Wilton Park

Report

Critical minerals information – sharing initiative

Monday 20 – Wednesday 22 March 2023 |

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In association with the Cabinet Office

Executive Summary

Critical minerals markets are vital for shared aims such as clean energy transition to net zero and Sustainable Development Goals, but are often opaque and volatile. Inconsistent data reporting and asymmetries of information characterise such markets. Data discrepancies, gaps, limited traceability, and poor pricing mechanism transparency are commonplace in this context. Barriers to change result from policy, regulatory, legislative, economic and cultural constraints. International governance is lacking. Policy could drive beneficial change through efforts to improve interoperability, digitalisation and streamlining to reduce transaction costs, support for public / private cooperation, and multi-stakeholder coordination. To help address such challenges, which go beyond the scope of any single institution, this conference aimed to design a bespoke process to enable trial of a critical minerals markets information-sharing initiative with global reach (CriMMIS).

The conference convened stakeholders from governments, international organisations, the private sector, civil society and research communities. Discussions centred on resource classification and reporting standards, information-system design and technology, data reporting for companion products, ESG standards, price mechanisms, market indicators, data licensing, and terms of reference for a trial. Wider considerations included varied possible incentives to share data, issues of labelling, circular economy for trade, international standards, trust among market participants, the value of remote sensing, and other recent information-related initiatives. The conference made a range of recommendations on the basis of the deliberations detailed in this report.

Information uncertainty & asymmetry characterise critical minerals markets globally. Refinement of trade codes coupled with use of “materials passports” and strategic partnerships could help. Further work is needed to address data gaps and quality issues through improved granularity, consistency, and accuracy including by standard-setting designed for consistent terminology and metrics. International collaborations, including across disparate trading blocs, are needed to enhance market transparency.

Varied **resource classification & reporting** systems complicate the current information landscape. Work with multiple stakeholders across sectors could encourage data-sharing, deepen understanding, and help to fill resource inventory data gaps. Use of the United Nations Resource Management System could further facilitate data-sharing orientated towards a common purpose, such as net zero and related Sustainable Development Goals.

Potential solutions include innovative **information system design and standards**. Arrangements such as data pooling networks could play an important incentivising role by enabling consistency and reliability of reporting, reducing trade frictions and associated costs, enhancing clarity on liabilities, and building trust. Such developments could also help identify mutual data gaps throughout value chains for all stakeholders. Tiered data systems with clear objectives could encourage data-sharing only when necessary. Distributed ledger technologies and synthetic data could also play significant roles by enabling safe, pre-competitive and trustworthy environments for data pooling.

Digital disciplines enabling data standardisation through **data-driven technologies and system design** can help to shape policy, principles and protocols through a joint approach with stakeholders. These could also support better use of existing data sources.

Specific information challenges characterise **companion products** of which extraction tends to be driven by major primary commodities. There is a need to handle uneven granularity, varied reporting frequency and timeliness of data. Detailed reporting on all such companion products is unlikely to be feasible in markets characterised by structural scarcity. Work is needed to define a minimum viable set for which the data can be credibly validated. Initial attention could, for example, focus on Cobalt and / or Tellurium.

There is clear need for a more unified framework for **ESG standards** designed to build efficiency, including through simple and pragmatic solutions that accommodate the minimum and set priorities while meeting primary objectives. Use of relative baselines and improved baseline data could help. Multi-stakeholder and participatory approaches are essential to address issues of trust in this context.

Use of **price mechanisms** could help to manage volatility and reduce market opacity by enabling a greater share of long-term fixed-price contracts, and encouraging price reporting agencies to expand portfolios to cover non-commercially viable commodities. Liquid exchange-traded futures contracts could help to build deeper liquidity pools and facilitate industry use. Market weighting in price mechanisms could facilitate prioritisation of ESG issues. Such steps could improve data availability and reflection of market fundamentals. For small and illiquid markets governed by producer pricing, an independent entity mandated to aggregate and anonymise data could improve data availability. Encouraging producers to use a spot-trading platform for a specified fraction of transactions would enable anonymous real markets to shape prices. In this context, the private sector and governments should avoid a “one-dimensional approach” to supply.

Transparent, comparable, reliable and dynamic **market indicators** are needed. These should cover the full life-cycle of mining costs to drive sustainability, including management of legacy mines. Longer term decision-making time horizons need to go beyond annual or short-term political cycles. In this context, stakeholders need to understand the causes of inertia. Appropriate indicators should use expected standards of ESG competence and could extend to sector financial liquidity throughout value chains. Needed are alignment and harmonisation of sustainability ratings across agencies, including the full positive impact of mining throughout value chains to significant end products, such as off-shore wind turbines.

On **licensing and IP issues**, user feedback on data quality should encourage industry associations and data suppliers to lower their prices or to donate data for the good of both the public and the business sector globally. Appropriate steps should support due diligence to reduce industry costs and flag the benefits of linking industry with government data. Cross-cutting stakeholder engagement is essential for achievement of these objectives.

The **general approach to CriMMIS and its Terms of Reference** should recognise the existence of different business models. Steps enabling policy and trade coordination should frame a common global purpose. This should recognise needs both for sustainable and resilient supplies, and for cost reductions to ensure private sector engagement. A CriMMIS should specify data selection criteria and processes, enable data validation, and include use of five-year rolling timescales for forecasts such as for potential choke points. It should cover whole value chains and reflect the extent of market circularity. Scope for improved reporting should include ESG indicators and Sustainable Development Goals. Tiering of data could allow variable levels of engagement and help to differentiate standardised from bulk data-sharing. The role and capabilities of market consultancies need understanding in this context. Balanced ownership of a CriMMIS, including both private and public sectors, should allow parallel research and other forms of collaboration.

1. The conference convened multiple stakeholders from governments, international organisations, private sector, civil society and research communities (see Annex A). Discussions centred on resource classification and reporting standards (see Annex B), information-system design and technology (see Annex C), data reporting for companion products, ESG standards, price mechanisms, market indicators, data licensing, and terms of reference for a trial critical minerals information-sharing initiative with global reach (see Annex D). The recommendations in Part A indicate ways to develop critical minerals data standards and information-sharing. By supporting efforts to build a transparent and “level playing field” in critical minerals markets worldwide, this initiative will contribute to global governance in this field. Part B sets out detailed session reports.

Part A: Recommendations

On market information uncertainty and asymmetry

2. Action on technical and standards issues for market information to include:
   - Adoption of consistent terminology, and making better connections between existing datasets.
   - Data on trade at required granularity, plus clarity and consistent on the approach to key metrics used, such as currency and weights, to increase data accuracy.

3. Consideration of relative merits of evolving existing codes and standards, versus tweaking existing schemes such as HS codes, through:
   - Collaboration as a key strategy to tackle significant imbalances in power and markets.
   - Strategic partnerships between allied countries or regions while recognising the importance of a ‘just transition’.
   - Importance of acting – and therefore having information available - at a global scale, with input from BRICS and other blocs.
   - Consideration of the degrees and interoperability of data required to support differing degrees of international cooperation – from trade agreements to minerals cooperation agreements to bilateral MoUs.

4. Consideration of specific initiatives or aspects of proposals, such as:
   - The role of the proposed EU Observatory in data around future technologies.
   - The role of the World Customs Organisation to better differentiate / aggregate HS codes
   - Material passports.

On resource classification and market reporting systems

5. Relevant stakeholders – governments, industry, investors, academia, NGOs, indigenous communities and the public – should work closely to establish ways to incentivise data sharing.

6. Need to engage experts when compiling resource inventories to ensure that data gaps are understood and, if possible, additional data are incorporated.

7. Principles are not enough: data sharing, for example via a global database based on UN Resource Management System principles, could underpin outcomes as expressed in the Sustainable Development Goals as implemented in industries, such as textiles and timber. See the background briefing note at Annex B.

On information system design, indicators and standards

8. There is a need to:
   - Encourage consistent and wider use of a unified product classification system.
   - Identify data gaps in value chain and concentrate on market products level.
   - Incentivise parties from industry to support reliability data.

9. Industry should be incentivised to reduce friction on trade. For example, the Ecosystem of Trust Programme[1] shows that distributed ledger technologies can enable operations to run faster than paper-based systems. Significant incentives to industry participation include deciding where liabilities lie, having a "frank conversation", avoiding costly delays, and having a disruptive business model.

10. Introducing a tiered data system, in which data are exchanged only where necessary and of which the purpose is clearly stated, can also offer good incentives.

11. For a Data Pooling Network, a safe, pre-competitive and trusted environment can incentivise sustained participation by industry partners. Such a Network could be formed using synthetic data with distributed technologies.

12. At the level of critical products in the value chain, an understanding of data gaps, and a focus on mutual knowledge gaps for both government and industry, can help save significant cost and effort where the approach is to pool as much data as possible.

13. Encouraging as many partners as possible to use the same "resource map" or classification system, such as UMIS[2], and to bridge any data gaps using Bayesian Material Flow Analysis, would be a more future-proof approach. See background briefing note at Annex C.

On data driven technologies to improve information system design

14. To help improve information system design, there is a need for:
   - Digital discipline" to include standardised data generation.

[1] https://www.gov.uk/government/news/transformational-border-pilots-to-create-an-ecosystem-of-trust

[2] R.J. Myers et al. 2018. Unified Materials Information System (UMIS). An integrated material stocks and flows data structure. *Journal of industrial ecology* 2018 doi:10.1111/jiec.12730. R. Myers et al. 2019. YSTAFDB, a unified database of material stocks and flows for sustainability science. *Nature Scientific Data* doi/10.1038/s41597-019-0085-7.

7. https://www.fao.org/policy-support/mechanisms/mechanisms-details/en/c/428659/

- Better use of existing sources, not necessarily more or different data.
- Principles & Protocols as well as incentives.
- Data-driven policy design.
- A joint approach by both markets and governments.
- Follow-up on “forensic” evidence of design efficacy and take-up by industry

15. New technology can provide good outcomes for data management. While this is a necessary contributor, it is not sufficient. Standards, policy, economic and diplomatic or international efforts need to go hand-in-hand with the technology. See background briefing note at Annex C.

On lessons from experience with the Agricultural Markets Information System

16. Any critical minerals market information system:
    - Requires strong international political support (at G7 / G20 level) and secure funding if it is to establish trust, effective collaboration and deliver timely and impactful analysis for policy- and decision-makers.
    - Requires the development of a team to ensure effective working with national authorities and both the public and private sectors to enable data collection and collation, recognising the difficulties of accessing and sharing commercially sensitive or proprietary information.
    - Should have an agreed and clear mandate and scope, with tightly defined deliverables and outputs, if it is to be successful.
    - The national and international response to a crisis will be the “acid test” of any system in terms of providing timely, transparent, quality analysis for policy- and decision-makers.

On consistency and clarity of reporting on companion products

General approach to a CriMMIS

17. Important considerations include:
    - Specification of a process to select data sets for inclusion, use, primacy and / or visibility.
    - System validation e.g. using at least one (or more) well-understood mineral.
    - Recognition of different business models for critical vs. strategic minerals.
    - Scope for parallel geo-metallurgy research and / or collaborations.
    - Scope for better reporting e.g. World Customs Organisation reclassification.

Co-product specific recommendations for a CriMMIS

18. Important points to recognise include:
    - A need for “low-hanging fruit” to enable a CriMMIS launch.
    - Unlikely feasibility of detailed reporting on all co-products at onset.
    - Need for system to handle co-products even if initial focus cannot cover all or update with the granularity or frequency possible for other minerals.
    - Value in obtaining a minimum viable set of reporting about all minerals, not just those of immediate concern.
    - Need for corporate buy-in for reporting of low tonnage materials.
    - An initial co-product focus could be on (1) Cobalt and / or (2) Tellerium.

On consistency and clarify of reporting on ESG standards

19. Consideration of mandatory procurement standards to encourage stronger ESG supply chains or to ensure that wider regulations drive change in specific sectors. Precedents include:

- A “race to the top” in which “big brands” unintentionally and negatively affect both supply chains and ESG standards adoption.
- Smaller producers being side-lined and selling to other markets.
- Companies using vertical integration to ensure supply and standards but with associated inefficiencies.

20. Development of a more unified standards framework to enhance efficiency. Risks include:
    - A “race to the top” in which “big brands” unintentionally and negatively affect both supply chains and ESG standards adoption.
    - Smaller producers being side-lined and selling to other markets.
    - Companies using vertical integration to ensure supply and standards but with associated inefficiencies.
21. A more flexible approach to Artisanal and Small-Scale Miners to encourage suppliers to engage in risk management e.g. by providing assurances that they will avoid penalty for identifying risks. This could
    - Enable a fair price e.g. for the reported 20% of cobalt from ASMs in DRC.
    - Support safety management and capacity building, including to finance.
    - Require continuous due diligence engagement, not a one-off process.
22. Focus on the opportunity ESG standards offer e.g. through Just Energy Transition priority for net benefits and fair distribution. This should:
    - Avoid falling below critical thresholds for mining.
    - Avoid overloading operations with inefficient ESG standards.
    - Consider the end-goal.
    - Provide simple and pragmatic solutions.
    - Avoid impracticable “one-size-fits-all” approaches.
    - Accommodate lowest as minimum but allow headroom for the capable.
23. Improve assurances by using new technology including satellites and appropriate incentives. Recognise that ESG is a differentiator and that there is a need for multi-stakeholder approaches.
24. Consider use of sustainability-linked loans (SLLs) to provide an incentive. Banks do little to focus on these but prefer a “green” label when deeper engagement is needed. Lack of engagement leads to “greenwashing”. For companies, brand protection is more important than Intellectual Property (IP). ESG is not an issue of IP concern: if done properly, the whole sector would gain equitable benefit.
25. Use a multi-stakeholder approach to overcome trust issues in ESG standards. There is a wide range of ESG standards with variable effectiveness, in part because those who bear costs may not participate in their development. Such unilateral approaches can affect small producers who are eventually priced out.
26. Consider incentives, such as grants to ESG standards providers, to attract private capital. The Towards Sustainable Mining (TSM) commitment of the Mining Association of Canada works well because mining companies participated in its design, although it has had mixed traction with investors as some groups were not involved in the process.

27. Look to ensure that ESG approaches go beyond specific projects or companies. Currently ESG standards predominantly focus on mines (opening, operation, closing), rather than on improving surrounding areas. To support a wider focus, baseline data quality needs to improve. Any new ESG framework should consider how it contributes to the COP15 Biodiversity Commitment.

28. Consider sector-specific ESG standards data, which could support a Critical Minerals Information Sharing initiative. The plethora of current ESG standards, with varying impact and metrics, hampers overall data utility.

29. Look to simplify the current ESG system around critical minerals, including through:
    - Identification of the ESG standards that are most impactful and bringing these under a single umbrella that encourages common baseline and data points.
    - Considering, for the longer term, a new mining standard that works for industry, consumers, investors, civil society and has the backing of governments, and has built-in flexibility ensure cultural and country specific baselines are recognised

30. Form a group able to convene discussions on standards with resource-rich countries. Existing groups could include the Mineral Security Partnership or the Canada-led Sustainable Critical Minerals Alliance.

On price mechanisms

31. Critical minerals should have a greater share of long-term fixed price contracts (e.g. 50%). Long-term fixed price contracts are the main method for overcoming price volatility. Both parties must accept that this may not give the optimal price at any given moment, but will provide security for both producer and consumer.

32. Prioritise ESG considerations / weighting for pricing mechanisms. Beyond pricing, governments and the private sector need to move away from a uni-dimensional approach to supply. Consumer economies cannot compete (e.g. with China) solely on price.

33. Improve data availability to reduce notional market fluctuations and better reflect market fundamentals. Speculation will, however, result in some degree of volatility even in markets that are fully transparent or as good as the information can be.

34. Mandate an independent entity to aggregate and anonymise data to improve transparency in small, illiquid markets for critical minerals governed by producer pricing. This could be a role involving governments.

35. Incentivise Price Reporting Agencies to expand their portfolios to cover commodities which are currently not commercially viable.

36. Governments could look to incentivise market actors to use liquid exchange-traded futures contracts to hedge and speculate. These would provide deeper liquidity pools, enable such contracts to be useful to industry, and reduce both price volatility and market opaqueness. Some such contracts exist (e.g. for cobalt and lithium) through the London Metal Exchange.

37. Governments could look to encourage producers and consumers to place a certain percentage of their transactions on a spot-trading platform to discover prices based on transactions. This allows buyers and sellers to match their transactions and therefore to form an anonymised price based on physical market transactions.

On clarity and consistency of reporting on market indicators

38. Create transparency and comparability on the full life-cycle cost of mining. Current market-led indicators are not driving sustainable mining. It can be difficult to compare different type of business. ESG ratings industries cannot meaningfully evaluate companies where ratings are not mining-specific, or focus primarily on operating businesses.

39. Create sustainability ratings specifically for mining. There is a need for harmonisation across all ratings agencies. “Green financing” does not tend to appreciate the full positive impact of mining projects.

40. Develop dynamic indicators. Historically most data evaluation has focused on credit assessment and ability to recover investment. Such evaluation has been neutral, professional, and expert-led using empirical and structured methods and empirical. Legal areas are more difficult to evaluate, more subjective, and serious in potential repercussions. ESG assessments now increasingly include gap analysis on expected standards of competence along with a path to alignment.

41. Recognise and use indicator knowledge as quickly as necessary. Sophisticated mid- / long-term indicators of industry trends, supply / demand gaps, and scenarios exist. Substantive knowledge exists on mid- / long-term market fundamentals and commodities issues (e.g. energy transition metal demand vs supply shortfalls known for >5 years); but attention and action are scarce.

42. Policy-makers, investors and others should encourage a change in horizons for decision-making beyond the next annual announcements or political cycles to reach over the longer-term, and should understand the causes of inertia.

On data licensing and IP issues

43. Data suppliers / third party suppliers or industry associations can be incentivised to sell data at a reduced cost / donate, for example by:
    - feedback on quality of their data (benchmarking);
    - feedback how their data will be used;
    - application for public good and industry good;
    - support to complete due diligence in reduced cost to industry (e.g., modern slavery in supply chain); and
    - benefits in data linkage with government data.

On adapting AMIS Terms of Reference for critical minerals

44. AMIS terms of reference could be adapted for CriMMIS along the following lines:
    - Report “potential choke points” rather than; “abnormal market conditions.
    - Include timescales with rolling annual forecasts looking 5 years out.
    - Incorporate the SDGs and ESGs.
    - Reflect circularity of markets and whole value chains.

- Use policy and trade coordination as the framing principle and a global common purpose, recognising the challenge as ensuring supply is sustainable and resilient.
- Include refining and processing as well as production in scope.
- Draw together public and private sector actors.
- Balance ownership of the mechanism.
- Note the incentive to draw in private sector through cost reduction.
- Note the main players:
    - Private sector: producers, processors, end-users
    - Intermediates (e.g. Geological Surveys)
    - International organisations
    - Governments as enablers
- Use data tiering to differentiate bulk data and standardised data, so as to recognise different levels of engagement and data-sharing across private and public sectors.
- Include waste, recycling, and reuse along with “design to recycle”.

Part B: Detailed Session and Working Group Reports

Scene-setting on critical minerals markets and trade networks. What are the main actionable areas of information certainty and asymmetry in critical minerals markets?

Points for consideration

45. Effective operation of critical mineral markets is a multidimensional problem – but information has a number of key roles to play.

46. It is important to distinguish between “critical” and “strategic” minerals. Whatever minerals are in scope of information collection and / or sharing, the purpose of information collection must be considered. For example, is information required to support the effective operation of economic markets, and what factors (political, economic, social, technical, legal and environmental) govern how the data will be used? Example questions to be addressed were as wide ranging as the adoption of policies such as stockpiling, protectionism or friend-shoring, and the forecasting of future demand taking into account future technology demands and possible material substitutions.

47. The development stages of a criticality assessment can be a useful proxy when identifying data considerations for policy-makers and industry to focus on: selecting relevant factors to address; setting appropriate metrics; and then identifying and accessing the relevant data sets.

48. Data are used to inform industrial policy, interventions and funding, so it is hugely important that methods are appropriate. The size of the market contributes to the challenge. There are practical (e.g. data validation) and principled (e.g. commercial sensitivities) issues to be considered.

49. More detailed points against the key themes identified above are addressed as follows.

A. Information considerations at every stage of the value chain

50. Information challenges arise at every point of the value chain. For some, the most acute current data challenges (in policy terms, and also to support the effective operation of markets) are in mid-stream processing / intermediates. On longer timescales, challenges might lie in access to primary (through exploration / exploitation) and secondary (recycling / circular economy) materials.

51. Examples of key information considerations raised at each stage of the value chain are as follows:

- **Exploration:** Information on potential future supply opportunities is limited for many critical minerals, with a low level of investment exacerbated by a lack of clear intelligence on prospective demand.
- **Exploitation / mining:** The number of projects under development varies significantly by mineral. There are no ruthenium projects, but many projects for example for gold, silver, nickel, copper, zinc and iron ore. This is in part driven by demand and market volatility, but also reflects information asymmetries.
- **Refining / processing / mid-stream / intermediates**: This may be the stage of the value chain with least accessibility of granular information due to the variety and interconnected nature of intermediate products. Many of these are not clearly defined in existing guidance, standards and regulations.
- **Manufacturing and assembly:** Mineral content is typically embodied within intermediates, sub-assemblies and components, whose processing and composition is often 'hidden' to downstream users and consumers. Trade codes often do not allow sufficient discrimination at this stage (see also section C below).
- **End-use sectors:** The role of some 'mega-sectors' (such as batteries, off-shore wind, PV, aerospace and defence) in driving demand was discussed. Industrialisation and development of future technologies will continue to be significant evolving impacts. Changes in demand over time will have an impact on real-world decision-making – and even where overall trends are clear, the pace of change and associated mass-market adoption points are significant uncertainties.
- **Recycling / circular economy:** Variation in end-of-life recycling rates between minerals affects economic and legislative drivers for access to information. Available data are often historic: oft-cited end-of-life recovery rates from UNEP concern 2011 data. Material **substitution** can have a role in circular economy, but also leads to further information uncertainties and on varying timescales.

52. Specific mineral value chains illustrating aspects of data challenges/solutions include:
- Magnesium: ahead of prices rising and ultimately peaking at five times historic levels in September 2021, actionable market intelligence enabled industry in one country to prepare in advance using risk assessment driven by access to – and purposeful processing of – relevant data.
- Rare earths: another country has increased granularity of trade data in relation specifically to magnets by moving from reporting the number of magnets to the mass of permanent magnet material.

- Minor metals: the size, scale and opacity of markets such as for Indium, Tellurium, Germanium, Gallium and Hafnium also illustrate such challenges.

B. Data for a purpose

53. The nature of the market scale, volatility, and uses of some critical minerals means that strong economic drivers do not always exist for developing information systems, or indeed for developing products or markets. Many additional challenges are associated with the 'companion' or by-product nature of some critical minerals.

54. Further, consideration is needed of the pace of change in geo-political factors and the implications of ESG standards. Any data considered need to underpin the broader global need to support sustainable development while keeping the wider geo-political context in mind.

55. Data bring value in understanding current and future risks, evaluating solutions being trialled or in current use, and gathering insights to prioritise the most actionable areas / future interventions.

C. Cross-cutting issues / meta-challenges to address

56. Further points include broad themes of timing; granularity of data; coverage / scope; and equity and sustainability:

    - **Timing: Timing mismatch** is a key practical constraint on markets – the timescales involved in establishing down-stream demand (for example in the final assembly of end-use products) are generally far exceeded by the upstream time to market (and whole-of-value-chain investment costs). Technology evolution / divergence / substitution risks also disincentivise investment in some upstream and mid-stream phases of the value chain.
    - A greater focus on future technology trends, to 2050 and beyond, could support efficient markets. Prospective information is hard to gather and analyse, but is important in enabling both industry and policy-makers to intervene. Price reporting agencies can lag behind markets and provide only a partial view; but real commercial sensitivities affect access to information, the more commercial the more so. Currently, often only broad trends are available. Ability to develop future insights is limited to those with sufficient information, such as specialist metal traders or key industry players. This often limits any one body's access to the development of overall trends.
    - **Granularity:** Global trade data do not work in harmony. Long, complex value chains limit the depth of data. Differences in proprietary data mean that they are asymmetric. For example, HS codes do not provide helpful granularity. Reconciling trade data (e.g. between UK, EU and proprietary data) is not possible. There is a large latitude for redaction of trade data. These tensions play out even in relatively high-value critical mineral markets, such as for platinum group metals. The picture is even harder for other metals, for process intermediates, and for waste products.

- **Coverage/Scope:** Critical mineral challenges are global in nature. Macro-political risks are driving the landscape in which decisions on critical minerals are being made by both commercial and state actors. Global geo-political actions inform friend- / ally-shoring. Partner countries desire to build their own capability as well as to collaborate. Examples of the scale and pace of current action include the United States' Inflation Reduction Act, and the EU's Critical Raw Materials Act and Net Zero Industry Act.
- Bilateral relationships and entities such as the World Trade Organisation can be used to prioritise actionable areas. Access to information would require agreement not only between national actors but also between international data systems and standards.
- **Equity & Sustainability**: Reports that up to 90% of some critical mineral value chains may be based on illegal inputs may motivate a push towards better information systems. Different information challenges associated with varying business models exist, for example in considering the role of artisanal small-scale miners. Access to information has an important role in exposing and enabling action on practices which may be causing social, economic or environmental injustices.
- Gaining access to the value of critical minerals can be an opportunity, as well as a challenge, in supporting a just transition. There is a key role for access to information, supported by consistent and transparent standards, for example to support initiatives that will enable capacity-building in resource-rich regions

Current resource classification and market reporting systems. What steps could most improve resource classifications and reporting systems for critical minerals, particularly those that are co - / by-products (of "companion" products) of major commodities?

Points for consideration

57. The global energy transition is heavily dependent on the supply of critical minerals. However, these markets are often characterised by geographical constraints on supply, sustainability issues related to production and use, and complex and opaque supply chains.
58. There is a lack of value attributed to critical raw materials, particularly those with by- or co-product status, which means they are often excluded under existing reporting standards. The trade-off between the monetary value and strategic value of mineral resources means that development of critical mineral projects often lose out to larger markets such as gold or base metals.
59. Policymakers require timely information on availability (reserves and resources), production and use of critical minerals to inform their response of improving security of supply and facilitating information sharing at different levels across borders.

Existing reporting systems

60. There are several internationally accepted systems (also known as codes or standards) of reporting resource and reserve data, including the Australian Joint Ore Reserves Committee (JORC) and the Pan-European Reserves and Resources Reporting Committee (PERC).

61. These codes and standards have been aligned and standardised to some extent by the Committee for Mineral Reserves International Reporting Standards (CRIRSCO).

62. CRIRSCO was designed specifically for the reporting of results to stock exchanges and to ensure investors have a consistent standard of information to inform decisions. As a result, reported reserves are not considered physical stocks or a true representation of total mineral inventory but economic entities, thus a poor tool for long-term strategic planning.

63. The concepts of mineral resources and reserves are commonly misused or conflated, which has serious consequences for decision-making by government and industry. Different reporting systems, codes and standards all use different definitions, which can have significant implications on the data reported. This can also vary by jurisdiction (in addition to internationally-accepted codes, many other national codes exist). One of the most widely accepted and commonly used definition is that defined by the CRIRSCO template.

United Nations Framework Classification

64. The United Nations Framework Classification (UNFC) is a global voluntary resource classification system to provide a harmonized and consistent way of reporting for a range of resources to support the development of policies and regulations in line with the Sustainable Development Goals (SDGs). It is not limited to minerals. It is highlighted that focusing on individual resources, projects, or ESG aspects in isolation will limit progress towards the SDGs. Under UNFC, projects are evaluated on the basis of their economic, technical, social and environmental feasibility for resource production in the future. UNFC is described as bridging the gap between the economic value and ESG value of a project.

65. With support from UNECE, the African Union has already developed a UNFC-based African Mineral and Energy Resources Classification and Management System (AMREC).

66. The UNFC has some advantages suited to resource reporting at national scale when compared to the CRIRSCO template. It is therefore a tool to aid decision-making for long-term resource management and policymaking.

67. The UNFC is a classification method, not a standard. This not a case of UNFC versus CRIRSCO. Even when using the UNFC, individual countries can still continue to use current systems of reporting to suit their internal purposes, many of which have a legal foundation.

Harmonisation

68. It is important, however, that the standards used by each individual country are consistent and comparable, and therefore can be converted to a single harmonised system such as UNFC. Conversion of CRIRSCO-compliant resource estimates to a UNFC classification can be readily accomplished, although in some instances is not straightforward. For example, a single category in CRIRSCO may fall under more than one category in UNFC.

Transparency

69. Transparent, trusted information also fuels social license to operate, allowing local and indigenous communities to evaluate and assess projects against stated ESG metrics. We have a moral obligation to support developing countries in a sustainable way, and the link between social acceptance and responsible resource management is clear.

70. Accurate information presented in a clear and easily understandable format is also essential for mining companies themselves, enabling them to convey a project's status to investors.

Challenges

71. In some instances, where there are a limited number of companies operating in a given industry/market, the disclosure of detailed information is likely to reveal commercially sensitive data. There is a lack of incentive for companies to provide sensitive data to a third party.

72. Industry is seeing a proliferation of standards and codes, and general increased demand for data. Small companies in particular, which dominate critical mineral markets, do not have the financial resources to report to multiple standards.

73. The value proposition for companies to adopt UNRMS is not particularly strong. Compiling together large amounts of data from disparate sources and aggregating resource information from a variety of different projects is complex. Additional challenges are associated with data gaps, and data that simply do not exist e.g. for co- and by-products, including as a result of a historical lack of exploration or of economic interest.

How can information system design, indicators and standards resolve data interoperability issues?

Points for consideration

Data interoperability and Product Classification System

74. Data interoperability specifically means the ability for different data to be used together. However, data interoperability can be an issue for the same kinds of data. For example, comparing "production of minerals, 200kt gold (BGS UKMY2018) with "mine production, 200kt gold" (USGS MCS2019) poses the question whether "production of minerals" exactly equals "mine production".

75. It is common for this kind of data to be classified in different ways. Industry classification systems include NACE (Nomenclature of Economic Activities) as the European statistical classification of economic activities, and UK SIC (Standard Industrial Classification) as the UK version. SIC only goes to 5 levels of disaggregation, stopping at e.g. “24450 other non-ferrous metal production”. There is insufficient detail on critical metals like lithium. Different definitions of “non-ferrous metal production” between nations lead to interoperability issues.

76. Product classification, such as an HS code from the UN Comtrade Database, provides information about products. Therefore, it is important for industry and product classification systems to match.

77. It is useful to try as much as possible for everyone to use the same “resource map” or classification. A translation tool is also useful to recover as much information as possible, such as through information system design based on Bayesian Material Flow Analysis and a Unified Materials Information System.

Case Study of Data Gaps in Value Chain

78. The UK’s UKRI Circular Economy Hub has completed a comprehensive case study on digital data assets to trace materials, components and products across the economy. A large number of data sources provided information with some covering materials up to finished products, some covered multiple material or product groups.

79. Available data were found to be concentrated in some areas of value chain and relatively scarce in others. For example, data were reasonably complete for inflows (imports and consumption) and outflows (through regulated waste systems and exports). Gaps were evident for material or product groups across reverse loops such as resale, refurbishment and remanufacturing. For example, Oracle / SAP holds a lot of information on in-bound flows.

80. Published data are at a level of aggregation. No data asset was found to capture information for any material, component or product across all value chain stages from its entry into the UK economic sphere and its exit therefrom.

81. Compositional data including Bill of Materials (BoM), as well as de-BoM, would help understanding of movement between the product- and the material-levels of assessment.

82. Therefore, it is important to have the capability to draw upon several sources to provide a value-chain-wide picture. The Data Pooling Network (DPN) method, augmented by data and insights from an industry consortium, can provide the overall picture digitally.

83. An initial DPN pilot has been completed with 7 industry partners from the Electrical Vehicle and Wind Turbine sectors in a safe, pre-competitive environment with the Office for National Statistics Integrated Data Service.

Reliability of data

84. Data pooling needs incentives across the value chain to minimise issues of data reliability and uncertainty. Understanding cultural value is also important. For example, bringing in tax data would be good, linking up with import and export codes.

85. Sensitive information, such as would enable company identification, cannot not be pooled. Companies may, however, be incentivised and convinced that they will benefit from this method. For example, protecting their sensitive information using synthetic data, exploring future ESG compliance, and identifying the next generation of green minerals or processes would help save future operating and investment costs.

How far can data driven technologies help to improve information system design?

Points for consideration

‘Digital Discipline’

86. Any system requires STACC - Standards & Interoperability, Transparency & Accountability, Data Privacy & Security, Collaboration & Engagement, and Data Governance.

87. It is probably impossible to track critical minerals from end to end of the value chain (unlike diamonds) because of their physical transformation through refining processes. It is important not to over-reach.

Use what we have

88. There is a need for all producers to be “in the same room” with a “default setting” of trust while a solution is in development. Simple imposition of, for example, a Product Passport without industry support is likely to fail.

89. Producers have much very useful data but need to see that participation in a system confers an overall benefit on them and on industry more generally.

Principles and Protocols

90. There is a need for joint public / private agreement on rules for the design and deployment of individual uses of data-driven technology.

91. Liability issues need to be addressed in the context of a different “culture” in which data are seen as a communal asset, not only as a commercial asset.

92. Incentivisation of industry is critical. Industry will base a decision to participate in a system only where they can see a quantifiable and material benefit. Vague references to longer term security or ESG are unlikely to suffice.

Data Driven Policy Design

93. Data design is progressing. The “intelligent commodity” is in prospect but there needs to be interoperability both between data sets and between the means of access to them.

94. Such design can start from either end of the value chain: from the original producer or mine, or from the consuming or importing Original Equipment Manufacturer (OEM). This process is likely to show a data gap in the middle of the value chain. This is likely to be a good area for more focused attention.

Joint approach

95. Links to government activity such as the negotiation of Trade and Digital Economy Agreements or existing pilot activity such as UK's Ecosystem of Trust Programme, can advance the agenda and deliver both commercial and public policy outcomes.

'Forensic' analysis of success of disruptive model

96. Objective measures of technology take-up and efficacy are needed. Such measures will indicate the ultimate level of success with industry and the acceptance of new models for data management.

What can critical minerals policy usefully learn from other market information systems, such as the Agricultural Markets Information System (AMIS), in order to improve market function, strengthen resilience, increase efficiency and reduce volatility?

Points for consideration

Background to AMIS

97. The 2021 G7 Panel on Economic Resilience recommended creating "an information-sharing platform on critical minerals … that maps stocks and flows, improves collective knowledge of volumes, supports traceability, and provides a policy coordination function, as AMIS has done for agricultural products since the 2007/2008 food crisis. Platform membership could begin with the G7 and be expanded over time" . What lessons does the AMIS experience offer for possible development of an information-sharing initiative for critical minerals?

98. AMIS formed under G20 direction and mandate in response to 2011 food market volatility affecting prices, stability and supply issues. Tightly defined scope focuses on 4 major food crops: wheat, maize, rice and soya beans with related production and supply chains.

Development and costs

99. Building on existing architecture reduced AMIS development costs. Running costs are circa $0.5m p.a. supported by a funding pool mechanism into which various sources contribute (Gates Foundation, WTO, member contributions). Modular programme design enables expansion or contraction as resources demand while retaining priority focus on core activities. Both Governments and the private sector support this arrangement.

Data sources

100. Nationally appointed G20 focal points provide national data to AMIS. Non-G20 data can be sparse. The private sector supply data, knowledge and expertise. Analysis includes public data and purchasable private data. This poses costs of buying data, potential issues of data analysis and publication, and issues of handling and use of commercially sensitive data. Data protection, anti-trust legislation and trade barriers among other risks all need consideration.

Organisation

101. The mandate includes member states and about 10 non-state organisations. The organisation comprises a secretariat function, a global food market information group and a rapid policy forum. A statement of core principles, methods of data collection and data sharing for use by all participants exists. Independence enables AMIS to accept or reject data sets as appropriate. Participants support the Secretariat by producing data, forecasts, and policy development information.

Lessons identified from AMIS

102. Central success have been:
- Tightly defined scope coupled with clear understanding of analytical issues.
- Strong, clear political backing if nation states are to provide data.
- Business case detailing:
  - full “life” costs comprising development;
  - full-time standing team staff costs to “own” the model for participants;
  - annual maintenance;
  - user training;
  - costs of data purchase;
  - planned upgrades; and
  - new functionality.
- Communication strategy and plan.
- Sufficient independence to enable choice of national data as appropriate.
- National and international policies to help shape and build trusting relationships.
- Appropriate institutional “ownership” of model and team to ensure effective messaging, “a single voice”, and adequate funding.
- Awareness that national and international crisis response is the test of any system’s ability to provide timely, transparent, quality data and analysis to support policy- and decision-makers.

103. Weaknesses include:
- incomplete coverage of areas such as parts of Africa;
- lack of reliable and up-to-date data;
- national-level data weakness;
- member states’ use of poor methods;
- lack of capacity; and
- lack of training by member states.

104. Notable successes include development of a Rapid Response Forum for global policy responses, and of a network of trust. These have calmed markets on multiple occasions, for instance during the Russia / Ukraine war.

Other systems: Germany’s Raw Materials Information System ROSYS

105. The ROSYS system for German industry[3] covers critical minerals and aims for complete value chain transparency. Cost and tonnage data for 60 years include USGS, BGS and private sector sources. ROSYS is available on-line in German due to data-sharing constraints. Development costs so far are c. €1million.

Other considerations

106. Regardless of incentives for private industry participation, a publicly funded system could risk Governments paying private sector companies to do what they would in

[3] https://www.deutsche-rohstoffagentur.de/DERA/DE/ROSYS/rosys_node.html

any case do in response to market signals. Potential incentives for private industry to ensure continued buy-in and support could include:

- Tax credits, tax breaks, off-sets and subsidies.
- Freeports.
- Softer incentives such as reduced reporting burdens.
- Positive ESG messaging.

Building consistency and clarity of reporting on companion products

Points for consideration

107. Companion products vary greatly in level of risk and recovery rates. The supply side is generally unresponsive / inflexible. Some producers will sell at a loss to maintain supply dominance**.**

108. For some “strategic” minerals, industry or government already intervene directly. For other co-products, the data do not necessarily provide the clear evidence to support rational decisions on market intervention, if needed.

109. Many minor metals exist in circulation and in tailings. On the principle that “we only find what we look for”, there is a need to prioritise and to get some useful information about a range of metals.

110. In some cases, extraction of co-products from tailings might be valorised by waste processing. Even where the grade appears high in tailings, extraction may not be economic.

Constraints

111. Constraints include:

- Proprietary reporting / data.
- HS code limitations (e.g. Bo-Te, ZrO-GeO; anode slimes).
- Misreporting under HS codes is also an issue

Standards

112. There is no one standard that would cover the key questions an information might seek to address, which are:

- How much is coming out of the ground?
- How much is being lost, and how much produced?
- Where is the produced material going to?

113. UNFC would be the obvious choice for understanding material in the geosphere (resources / reserves). Material flow analysis is likely to be needed to tackle questions (2) & (3)

114. Seminal works on the topic are the Nedal 2015 paper; the issue was also attempted to be addressed in the EU 2015 Criticality Assessment

115. Other initiatives to consider/draw from could be the USGS Earth Mapping Resources Initiative, and NI43-101 reporting standards

Data Requirements

116. Requirements for data cover the following:

Geological data
- Deposit grades
- Mineralogical partitioning

Extraction Data
- Millhead grades
- Production & concentration losses
- Accumulation versus batch process recovery

Production Data
- Resolution at facility, corporate and national levels
- Primary versus secondary inputs
- Commodity forms (can be complex!)

Trade Data
- Elemental content by HS code (noting constraints)
- Tonnage & value of trade for each HS code

Building consistency and clarify of reporting on ESG standards

Points for consideration

117. Mining companies work to a wide range of standards, general and specific, including around 30 ESG ratings and rankings. Larger companies may have a dedicated, full-time external reporting team with a substantial budget to oversee audit and compliance.

118. Customers care. Buyers recognise Coppermark, for example. Adopting such well-recognised standards brings a small premium. Implementation is onerous and costly. Industry investing in standards want to maximise benefit.

119. Moves to adopt further ESG standards should consider impact on the range of stakeholders affected. This should include community engagement, such as with indigenous groups, and consider all supply chain actors. Some participants may be more resistant to changes than others.

120. Appropriate consolidation of ESG approaches could support an information-sharing initiative and clear real-world outcomes along AMIS lines for food security. For critical minerals, such consolidation could aim to maintain focus on contributing to low-carbon economy, for example by concentrating initially on a tightly defined set of critical minerals.

121. Large commodity traders approach standards holistically. This includes building miners' capacity to attain them, and supporting long-term viability and sustainability of mining operations.

122. Down-stream users currently drive ESG audits, influencing industry change. Lessons from the agriculture sector include the Round Table on Sustainable Palm Oil (RSPO) system. Established in 2004, RSPO created a common sector language but accounts for only 20% of global production as many large buyers do not require suppliers to meet RSPO standards.

123. Certification costs may favour large producers, suggesting unintended consequences of high standards. The automotive industry IRMA standard has many data points and is unattainable for most mining enterprises. Few mines have been certified so far, and these at significant cost.

124. Downstream actors need to manage their power to effect change. Large buyers' demands and audits over several years, for example, have not in DRC affected small artisanal miners whose products still enter the supply chain.

125 Evidence on ESG framework effectiveness suggests that:

- Downstream actors should focus on where to audit and engage directly with suppliers to understand ESG delivery capacity.
- Business case requirements should incentivise suppliers to change.
- Capital providers should avoid simplified metrics, and consider sustainability link-loans for capacity-building and security around small mines.
- Large suppliers should consider their subsidiaries and focus on sector-specific areas.
- Stakeholders should focus on enhancing safety of ASM operations (90% of miners globally), so that they recognise the benefits of both societal impact and supply chain security.

Building consistency and clarify of reporting on price mechanisms

Points for consideration

126. Critical mineral supply chains are complex and opaque, and markets can be volatile and distorted. Price volatility is an economic vulnerability indicator reflecting commercial risk and deterring investment. This is not, however, a description that applies to all critical minerals: some markets are more volatile and / or opaque than others.

Current pricing for critical minerals

127. There are three main pricing types for critical minerals: producer pricing, price reporting agencies (PRA), and exchange pricing.

- Producer pricing – producers set a price directly with consumer (least transparent)
- Price reporting agencies – publish price assessments to specific methodologies, with greater detail on grades and illiquid markets (greater degree of transparency)
- Exchange pricing – prices are discovered by buyers and sellers on a regulated marketplace (greatest transparency)

128. Greater price transparency comes with increasing liquidity.

Challenges

129. Most critical mineral markets are small and highly illiquid and are therefore "off-exchange" commodities. They often have niche applications with a limited number of end-users. They lack a deep liquidity pool. They lack the mass-market demand for PRAs to publish price assessments.

130. Not all critical minerals are in forms suitable for ware-housing. Irrespective of liquidity, exchange pricing will not be appropriate for all critical minerals.

131. Spot pricing can create huge shifts in certain markets, despite accounting for only a small share of total trading. Prices may not reflect the proportion of short- to long-term contracts.

132. Prices do not reflect the true cost of negative externalities (ESG issues). The market does not differentiate based on provenance. ESG standards vary in their definition. No price premium currently applies to “green” commodities. Responsible companies have additional costs to do things correctly, putting them at a competitive disadvantage.

Building consistency and clarity of reporting on market indicators

Points for consideration

What is winning?

133. An understanding of goals is essential to developing appropriate indicators. Such goals could include to incentivise investment, secure supply (including from acceptable providers), understand true cost of extraction or other phases of the value chain, and therefore to understand liabilities and prices.

134. What is important depends on stakeholder perspective. Everything is a network. What is a leading indicator for one is a lagging indicator for someone else.

135. Indicators need to be meaningful for the host countries that will ultimately determine recipients of mining licenses. An issue is whether transparency would affect permissions for Chinese companies.

136. Market indicators used by China have driven good investment decisions; but if these are used globally, then Western actors will fail. There could then be a case for using broader criteria linked to Western values.

137. Distinctive indicators could include building indicators of the full cost of extraction (including e.g. costs of closure and reclamation of batteries etc) and the full potential value-in-the-ground for host countries (including moving downstream).

Data licensing and IP issues

Points for consideration

138. Suppliers provide data for a finite time under a subscription model. Data integration into other datasets in an information system could lead to vendor lock-in. Once a subscription contract ends, disaggregation and deletion of linked datasets could be difficult.

139. Data suppliers sell data to multiple government departments on multiple occasions, which can be costly. A single commercial cross-government data acquisition model could save time, cost and duplication while enabling data transparency.

140. Data sharing among multiple government departments with distinct contractual needs can also pose issues. A unified Non-Disclosure Agreement or MoU and a single cross-government data licensing point could help.

141. A static privacy notice hard-coded on data collection purposes, as under GDPR, requires participants' consent to any subsequent changes. This issue applies to data suppliers, third parties, and government departments.

142. Publicly available data can be pooled, subject to legal advice.

143. Geological data or information, such as chemical analysis for mine exploration, would ideally be treated as national assets. This would enable tracing of information back to its source without loss or duplication.

144. Different international jurisdictions have different ability to compel data acquisition (e.g., U.S. Energy Act 2020).

CriMMIS Terms of Reference and Governance

Points for consideration

145. This working group suggested amendments to draft Terms of Reference (Annex D).
    - Rather than reporting "abnormal market conditions", much better to refer to the mechanism being used to forecast "potential choke points";
    - Timescales need to be included – they are very different to AMIS and tend to be longer;
    - Incorporate the SDGs and ESGs;
    - Need to reflect circularity of markets and whole value chains;
    - Policy and trade coordination is the framing principle – a global common purpose. The challenge is not shortage of minerals but ensuring supply is sustainable and resilient.
    - Essential to include refining and processing as well as producing in the scope;
    - Drawing together public and private sector actors critical: it can't a case of the private sector handing over information. Balancing ownership of the mechanism will be important;
    - What is the incentive to draw in private sector – *cost reduction*;
    - The hierarchy/schematic of the main players – see that attached pic of Paul's diagram
        - Private sector: producers, processors, end-users
        - Intermediates (e.g. Geological Surveys)
        - International organisations
        - Where do governments fit/work in the above? As enablers – engage/pressurise/incentivise private sectors, use groupings like G7, G20;
    - Different levels of engagement and sharing – private sector will not be willing to share as much info as public sector. Hence tiering – bulk data and standardised data.
    - Again, processing, refinement and recycling to be included on the list;
    - Relevant waste also to be included;
    - Pricing issue will be tricky, but previous group looked at that;
    - Timescales – group favoured rolling annual forecasts, looking 5 years out. Possible ad hoc ones where circumstances warrant them;
    - Recycling and reuse issue – "design to recycle"

Conclusions

146. Summary conference recommendations highlight:

- the importance of strong and clear political backing including cross-sector communications coupled with sufficient independence from political dynamics to ensure trust;
- the importance of cooperation including collaboration to address imbalances of power and markets, strategic partnerships, action at a global scale with input from BRICS and other blocs, and consideration of data interoperability requirements needed;
- the need to consider existing initiatives such as the proposed EU Observatory, the role of the World Customs Organisation, and development of the “material passport”;
- the requirement for a data pooling network to use a consistent and widely used unified product classification system, identify data gaps, and support reliability data with industry incentives;
- adoption of consistent terminology along with access to data of required granularity and the relative merits of evolving or revising existing codes and standards;
- ways in which data-driven technologies can enhance system design provided that standards, economic and diplomatic efforts are supportive;
- the need for a process to select datasets for inclusion or visibility in an information system;
- the importance of information system validation based on at least one well-understood mineral;
- recognition of disparate business models applicable for “critical” versus “strategic” minerals;
- prioritisation of minerals to enable system launch while recognising that granularity or frequency of co-product data may not match that of other minerals;
- need for corporate buy-in for reporting of low-volume materials;
- importance of parallel geo-metallurgical research collaborations and options to improve trade reporting;
- need for CriMMIS to be an open initiative, not to be seen as an exclusive or “rich country club”; and
- need for trial scoping and delivery to provide a minimum viable approach and to involve all sectors as convened through the conference process

Simon Strickland
Wilton Park | August 2023

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ANNEX A. PARTICIPATION IN 2023 WILTON PARK CONFERENCE ON A CRITICAL MINERALS INFORMATION-SHARING INITIATIVE

National authorities	International organisations	Private enterprise / civil society	Research / think-tank communities
Argentina	International Council on Mining and Metals	Société Générale	British Geological Survey
Chile	OECD	Satarla	United States Geological Survey
France	UN Economic Commission for Europe	Rolls Royce	University of Exeter
Germany	World Trade Organisation	Teck Resources	Imperial College London
Japan	Extractive Industries Transparency Initiative	Critical Minerals Association	Institute of Urban Environment, Chinese National Academy of Sciences
South Korea	Agricultural Markets Information System	Everledger	Politecnico di Torino, Italy
United States	UN Economic Commission for Africa	Johnson Matthey	
United Kingdom	World Economic Forum	London Metal Exchange	
		Mines to Markets, PACT	
		Rare Earth Industry Association	
		Benchmark Mineral Intelligence	
		Chainvine	
		Trafigura	

ANNEX B. Background briefing note on the role of the UN Framework Classification and UN Resource Management System

The role of the United Nations Framework Classification (UNFC) and United Nations Resource Management System (UNRMS) in the management of critical raw materials

The way that that society explores and exploits raw materials is undergoing significant change, owing to greater scrutiny on the sustainability of mineral supply chains and associated environmental and social issues. This is principally driven by the need to decarbonise, in response to anthropogenic climate change, and to reduce our environmental footprint to address biodiversity issues and habitat loss. This has resulted in ever increasing demands from both national governments and consumers for increased transparency in where raw materials are sourced from, and greater emphasis on ensuring supply chains remain secure and resilient and meet sustainability objectives.

As a result, it is likely that there will be increasing demands on minerals data to meet these policy requirements. This will require improved understanding of data, alignment of data and new tools to enable data to be presented in a consistent and understandable way to a wide range of stakeholders. Two such tools have been developed by the UN Economic Commission for Europe (UNECE). These are the United Nations Framework Classification (UNFC) and United Nations Resource Management System (UNRMS). These have been designed to improve understanding and the management of mineral resources and to support the development of more sustainable supply chains.

The UNFC is a system for capturing resource (fossil fuels, mineral resources, renewable energy, etc.) data in line with the needs of organisations that are responsible for national and regional planning. It operates on the basis of classifying projects on three separate axes: environmental-socio-economic viability (E-category); field project status and feasibility (F-category); and degree of confidence in the estimate (G-category). See Figure 1.

Various analytical methods and reporting systems exist globally. CRIRSCO (Committee for Mineral Reserves International Reporting Standards) defines industry templates, such as the Australian Joint Ore Reserves Committee (JORC) code. These are designed for ensuring investor confidence for reporting data to international stock exchanges. CRIRSCO's template does not allow for reporting of what may be deemed "uneconomic" at a given time, indicating significant limitations in the value of such data particularly with respect to by-products, such as cobalt. Recent findings show that most European statistical agencies and geological survey organisations use a national reporting code or CRIRSCO-compliant codes (however significant efforts are being made to transition to UNFC for national reporting). Major metal reporting systems, such as those of the OECD and Eurostat, tend to use material flow indicators to reflect national economic activity while ignoring minor but critical materials. A separate reporting standard for co- / by-products could lessen use of estimates based on perception of limited economic value, improve data quantification, increase investment in "companion" metal recovery, and enhance market supply elasticities.

A notable difference of the UNFC system compared to CRIRSCO, is that it has the capacity to include projects where the confidence (in the geological, technical or environmental aspects) is low. As a result, the range of deposits considered a 'resource' covers a broad range of situations, including those considered 'uneconomic' and not covered by many industry standards. This can be of considerable benefit in understanding regional and national stocks of mineral resources for strategic planning over long timescales. In this way it supports the development and implementation of appropriate policies to overcome the barriers to project development.

The UNFC is the foundation of the recently developed UNRMS. This a proposed framework to visualise and manage the complete raw materials supply chain. Government policy is increasingly driven by the decarbonisation and circular economy targets, which require a greater focus by industry on all aspects of extraction, from sourcing and emissions to recycling. Examples include the requirement for traceability of supply chains to comply with conflict mineral legislation, or the need for information on recycled contents of batteries, as specified by the Environment Act. Accordingly, tools such as the UNFC and UNRMS, are required to fulfil a need for a global, unifying resource standards that acknowledge the wider environmental, social and economic impacts of resource development.

The main goal of the UNRMS is to develop tools for the sustainable management of resources aligned with the UN Sustainable Development Goals, and with environmental, social and governance aspects at the core. This is different to other established and mature resource management systems, for example the Petroleum Resource Management system (PRMS), where the focus is on the commercial status of projects. The UNRMS is defined by 12 principles aimed at covering all aspects of strong resource governance. See Figure 2.

The UNFC lies at the heart of the UNRMS by providing a system for a harmonised quantification and aggregation of different resource types based on project maturity. The UNRMS can use this information to build a holistic system that integrates all parts of the supply chain (i.e. production, processing, manufacturing, use, end-of-life treatment). In addition, it considers resources not as isolated and independent elements, but integrates different resource types from various sectors and their relationships and effects on one another (e.g., mineral resources and groundwater resources). This is depicted, alongside the UNRMS's relationship to UNFC and various stages in the minerals value chain, in Figure 3.

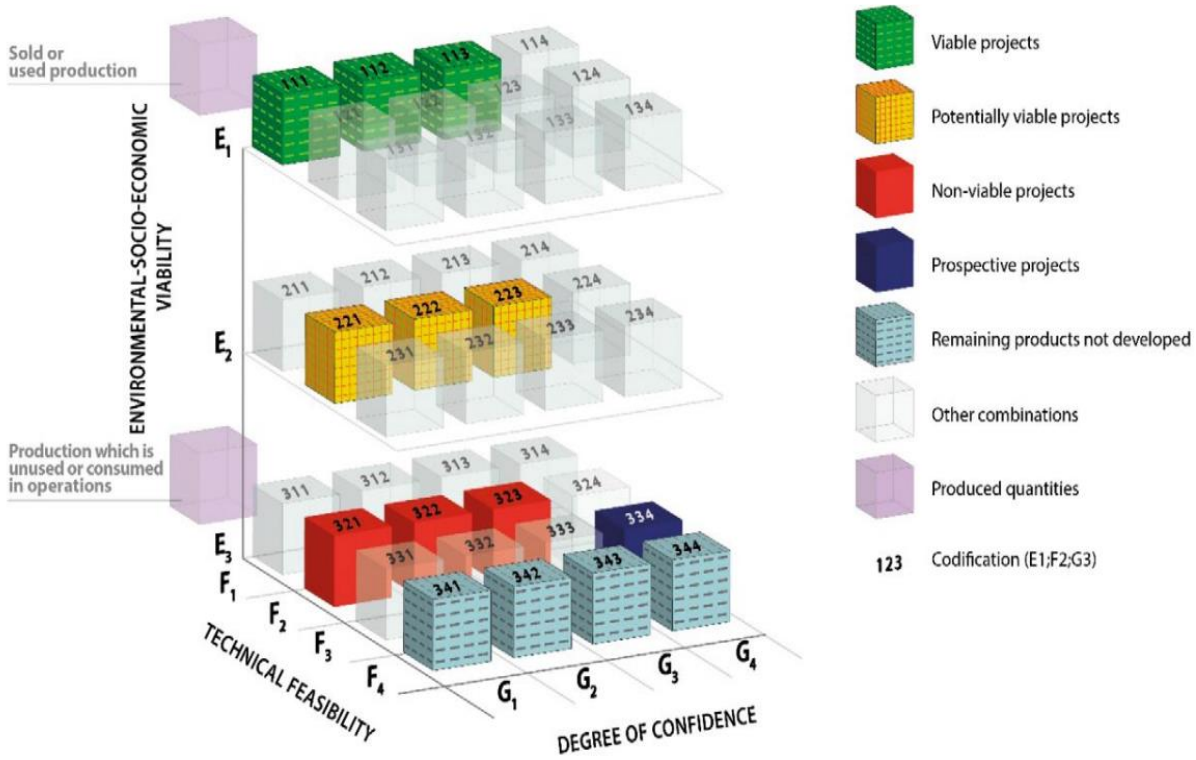

Figure 1. The UNFC classification system. From United Nations Framework Classification for Resources Updated 2019, UNECE, © (2022) United Nations. Reprinted with the permission of the United Nations.

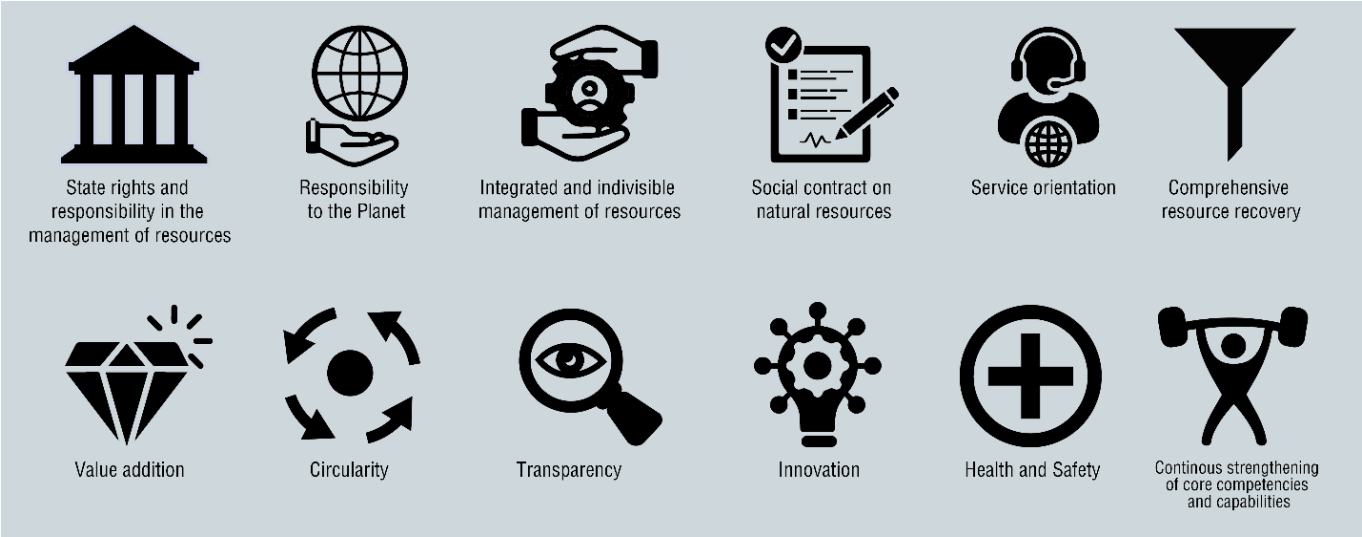

Figure 1. The UNRMS principles.

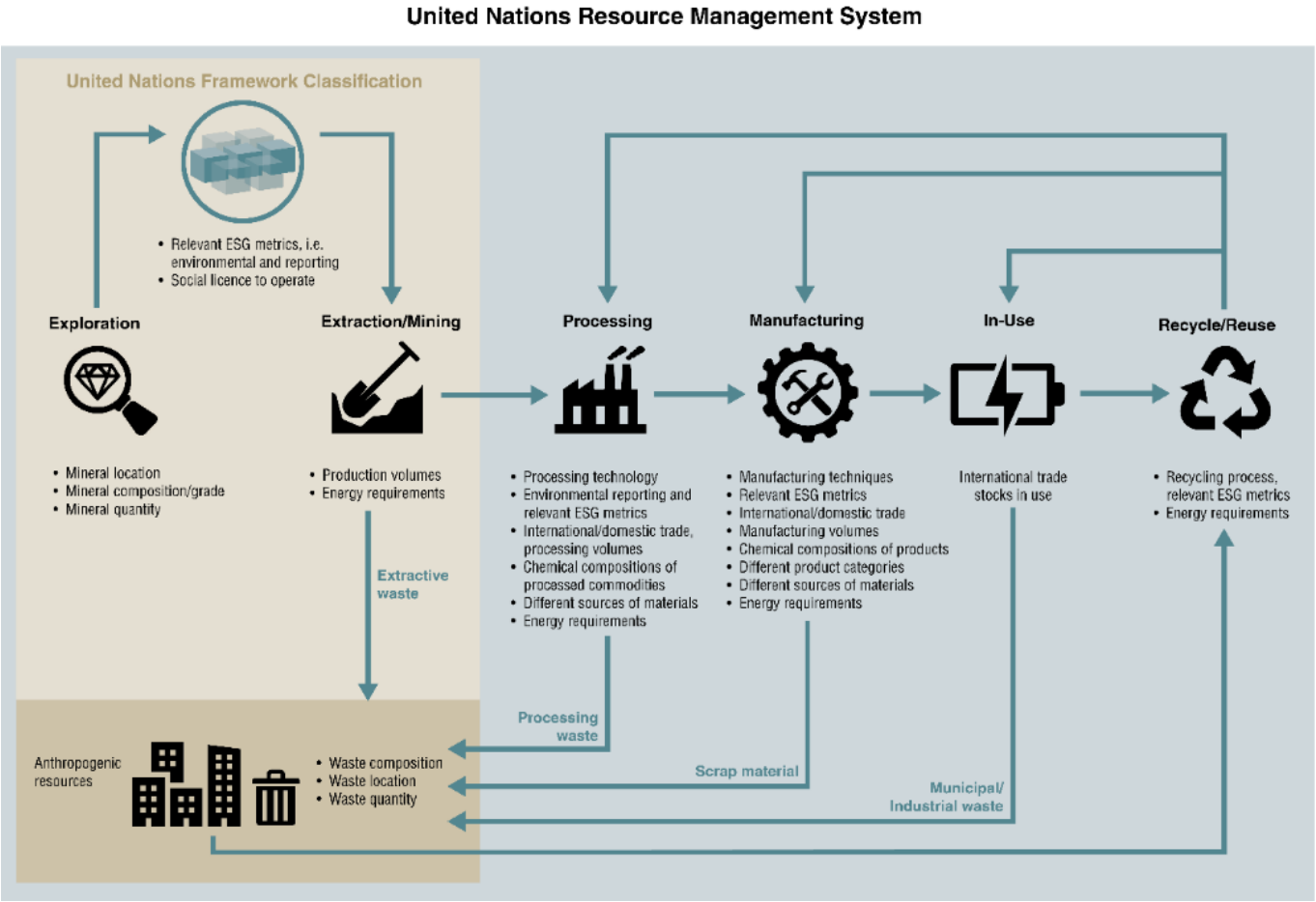

Figure 2. Schematic representation of the UNRMS, showing the value chain and associated data requirements and the linkage to the UNFC. While UNFC assesses data for the exploration and extraction phases, the UNRMS requires data for the whole value chain.

ANNEX C. Background briefing note on approaches to information system design and technology

Questions for discussion:

Q.1 How can information system design, indicators and standards resolve data interoperability issues?

Q.2 How far can data-driven technologies help to improve information system design?

Statement of the problem:

Several critical materials are fundamental to strategies for electrification, the green economy, and delivering Net Zero by 2050. REE permanent magnets are one example, where many countries are exposed to significant supply chain risks. These will intensify in coming years, as the International Energy Agency has emphasised. These products and their materials can be maintained and circulated within the economy at much higher value (x50) for much longer time periods (x20) than is currently the case. To achieve this requires system-wide innovations, enabled by information system design and technologies to make data on these material stocks and flows within the economy ***visible, verifiable and significantly more valuable***. Many of the component parts of such systems are in place or available, but currently disjointed and lack co-ordination.

Many sectors have pivotal roles to play in enabling such systems and transitions, including governments through their ability to convene stakeholders across multiple sectors and fora. Collection and analysis of information on the supply, demand, and market dynamics of critical minerals enable development of evidence-based policies designed to improve resilience of critical minerals value chains. Use cases can show how data pooling and data trust frameworks can bring government, industry and civil society together to identify value creation opportunities in a safe, trusted environment. This will reduce the need for costly one-off, linear data collection models while enabling multi-lateral data interoperability for the wider public good. Tech-enabled platforms are developing in international trade, as traders recognise the fragility of their supply chains and how greater transparency and accountability in them can provide both commercial and compliance benefits. To date such information systems have been developed for some activities. Data visibility of products, by-products, materials in use and as they flow through economic systems offer significant untapped value creation opportunities. These are often fragmented, invisible or obscured, losing the potential for capturing multiple environmental, social and governance (ESG) benefits.

The ability to pool, access, and process data from multiple sources without losing or mis-interpreting information and while preserving both commercial confidentiality and customer privacy, is a key feature of trustworthy and up-to-date information system design. This is commonly known as data interoperability, a key enabler for efficient operations, storytelling, visualisation, and scenarios testing at system level.

Key challenges in data interoperability

1. **Lack of standardisation** – Data holders often pool and process data and information to address their organisational needs. Adoption of globally recognised data standards varies depending on their business needs.
2. **Consent** – Data holders cannot share data with external parties without expressed consent. Even with previous consent, organisations are cautious and tend not to share information. New models for data access based on, for example, Zero Knowledge Proof are not widely understood.

3. **Administrative burden on usable data** – Currently, information is often stored on different platforms in different formats that are frequently not inter-operable. A team of data and business experts is needed to systematically clean, interpret, map, and link information before such data can be structured to an agreed format for use.
4. **Data protection, security and disclosure control** – Rigorous penetration testing with appropriate/tailored accessing control and ethics assessments are necessary to protect data subjects and provide assurance. There are challenging trade-offs between utility (granular data) and information privacy (sensitive commercial data protection). Appropriate data governance processes must be applied to meet data statutory constraints (General Data Protection Regulation (GDPR) and competition law). Different global models for data management (logistical, operational, and strategic) are also needed – not just to meet the current use case, but because the increasing use of distributed systems demands it.
5. **Data sensitivity and classification** – Currently, many information systems have isolated data storage systems for different classifications and access controls. As more data are pooled into a centralised data storage infrastructure, information security classifications can be highly complex and challenging to process in a timely manner. Appropriate data security protocols are necessary to prevent any data breach including through "jigsaw effects".
6. **Organisational culture, industry incentives and overall cost of data pooling** – Since industry, government and civil society stakeholders can also vary in organisational culture, the timescale to achieve consensus can be long and unpredictable. Some data suppliers would rather lose sales opportunities than their competitive edge in the market. Even if successfully negotiated, data-sharing agreements may be bi-lateral rather than multi-lateral. With a long and unpredictable lead time, and often a limited number of experts available, outcomes may only reflect an analytical snapshot in time.

Some opportunities and tools

1. New techniques for the **"pooling" of data** without having to expose raw data between competitors are available but are yet to be proven at scale. By deploying distributed systems, mutual accounting and Zero Knowledge Proof, global systems can be developed that enable controlled access to significant datasets, thus reducing the huge amount of replication of data involved in international trade. Governments globally may be able to play a catalytic role in facilitating data pooling networks and the identification and quantification of the commercial and policy delivery benefits that can accrue to all from participation in such networks.
2. Technology deployment in **"utility" platforms** (not controlled by one or a syndicate of commercial entities) would enable the assurance of, and access to, data in broadly real time. Building on systems that already exist and are in commercial use, "utility" platform technology can work to assure not just the individual elements of an international transaction but can enable data analysis and insight derivation. For example, Artificial Intelligence (AI) in the background can highlight anomalies and flag risks. This would enable stakeholders globally to work together across sectors to maintain and enhance supply chain security in the future.
3. **Networks** of Digital Economy Agreements (DEAs) and Free Trade Agreement (FTAs) are developing, and more and more jurisdictions are in the process of enacting legislation along the lines of a Model Law on Electronic Transferable Records (MLETR). These can provide the legal frameworks that take utility systems and digital trade out of the private law area and into universal public law implementation. National authorities then have the opportunity to provide the anchor by which supply chain management can become "digital by default" and thus more secure and accountable for all.

4. A **catalogue of the best standards** applicable in data format, capture and access can provide the basis for data interoperability. This requires three elements: the legislative/treaty-based authority provided by governments; the standards provided by impartial global organisations; and the technology provided by the world's leading tech suppliers. International cooperation within pre-competitive frameworks could enable an open and collaborative approach to building utility capability.

There is broad recognition that greater transparency, based on properly protected data-pooling processes, offers a strategically fruitful way to reduce critical minerals supply chain risks. Industry-specific interests and competitive market engagement coupled with a wide range of stakeholder communities, however, point to a need for all parties to work together to develop the capability needed.

Alongside the international diplomatic and regulatory arrangements, there is a need for practical testing, assuring and eventual implementation of the sorts of platforms and systems required to improve critical minerals market resilience.

Some representative examples of use cases/technologies for data pooling network pilots around the world are:

1. UNECE Cotton Chain Use case: Harnessing the potential of blockchain technology for due diligence and sustainability. [ECE_TRADE_C_CEFACT_2021_12E-TextilePolicyBrief_0.pdf (unece.org)]
2. UNECE Leather Supply chain Use case. [PowerPoint Presentation (unece.org)]
3. UNECE Sustainability pilots [UNECE-Blockchain-Pilot-Infographic.pdf]
4. Catena-X Automotive Data Exchange Network: The data ecosystem based on preliminary work of Gaia-X and International Data Space Association
5. Proposal for a climate data utility: The idea is that this will be, amongst other, fuelled by data from the implementation of the EU Corporate Sustainability Reporting Directive (CSRD), which will require machine readable reporting with data from 50,000 European companies.[Climate Data Steering Committee Proposes Recommendations for the Development of First-Ever Publicly Accessible Climate Data Utility | Glasgow Financial Alliance for Net Zero (gfanzero.com)]
6. Everledger's Critical Minerals Pilot with the Australian Government [https://everledger.io]

Note that none has been fully implemented into a complete inter-operable information system. A UK use case on Rare Earth Element Permanent Magnets provides one example of how data pooling can drive proof of value within critical supply chains.

ANNEX D: REVISED DRAFT CRIMMIS TERMS OF REFERENCE

1. CriMMIS is an initiative of a group of countries sharing a concern for the efficient, transparent and reliable function of critical minerals markets worldwide[4]. It is a global market information-sharing initiative concerning itself, at least initially, with matters relating to a defined set of minerals and metals critical for achievement of globally shared objectives such as sustainable development goals consistent with the Paris 2015 Climate Accord[5]. Subject to agreement on its practical scope, a trial set of minerals may comprise some or all of: Cobalt, Lithium, Graphite, and the Rare Earth Elements.

2. CriMMIS recognises that the challenge is not a shortage of minerals but ensuring that supply is sustainable and resilient as a globally common purpose. CriMMIS is therefore designed to:
   a. improve critical minerals market information, analyses and forecasts at both national and international levels;
   b. report on potential choke points[6] in international market conditions, including structural weaknesses, as appropriate and strengthen global early warning capacity on these movements, including with reference to relevant time-scales;
   c. collect and analyse policy information, promote dialogue and responses, and international policy and trade coordination in relation to a global common purpose in terms of Sustainable Development Goals and Environmental, Social and Governance standards, throughout value chains reflecting the circular economy in markets, and to ensure sustainable and resilient supplies; and
   d. build data collection capacity in participating countries.

3. This is an open initiative. However, in a first step it will be the result of a collaborative trial between main producing, exporting, refining, processing, and importing countries, in association with international organisations, and drawing together private and public sector actors. The model is a form of balanced ownership on conditions to be defined by participating countries and designed to enable market cost reduction, including through levels of engagement and standardisation of data. The participation of any new country is approved by the participants. Participants comprise private sector producers, processors and end-users; intermediates such as geological surveys; international organisations; and national authorities as enablers including through fora such as G7 and G20. CriMMIS operates, to the extent possible, by electronic means in order to promote efficiency.

4. In order to ensure the effective discharge of the functions of CriMMIS, participants commit to provide to the CriMMIS Secretariat, as far as practicable, in a regular and timely manner, data and information as requested by the Information Group. This includes:
   - National data and relevant supporting information on production, processing, refining, consumption, waste, recycling, reuse, import, export, stocks and prices for the selected commodities and information concerning the short-term information outlook through rolling annual forecasts looking ahead 5 years, supplemented by ad hoc forecasts where appropriate;
   - Information concerning policy changes likely to impact on the production and trade of the selected commodities;
   - Participation in meetings of the Information Group and Forum;
   - Liaison with the Information Group and Secretariat in the improvement of statistics and information.

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[4] National authorities, international organisations, private sector and other Wilton Park conference participants.
[5] International Energy Agency. 2021. *The role of critical minerals in clean energy transitions* pp.29-30.
[6] The Secretariat will convene, as early as possible, a meeting of experts from international organisations to clarify the concept and definition of "potential choke points" and to work towards the development of a set of indicators to measure such movements.

5. To carry out its functions, CriMMIS is composed of:
   a. **The Secretariat** The Secretariat is formed by the following international organisations and entities: XXX, YYY, ZZZ, AAA[7]. Organisations contributing financial or staff resources to CriMMIS have a decision-making role with respect to the overall planning and day-to-day implementation of CriMMIS. Contributions from the International Organisations to the fulfilment of the functions of the Secretariat will reflect those organisations' comparative advantage and expertise. The Secretariat is housed in XXX headquarters in Place YYY, supports all functions of the Forum and the Information Group of CriMMIS, and fulfils the following functions:
      i. organises the meetings of CriMMIS and prepares documents for the Forum and the Information Group;
      ii. assesses the quality of data provided by participating countries and produces high quality market outlook information products for frequent dissemination;
      iii. assesses capacity development needs in member countries, in coordination with relevant International Organisations, Regional Organisations and supports development of national market information systems; CriMMIS efforts in capacity building will focus on:
         - a manual defining best practices and methods for critical minerals market data collection and analysis;
         - a series of regional training sessions to enhance data collection capacity and to assist in the development of methods for creating critical minerals market outlooks; and
         - the identification, design and implementation of special projects, aiming at enhancing data collection, analysis and outlooks.
      iv. ensures liaison and regular information exchange with its members' organisations, other international organisations and market monitoring agencies;
      v. develops appropriate methods and global indicators in collaboration with the Information Group;
      vi. if warranted, and where there is a particular urgency for policy coordination, draws this to the attention of the Rapid Response Forum ('Forum'), on the basis of work described in para 5(a)i above;
      vii. in collaboration with the Chair, ensures liaison and regular exchange of information with the Secretariat and Office of [a specified global consultation process] XXX;
      viii. receives information on critical minerals security assessments in vulnerable countries from national, regional and international information-sharing systems, such as the XXX and YYY;
      ix. issues press communiqués concerning the activities of CriMMIS, in consultation with the Chair of the Information Group and the Forum;
      x. undertakes such other functions in support of CriMMIS, as required, including for the purposes of cooperative scenario-based stress-testing of the response to market shocks;
      xi. acquires funds for the operation and activities of CriMMIS in conformity with the Financial Regulations and principles of the host organisation; and
      xii. informs the Information Group and the Forum regarding its main activities and outputs.

   b. **The Global Critical Minerals Market Information Group ('Information Group')** The Information Group consists of technical representatives from countries participating in CriMMIS. The

[7] To date, XXX, YYY, ZZZ have taken the lead in setting up the Secretariat or indicated their commitment. Subject to views, such organisations actively engaged on critical minerals issues might include for example AAA, BBB, CCC, DDD, EEE, FFF and GGG.

field of competence of the Information Group covers production, stocks, trade, utilisation and prices (including futures prices). Its members fulfil the following functions:

i. promote the improvement of statistics and information, including the enhancement of national information systems as well as related databases;
ii. act as a conduit to each CriMMIS member country to facilitate the sharing of data and market information;
iii. share improvements on data collection methods and provide the Secretariat with guidance on capacity building;
iv. provide regular reliable, accurate, timely and comparable data regarding the supply and demand position and its probable short term development, as well as regarding prices, of the X commodities covered by CriMMIS so as to support forecasting or “early warning” activity;
v. organise the timely collection of national policy developments that could impact the market situation and outlook, and collation of reports covering critical minerals markets, in particular for commodities covered by CriMMIS; and
vi. work closely with the CriMMIS Secretariat, exchanging relevant information on a timely basis and representing their country at CriMMIS meetings.

c. **The Rapid Response Forum (‘Forum’)** The Forum is composed by Senior Officials from countries participating in CriMMIS. It is designed to promote early discussion among decision-level officials about *abnormal* international market conditions to encourage the coordination of policies and the development of common strategies. In particular, it:

i. promotes early information exchange and discussion on crisis prevention and responses among policy-makers;
ii. assists in mobilising wide and rapid political support for appropriate policy response and actions on issues affecting critical minerals production and markets in times of crisis; and
iii. briefs and maintains a two-way dialogue with the Secretariat and other relevant global organisation(s) on the deliberations of the Forum.