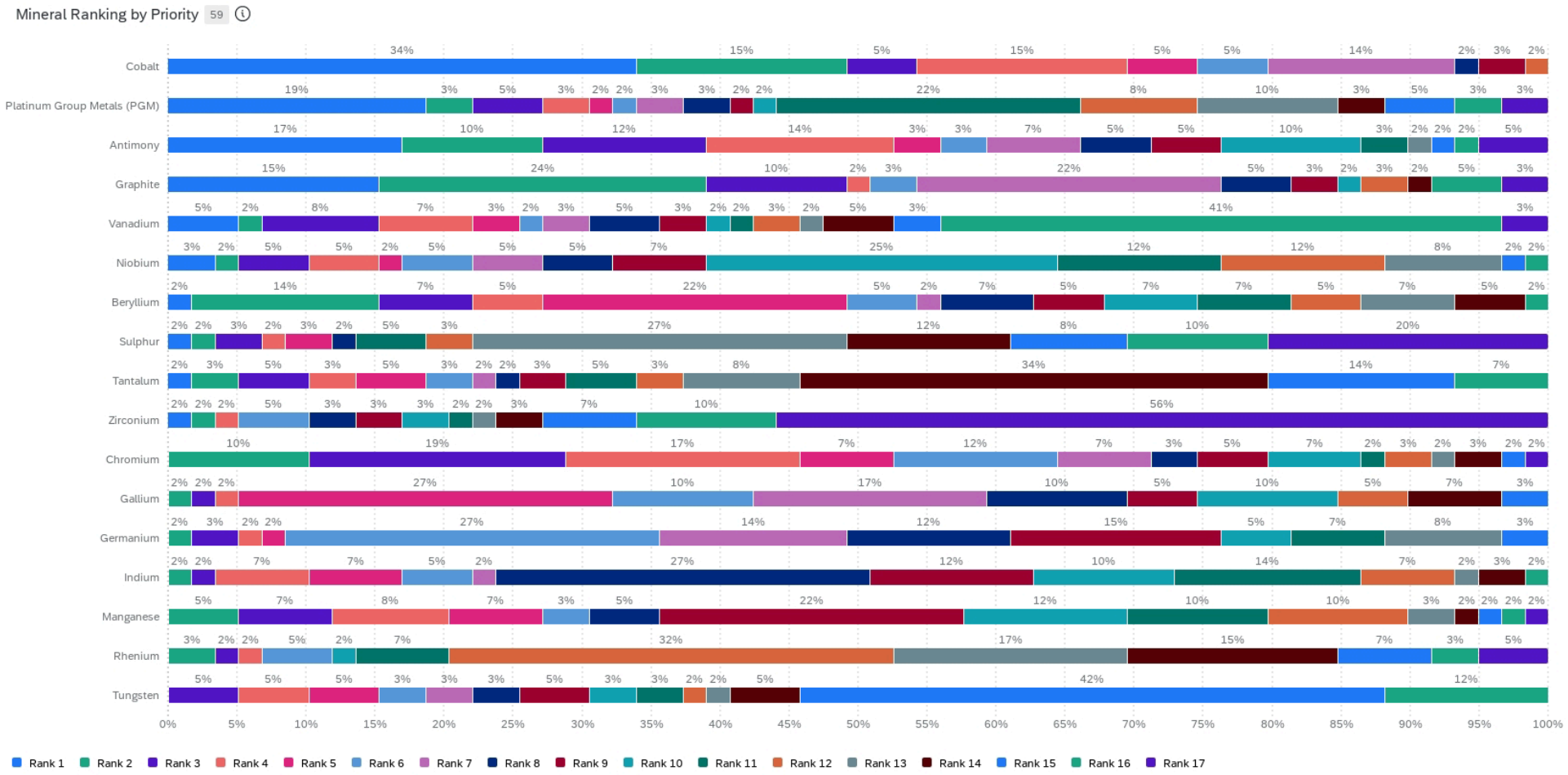
1.4 Mineral ranking by region: Asia



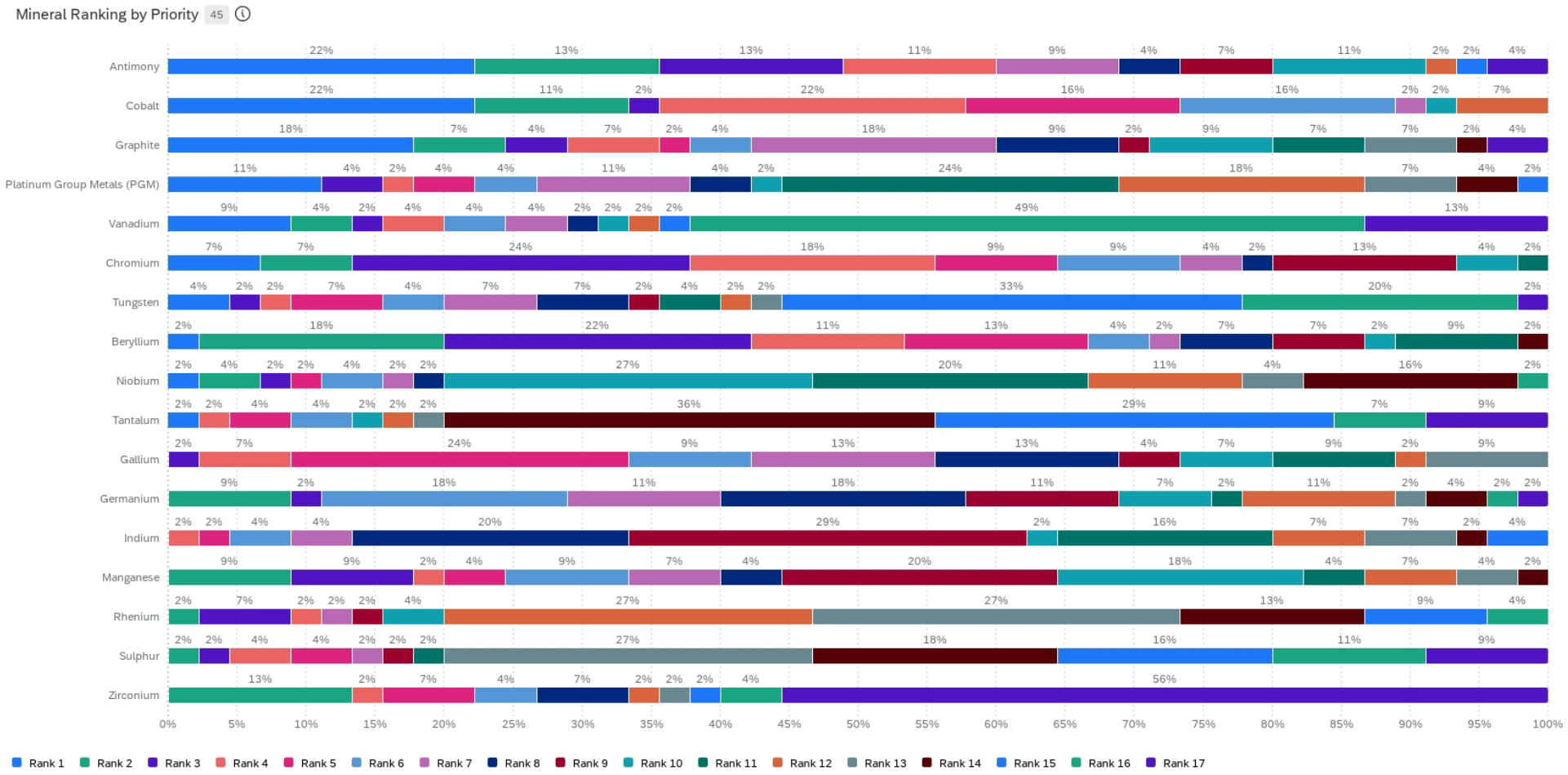
1.5 Mineral ranking by region: Rest of World



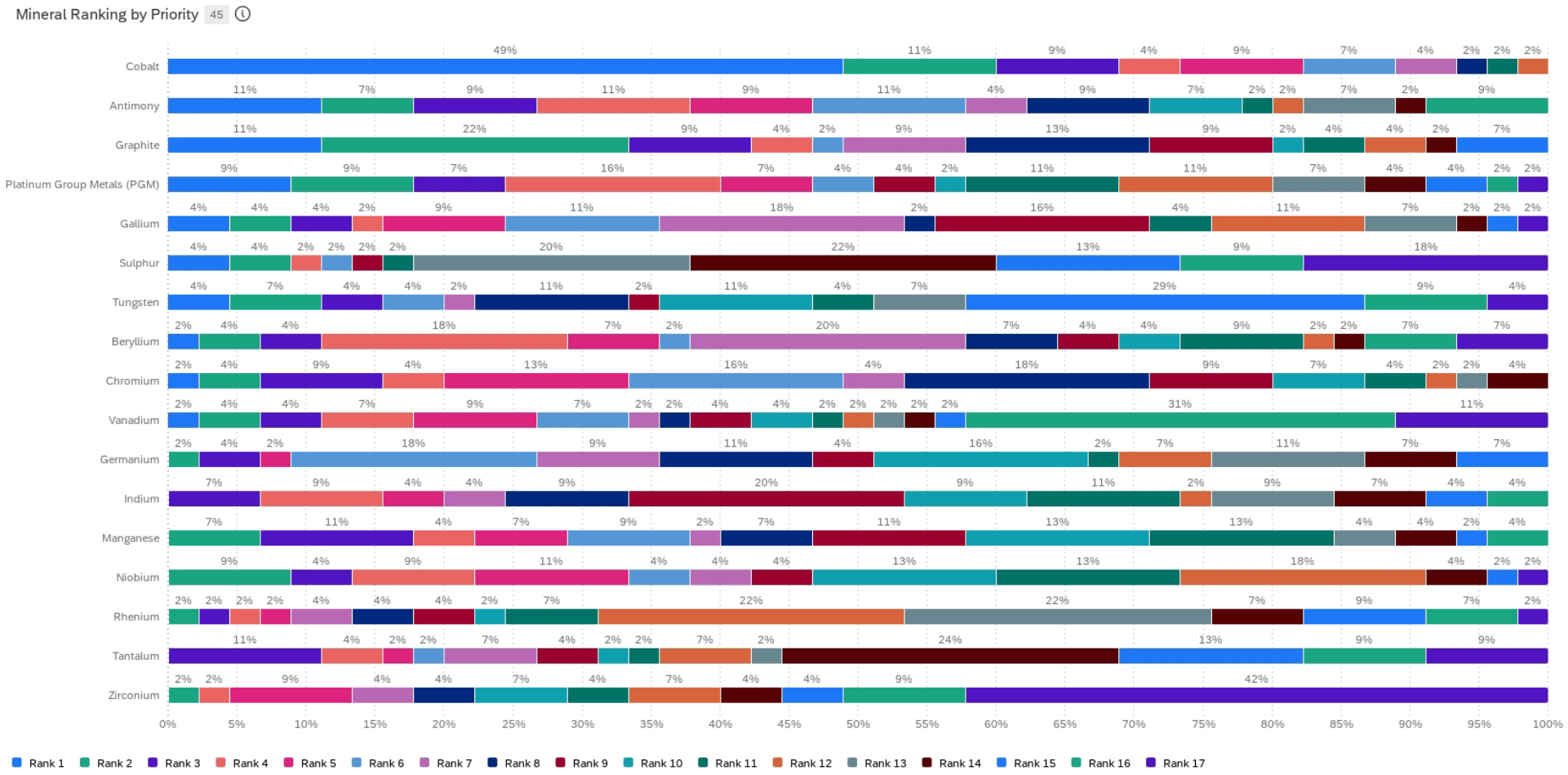
1.6 Mineral ranking by sector: Mining



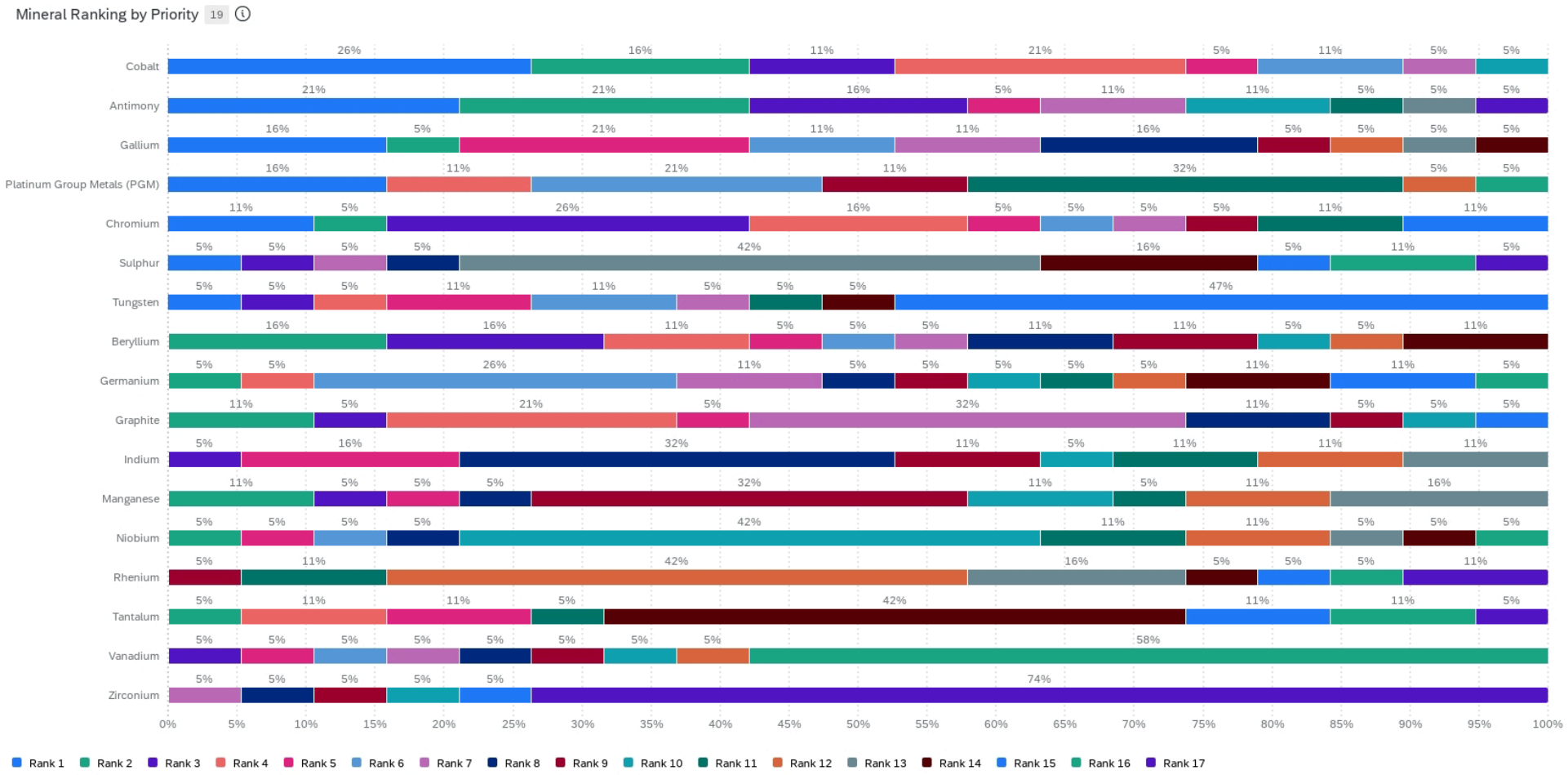
1.7 Mineral ranking by sector: Industry/Manufacturing



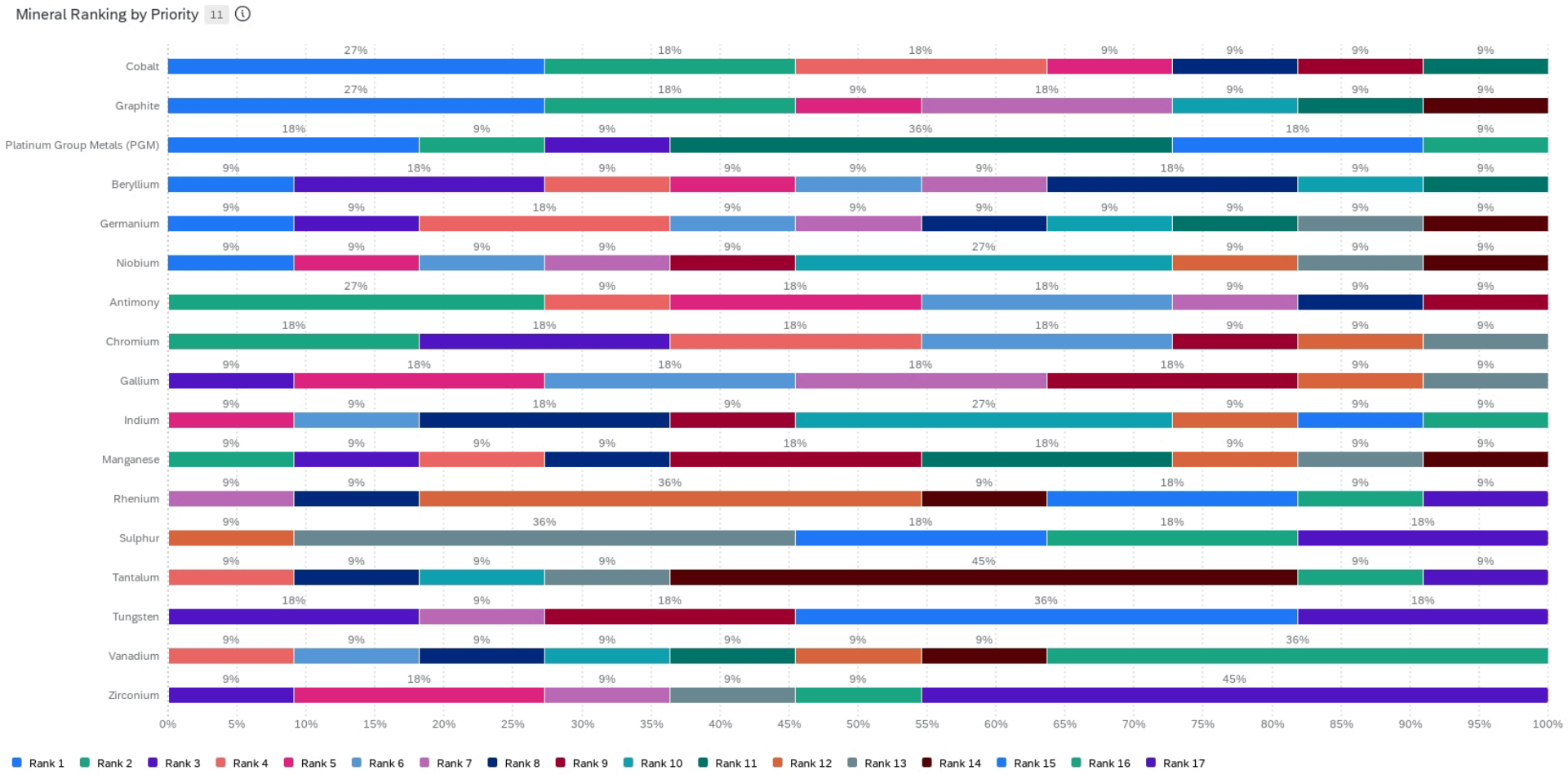
1.8 Mineral ranking by sector: Research/Academia



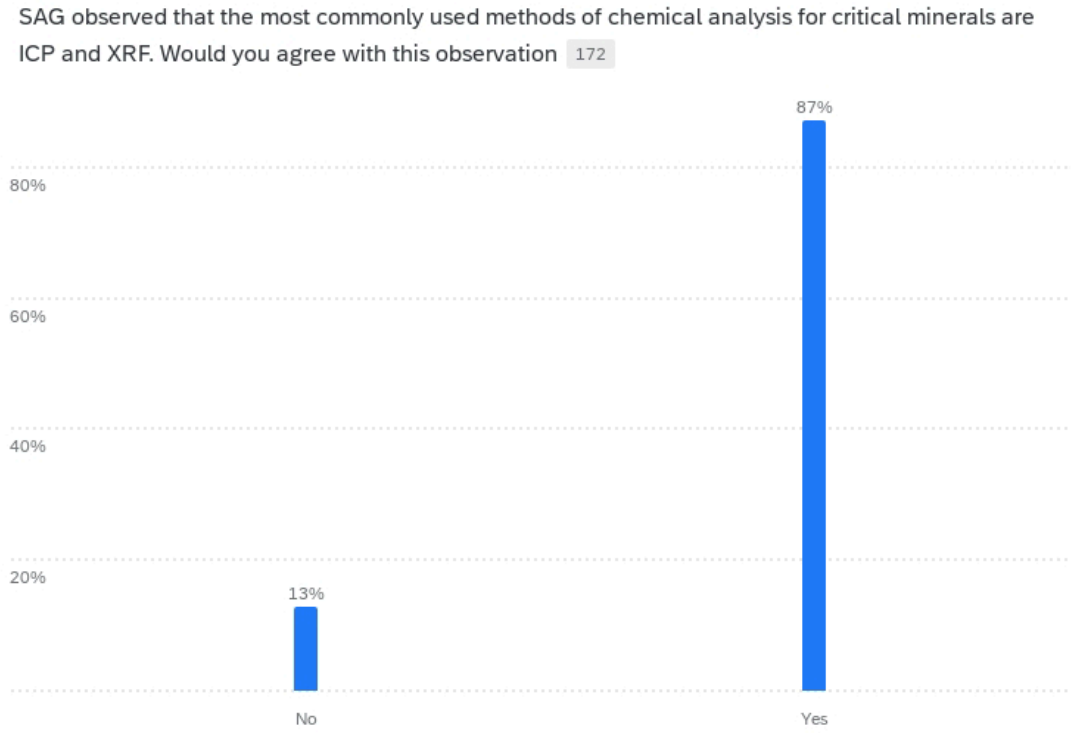
1.9 Mineral ranking by sector: Standards Application



1.10 Mineral ranking by sector: Testing/Certification

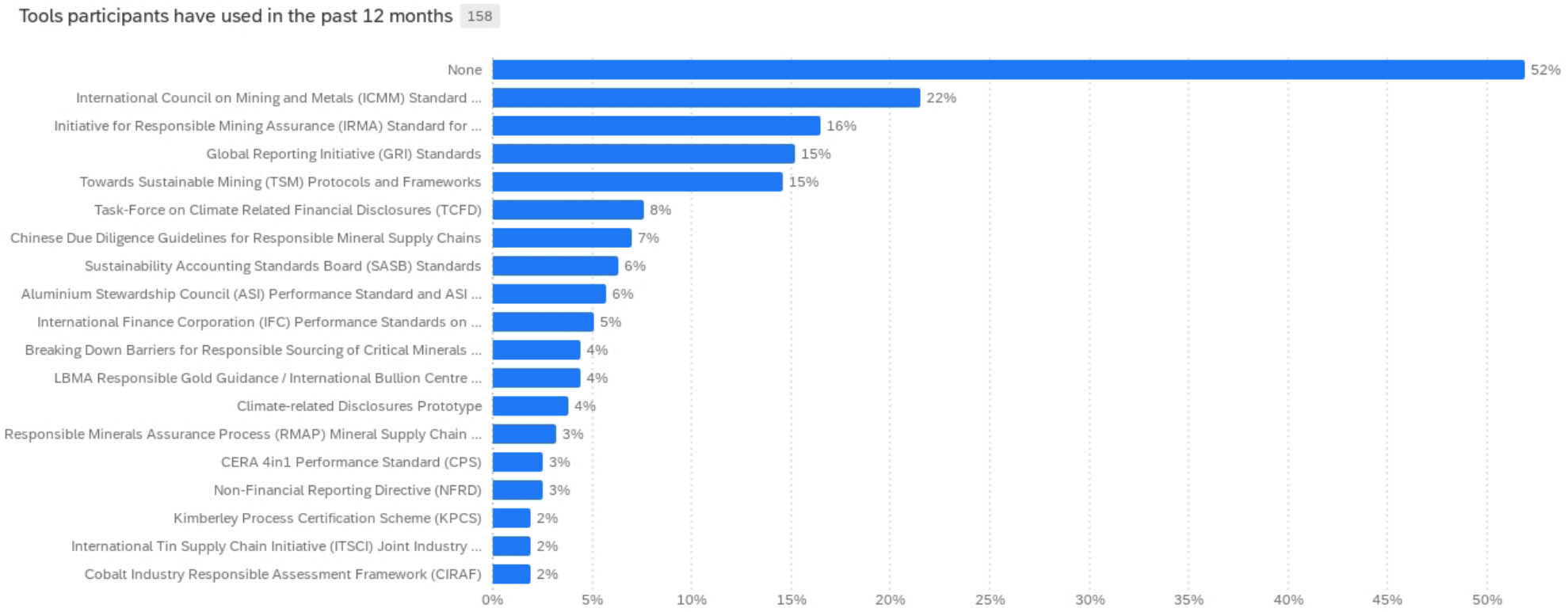


1.11 Which technique do you think is most widely used

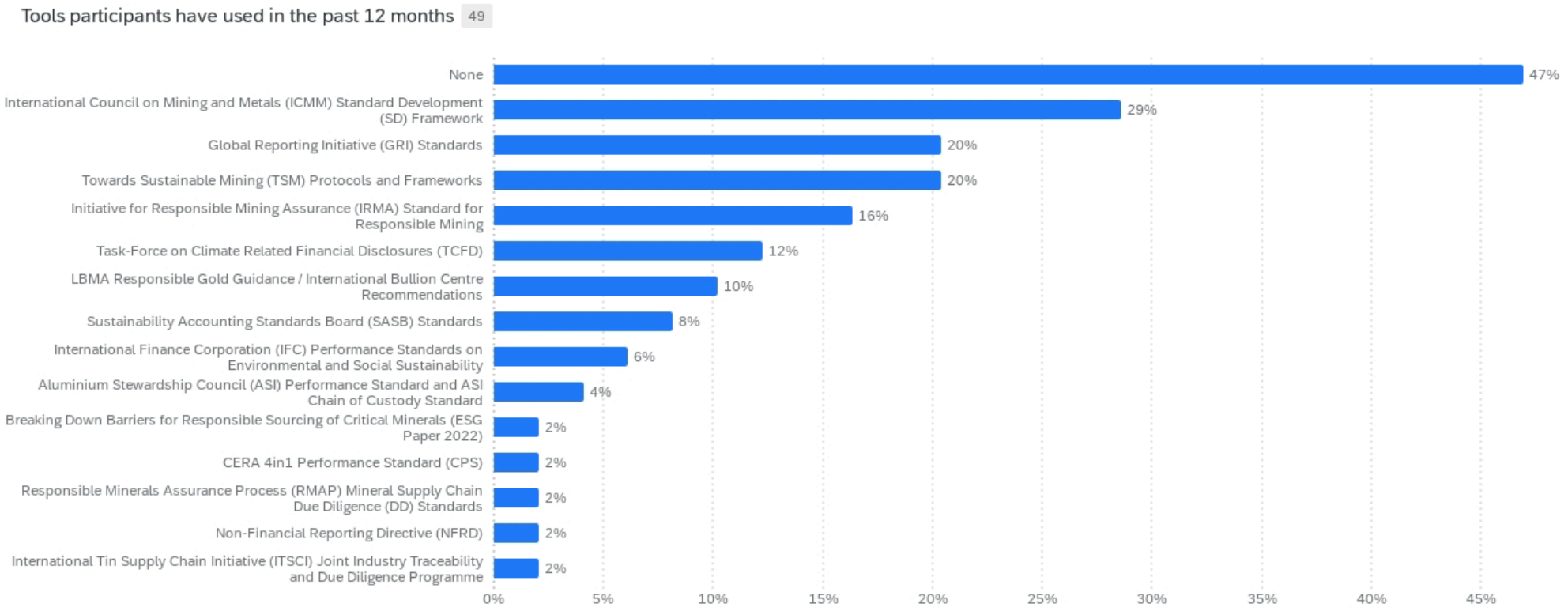


Section 2 – Tools for Critical Minerals

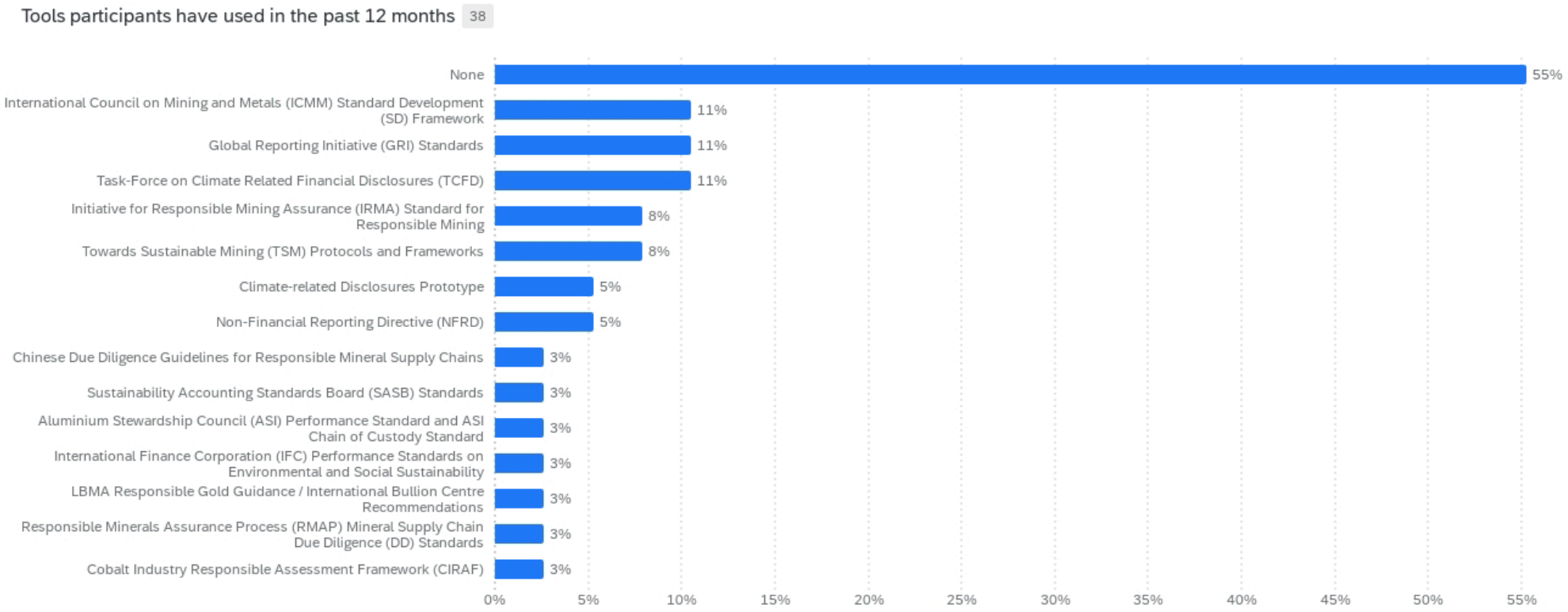
2.1 Tools used within the last 12 months



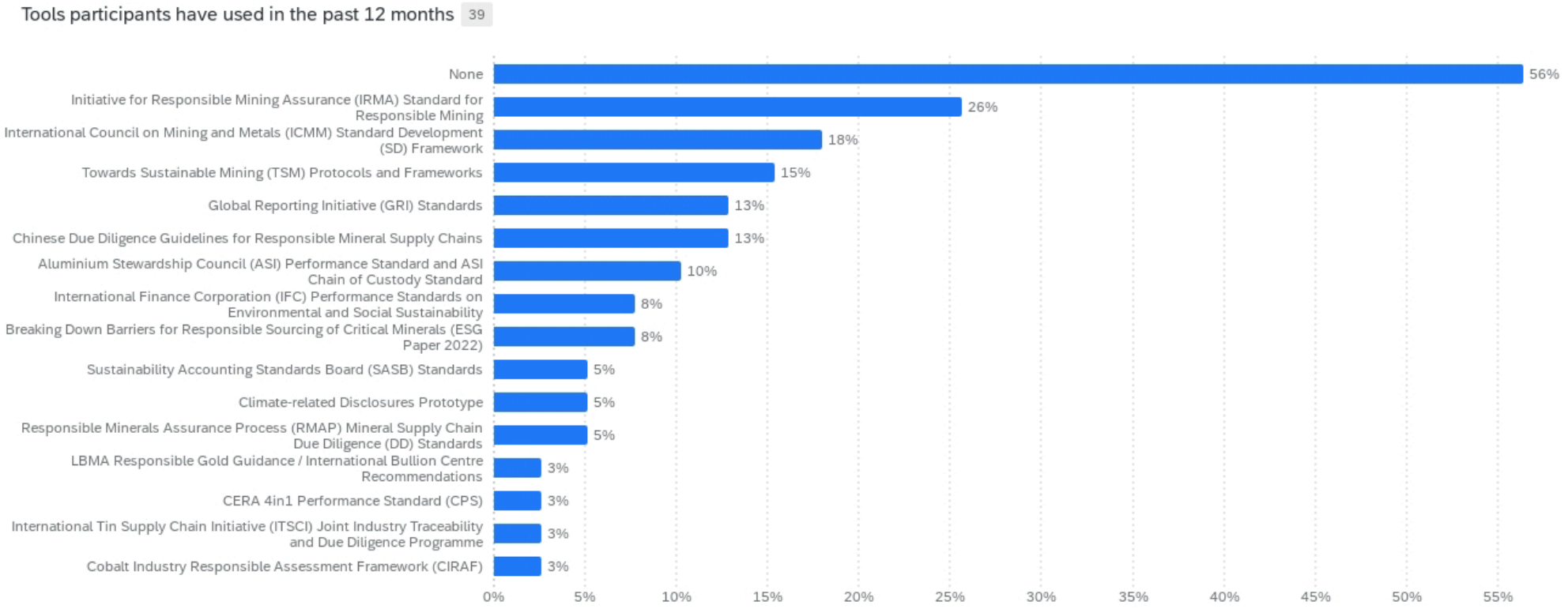
2.2 Tools used within the last 12 months by Sector Sector: Mining



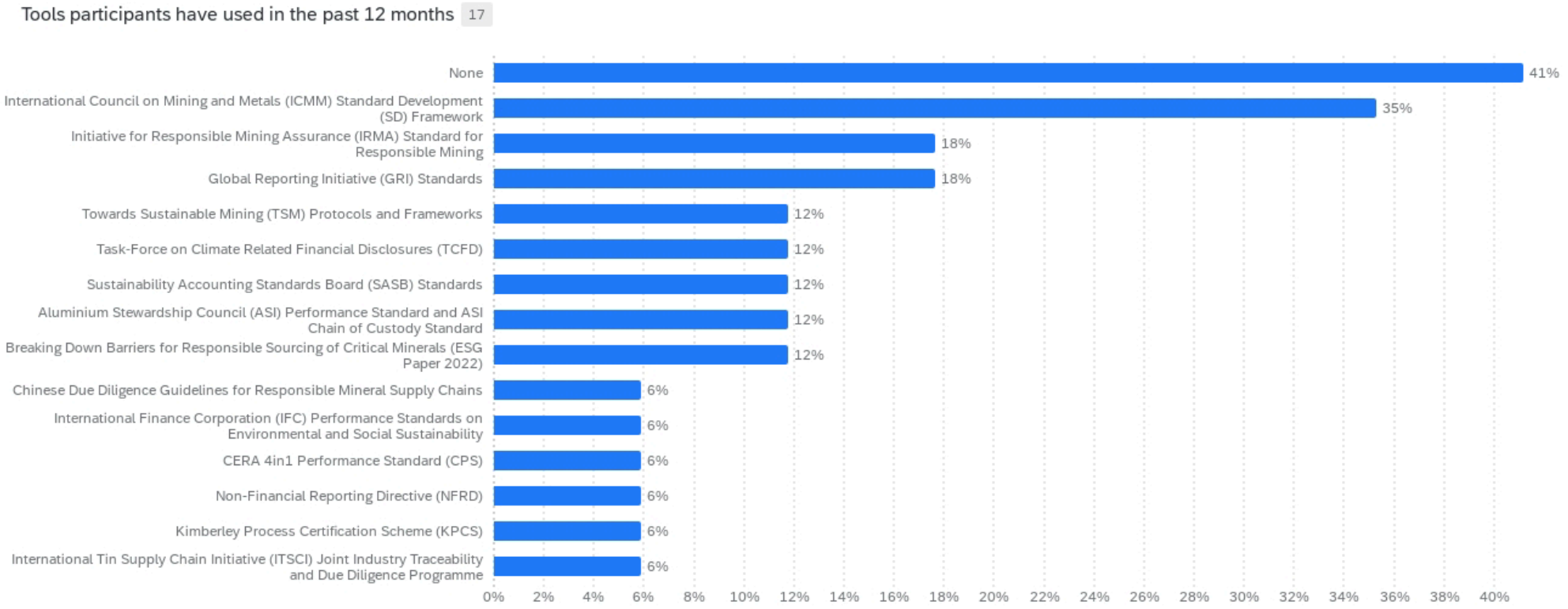
2.3 Tools used within the last 12 months by Sector Sector: Industry and Manufacturing



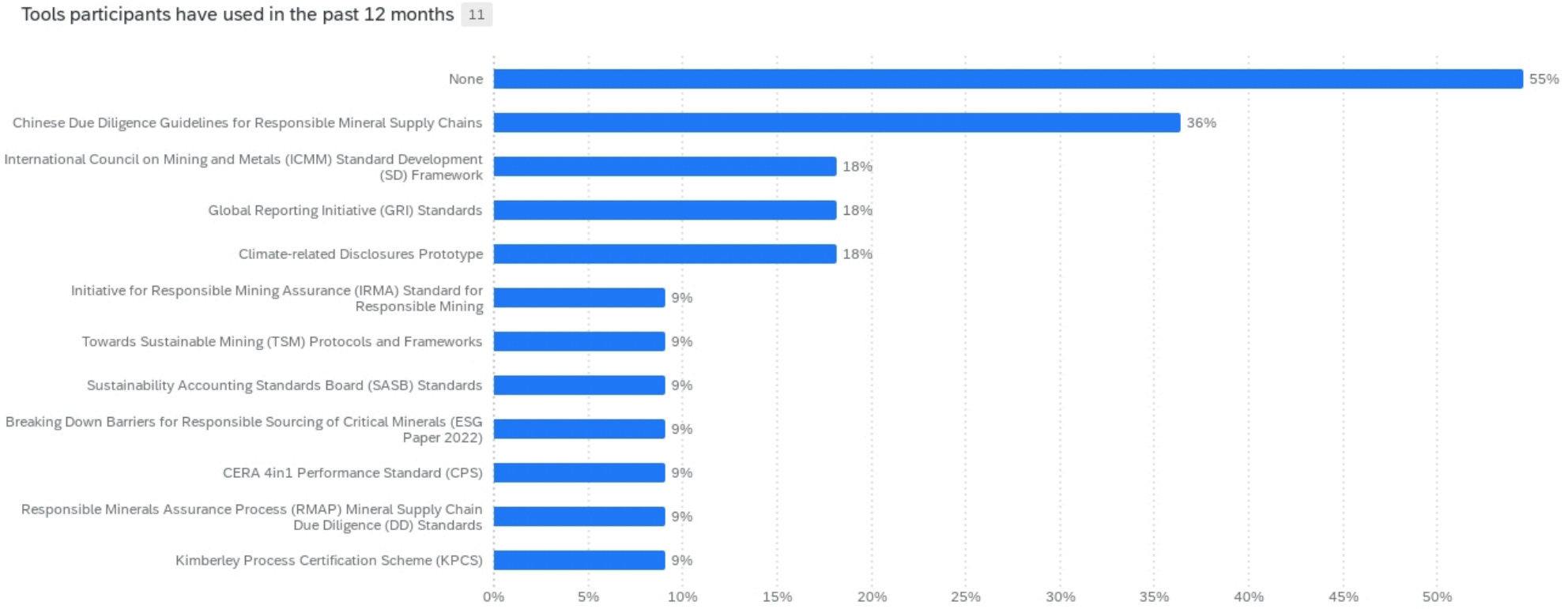
2.4 Tools used within the last 12 months by Sector Sector: Research and Academia



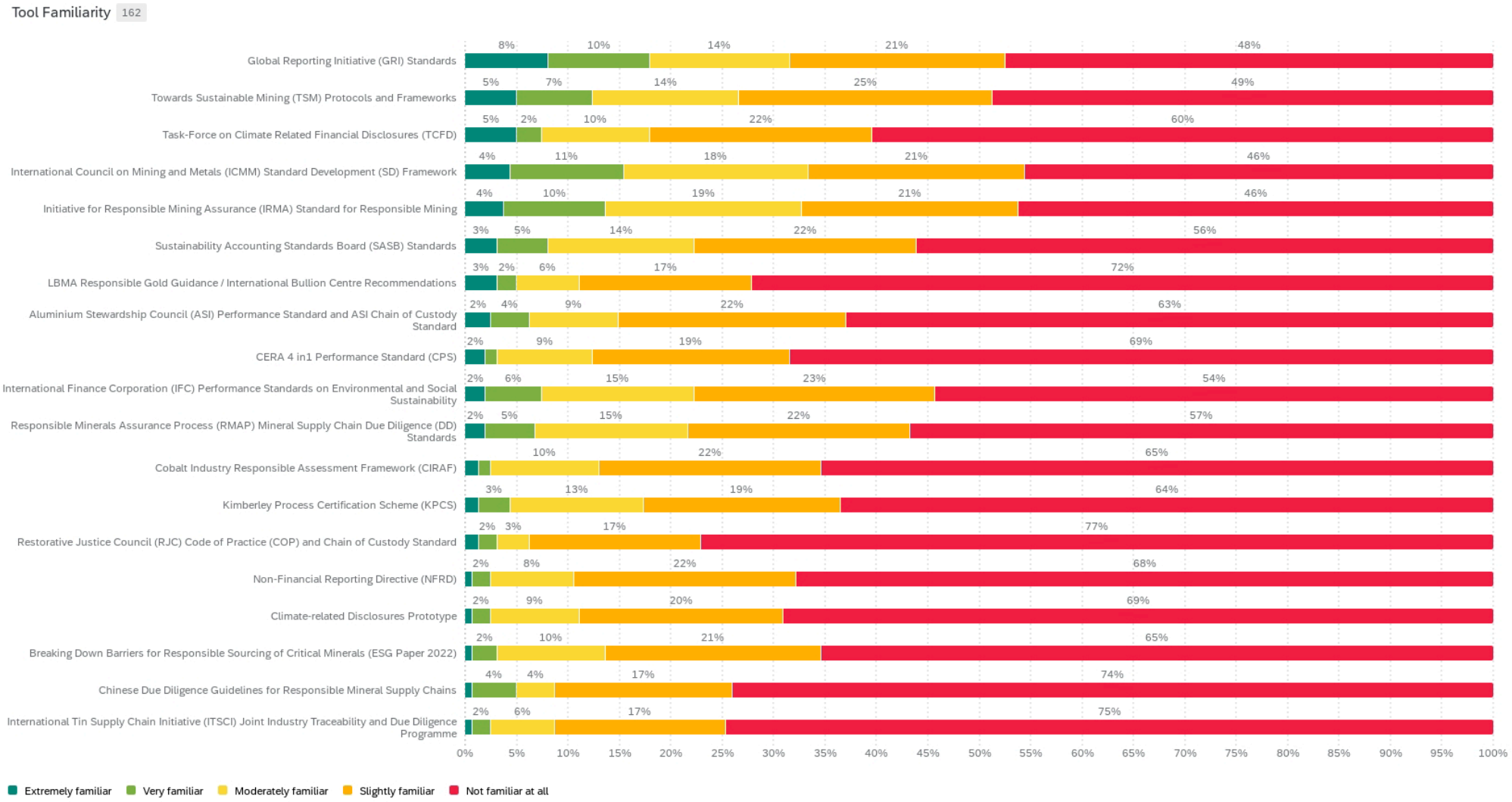
2.5 Tools used within the last 12 months by Sector Sector: Standards Application



2.6 Tools used within the last 12 months by Sector Sector: Testing/Certification



2.7 Tool familiarity



2.8 Other tools used

Chemical Analysis

- Inductively Coupled Plasma (**ICP**)
- The Mineral Liberation Analyzer (**MLA**)
- Quantitative Evaluation of Materials by Scanning Electron Microscopy (**QEMSCAN**)
- X-ray Powder Diffraction (**XRD**)
- X-ray fluorescence (**XRF**)

Sustainability

- Copper Mark
- Responsible Jewellery Code of Practice – includes PGM
- Responsible Steel - includes input materials like Mn, Ni, Co, W, etc.
- The United Nations Framework Classification for Resources (**UNFC**)
- United Nations Resource Management System (**UNRMS**)

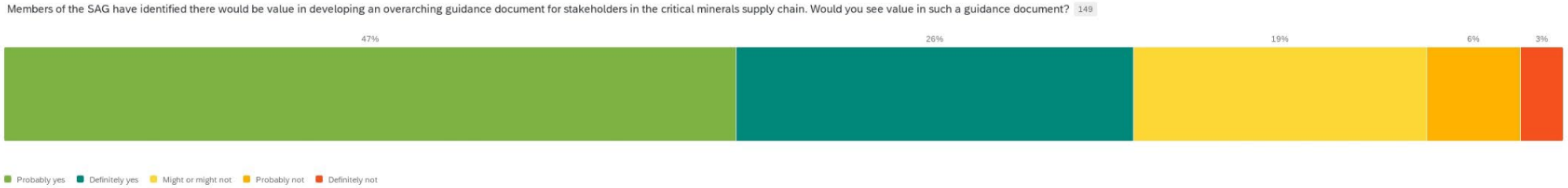
Reporting

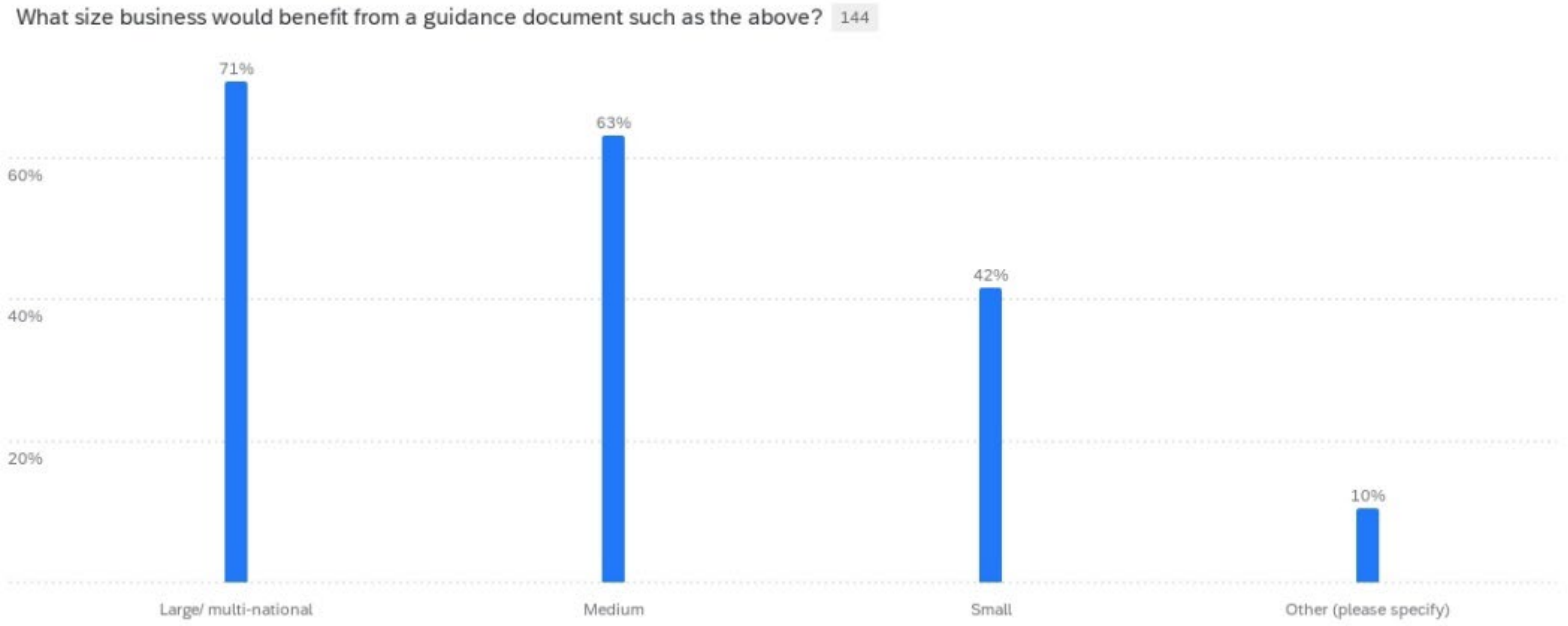
- The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (**JORC** Code)
- National Instrument 43-101 (**NI 43-101**) is a national instrument for the Standards of Disclosure for Mineral Projects within Canada.
- Securities and Exchange Commission (**SEC**) Rules
- Toronto Stock Exchange (**TSX**) Rules

Already covered

- CERA 4 in 1 Performance Standard (**CPS**)
- Global Reporting Initiatives (**GRI**)
- International Council on Mining and Metals (**ICMM**) Standard Development (SD) Framework
- International Finance Corporation (**IFC**) Performance Standards on Environmental and Social Sustainability
- Sustainability Accounting Standards Board (**SASB**) Standards
- Towards Sustainable Mining (**TSM**) Protocols and Frameworks

Section 3 – Overarching guidance on Critical Minerals Supply Chain





Section 4 – Additional comments

Sample of final comments:

"I strongly support the initiative to standardize those topics considering their importance in the next future."

"I have great difficulty in understanding what role Standards play in Critical Minerals"

"This is an important survey and it is hoped that the results will enable a tight focus for the SAG's work"

A survey should be conducted to determine if the risk tradeoffs of environmental issues are well understood. There is a need to educate the public on the need to have a holistic view of environmental issues, rather than focusing on a particular ISO or environmental issue.

"Integrated standardization, such as guidance and international standards, of information disclosure and any sustainability-related implementation is required."

"Stemming from the work of this SAG on Critical Minerals, a Technical Committee on Critical Minerals could be created."

"I'm extremely in favor of new standardization works on this scope and the kick-off of a new specific technical committee"

"Many organizations are separately standardizing tools and requirements, and those items are not harmonized with each other. Sustainability-related criteria, life cycle inventory data, and measurement methods should be shared through SAG's guidance. SAG's work will be a tough one. Still, the overview of challenges and possibilities of standardization in the field of critical minerals can contribute to clearing the issues and possible solutions for ISO standardization"

"I don't understand the need for specific ISO guidance to the mineral industry"