Wood Mackenzie

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New Zealand Critical Minerals List

Prepared for the New Zealand Ministry of Business, Innovation & Employment

Summary

The New Zealand Critical Minerals List has been developed by Wood Mackenzie for the Ministry of Business, Innovation and Employment (MBIE).

New Zealand's Critical Minerals List includes the minerals that are both economically important to New Zealand and whose supply is at risk. This includes minerals that are:

- essential to New Zealand's economy, national security, and technology needs, including renewable energy technologies and components to support our transition to a low emissions future; and/or
- in demand by New Zealand's international partners to enable us to benefit from international economic opportunities, contribute to the diversification of global mineral supply chains and improve the pipeline of the end-use products for which these minerals are essential; and
- susceptible to supply disruptions domestically and internationally. In some instances, New Zealand relies on domestic sources of minerals, but the supply of these minerals can be constrained. Internationally, supply chain disruptions could arise due to global supply shortages, or geopolitical risks.

New Zealand's Critical Minerals List has been developed in consultation with a range of industry stakeholders, through the following steps:

1) Definition of Critical Minerals within the New Zealand context
2) Analysis of New Zealand mineral production, consumption and trade, including analysis of indirect demand through imported goods
3) Data gap analysis and industry consultation to further understand New Zealand mineral requirements and production
4) Development of a Long List identifying minerals produced by and/or essential to New Zealand
5) Supply risk assessment to assess the risk of domestic/international supply disruption for each mineral
6) Public consultation of the Draft Critical Minerals List

Out of this process, the following minerals have been identified by Wood Mackenzie as critical for New Zealand:

Table 1: New Zealand Critical Minerals List

Aggregate & Sand	Aluminium	Antimony	Arsenic	Beryllium
Bismuth	Boron	Cesium	Chromium	Cobalt
Copper	Fluorspar	Gallium	Germanium	Graphite
Indium	Magnesium	Manganese	Molybdenum	Nickel
Niobium	Phosphate	Platinum Group Metals	Potassium (Potash)	Rare Earth Elements
Rubidium	Selenium	Silicon	Strontium	Tellurium
Titanium	Tungsten	Vanadium	Zinc	Zirconium

The New Zealand Critical Minerals List is designed to guide decision making to support supply security for minerals identified as critical through production, recycling and trade relationships. Several minerals which are economically important to New Zealand have not been included on the list as their supply risk was assessed to be low. The Critical Minerals List is being developed within a broader New Zealand Minerals Strategy, which is expected to support a wider range of mineral extraction, processing and recycling projects within New Zealand to deliver economic growth.

Additional detail on the Critical Minerals List is available in Appendix A and an overview of the process followed to develop the List is included in Appendix B.

Appendix A: New Zealand Critical Minerals List (Details)

Table 2: New Zealand Critical Minerals List (Details)

Mineral	Key identified use(s)	Supply Risk Score	NZ Demand	NZ Production	International Partner Critical Minerals List				
					USA	UK	EU	AUS	CAN
Gallium	PV cells and electronics (semiconductors)	8.90	Indirect Demand	N/A	Y	Y	Y	Y	Y
Fluorspar	Used in aluminium production, insulating foams, refrigerants and steel	8.28	Direct Demand	N/A	Y	N	Y	N	Y
Chromium	Stainless steel and other steel alloys	7.58	Direct Demand	Potential future producer	Y	N	N	Y	Y
Germanium	Electronics (semiconductors)	7.20	Indirect Demand	N/A	Y	N	Y	Y	Y
Silicon	Glass, casting sand, nanomaterials and electronics	7.18	Direct Demand	Current producer (unquantified)	N	Y	Y	Y	Y
Platinum Group Metals	Catalysts, hydrogen fuel cells, EVs, electronics and communications	7.18	Direct Demand	Potential future producer	Y	N	Y	Y	Y
Rare Earth Elements	Permanent magnets, glass polishing, ceramics, metal alloys, LEDs, lasers	6.95	Direct Demand	Current producer	Y	Y	Y	Y	Y
Tungsten	Tools for drilling, mining and cutting	6.95	Indirect Demand	Potential future producer	Y	Y	Y	Y	Y
Molybdenum	Steel alloys and high temperature alloys, fertiliser and livestock health	6.75	Direct Demand	N/A	N	N	N	Y	Y
Antimony	Defence, EVs and medical	6.63	Direct Demand	Potential future producer	Y	Y	Y	Y	Y
Indium	Electronics, solders, batteries, PV cells, bearings	6.58	Indirect Demand	N/A	Y	Y	N	Y	Y
Graphite	Battery and energy storage applications	6.58	Direct Demand	N/A	Y	Y	Y	Y	Y
Nickel	Stainless steel and other steel alloys, batteries and energy storage applications	6.53	Direct Demand	N/A	Y	N	N	Y	Y
Aluminium	Packaging, automotive, aerospace, defence	6.43	Direct Demand	Current producer	Y	N	Y	N	Y
Bismuth	Electronics (data storage)	6.35	Direct Demand	Potential future producer	Y	Y	Y	Y	Y
Tellurium	PV cells, electronics	6.33	Direct Demand	N/A	Y	Y	N	Y	Y
Zinc	Anodising, corrosion protection, fertiliser and livestock health	6.25	Direct Demand	N/A	Y	N	N	N	Y
Selenium	PV cells, electronics, fertiliser and livestock health	6.23	Direct Demand	N/A	N	N	N	Y	N
Niobium	High-temperature superalloys	6.13	Indirect Demand	N/A	Y	Y	Y	Y	Y
Manganese	Steel and aluminium alloys, batteries, catalysts, glass, electronics, fertiliser and livestock health	5.93	Direct Demand	N/A	Y	N	Y	Y	Y
Cobalt	Battery and energy storage applications, steel alloys, fertiliser and livestock health	5.88	Direct Demand	Potential future producer	Y	Y	Y	Y	Y
Arsenic	Treatment of wood and electronics (including semiconductors)	5.83	Indirect Demand	Current producer (unquantified)	Y	N	Y	Y	N
Vanadium	Steel and titanium alloys, catalysts, magnets, coatings, battery and energy storage systems	5.68	Direct Demand	Current producer	Y	Y	Y	Y	Y
Strontium	Magnets, alloys and paints	5.58	Direct Demand	N/A	N	N	Y	N	N
Cesium	Cancer treatments, electronics, optics, aerospace and PV cells	5.50	Indirect Demand	Potential future producer	Y	N	N	N	Y
Rubidium	Medical and electronics	5.50	Indirect Demand	Potential future producer	Y	N	N	N	N
Boron	Permanent magnets, electronics, PV cells, fertiliser	5.48	Direct Demand	N/A	N	N	Y	N	N
Magnesium	lightweight alloys, fertiliser and livestock health	5.35	Direct Demand	Potential future producer	Y	Y	Y	Y	Y
Titanium	Aerospace and medical	5.28	Direct Demand	Current producer	Y	N	Y	Y	Y
Beryllium	Aerospace and electronics (semiconductors)	5.10	Indirect Demand	N/A	Y	N	Y	Y	N
Potassium (Potash)	Fertiliser	5.08	Direct Demand	N/A	N	N	N	N	Y
Copper	Power transmission, electronics, EVs, fertiliser and livestock health	5.03	Direct Demand	Potential future producer	N	N	N	N	Y
Zirconium	Fuel cells, auto catalysts, bearings	4.55	Direct Demand	Current producer	Y	N	N	Y	N
Phosphate	Fertiliser, battery and energy storage applications	4.23	Direct Demand	Potential future producer	N	N	Y	N	N
Aggregate & Sand	Roading and construction	2.80	Direct Demand	Current producer	N	N	N	N	N

1. Platinum Group Metals include Iridium, Osmium, Palladium, Platinum, Rhodium and Ruthenium.
2. Rare Earth Elements include Cerium, Dysprosium, Erbium, Europium, Gadolinium, Holmium, Lanthanum, Lutetium, Neodymium, Praseodymium, Promethium, Samarium, Scandium, Terbium, Thulium, Ytterbium and Yttrium.

Appendix B: Critical Minerals List Development Process

The New Zealand Critical Minerals List has been developed by Wood Mackenzie for the Ministry of Business, Innovation and Employment (MBIE). This appendix outlines the process undertaken to formulate the List.

New Zealand's Critical Minerals List has been developed in consultation with a range of industry stakeholders, through the following steps:

1) Definition of Critical Minerals within the New Zealand context
2) Analysis of New Zealand mineral production, consumption and trade, including analysis of indirect demand through imported goods
3) Data gap analysis and industry consultation to further understand New Zealand mineral requirements and production
4) Development of a Long List identifying minerals produced by and/or essential to New Zealand
5) Supply risk assessment to assess the risk of domestic/international supply disruption for each mineral
6) Public consultation of the Draft Critical Minerals List

1. Basis of New Zealand's Critical Minerals List

New Zealand's Critical Minerals List includes the minerals that are both economically important to New Zealand and whose supply is at risk. This includes minerals that are:

- essential to New Zealand's economy, national security, and technology needs, including renewable energy technologies and components to support our transition to a low emissions future; and/or
- in demand by New Zealand's international partners to enable us to benefit from international economic opportunities, contribute to the diversification of global mineral supply chains and improve the pipeline of the end-use products for which these minerals are essential; and
- susceptible to supply disruptions domestically and internationally. In some instances, New Zealand relies on domestic sources of minerals, but the supply of these minerals can be constrained, for example by regulatory factors. Internationally, supply chain disruptions could arise due to global supply shortages or geopolitical risks. The extraction and processing of many minerals is concentrated in few countries. Socio-political disturbance in a country of high minerals concentration could unsettle the international minerals market dynamics and adversely impact import-dependent countries.

1.1. Definitions

As defined by the New Zealand Crown Minerals Act 1991 (CMA), a **Mineral** "means a naturally occurring inorganic substance beneath or at the surface of the earth, whether or not under water and includes all metallic minerals, non-metallic minerals, fuel minerals, precious stones, industrial rocks and building stones, and a prescribed substance within the meaning of the Atomic Energy Act 1945."

For the purposes of this project, additional filters were applied to define the minerals to be assessed:

- exclusion of non-solid minerals (such as mercury and liquid or gaseous hydrocarbons) except for helium and hydrogen
- exclusion of building or decorative stone.

The list of minerals assessed by Wood Mackenzie for the critical minerals assessment expands on the non-exhaustive list of minerals noted in the CMA, and included minerals such as cobalt, graphite, lithium and rare earths.

A **Critical Mineral** includes minerals that are:

- essential to New Zealand's economy, national security, and technology needs, and/or equally important to New Zealand's international partners; and is

- susceptible to supply disruptions domestically and internationally.

Essential is defined as critical to maintaining the New Zealand's economy today and into the future and not readily substitutable.

Wood Mackenzie's analysis has been undertaken considering a 5-year time horizon for New Zealand's mineral requirements, production and supply risk. This timeframe is considered the most suitable to ensure that the resulting Critical Minerals List is focused on current risks and opportunities. Looking forward, it is expected that additional minerals will emerge as essential to New Zealand through technological advancements and resource identification. As per international norms, it is expected that the New Zealand Government will periodically review the Critical Minerals List to ensure it is reflecting current needs and supply risks.

2. New Zealand Essential Minerals

2.1. New Zealand Mineral Demand and Production

Wood Mackenzie completed an initial assessment of mineral demand in New Zealand, including domestic mineral production. To estimate mineral demand in New Zealand, Wood Mackenzie considered the following:

- Mineral production
- Net mineral imports (imports less exports)
- Indirect mineral imports (excludes indirect mineral exports), estimated across the following sectors:
    - Battery Storage
    - Vehicles (Electric vehicles (EVs) including hybrid and battery electric vehicles, Internal Combustion (ICEV))
    - Wind Turbines
    - Solar Panels
    - Appliances/white goods
    - Fertiliser
    - Semiconductors (mineral inputs identified but not quantified due to data availability)
- Total mineral demand in New Zealand is calculated as:
    - Mineral production + net mineral imports (imports less exports) + indirect mineral imports.

New Zealand demand has been categorized as "Direct Demand" where minerals are imported into New Zealand and/or where production is greater than exports. Where New Zealand has been identified as an importer of the goods listed above, containing identified minerals, we have categorized New Zealand as having "indirect demand" for these minerals.

Demand and production data was sourced from various New Zealand government publications, Wood Mackenzie mineral and end-market coverage, the Institute of Geological and Nuclear Sciences Limited (GNS), Global Trade Tracker, United Nations publications as well as through New Zealand industry and stakeholder consultation.

This initial assessment identified 94 minerals which may be essential to New Zealand, for further investigation during stakeholder consultation.

2.2. Consultation Process

Wood Mackenzie sought consultation from over 50 stakeholders within New Zealand, based on a list developed with MBIE and relevant industry bodies. Stakeholders were asked to provide their informed views and data on which minerals they believed to be essential to New Zealand's economy, national security, and technology needs, including renewable energy technologies and components to support New Zealand's transition to a low emissions future. They were also encouraged to provide any information regarding the current production and potential future supply within New Zealand

of the 94 minerals identified in the initial assessment. Additionally, the stakeholders were also given the opportunity to suggest any further minerals or products to be considered.

Industry consultation was conducted via a survey and/or a meeting. Wood Mackenzie received twenty-three survey responses and conducted 14 meetings, culminating in the further refinement of the NZ demand and supply data.

2.3. Determining New Zealand's essential minerals

Wood Mackenzie assessed the information gathered through market and trade analysis and from industry consultation to identify the minerals which were essential to New Zealand's economy, security and technology needs. Demand and supply volumes were assessed, providing a measure of economic importance to New Zealand. However, mineral essentiality was considered on a binary basis (minerals produced or required at any scale were included where they were in scope). The inclusion of minerals even where demand or supply volumes were small was considered important as in many instances small volumes of un-substitutable minerals are required in technological or security applications, with significant downstream economic implications if these minerals are unavailable.

Through this process, supply and demand data and information provided through stakeholder consultation was assessed to provide the following outcomes:

- A total of 79 minerals were identified as essential to New Zealand, making up the Long List which proceeded to the supply risk assessment.

  These include: aluminium, antimony, arsenic, barite (barium), beryllium, bismuth, boron, cadmium, carbon, cesium, chromium, cobalt, copper, fluorspar, gallium, germanium, gold, graphite, hafnium, helium, hydrogen, indium, iodine, iron, lead, lithium, magnesium, manganese, metallurgical coal, molybdenum, nickel, niobium, nitrogen, phosphate, phosphorus, iridium, osmium, palladium, platinum, rhodium, ruthenium, potassium (potash), cerium, dysprosium, erbium, europium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, promethium, samarium, scandium, terbium, thulium, ytterbium, yttrium, rhenium, rubidium, selenium, silicon (including high purity silica sand), silver, strontium, sulphur, tantalum, tellurium, thermal coal, thorium, tin, titanium, tungsten, vanadium, zinc, zirconium, aggregate & sand, lime (including limestone and dolomite) and garnet.

- A further 34 minerals were assessed through consultation but ultimately excluded from the Long List due to one of the following reasons: lack of New Zealand demand; not having a defined chemical composition, where constituent element(s) were captured individually or being deemed out of scope.

  These include: alumina (high-purity), argon, bauxite, bromine, chlorine, feldspar, fluorine, neon, neptunium, plutonium, radium, sodium, thallium, uranium, cement, olivine, asphalt, natural pozzolans, bentonite clay, ceramic-grade clays (halloysite, kaolinite), lignite, serpentine, steel, fertilizer, petroleum and gas, oxygen, diatomaceous earth, monazite, xenotime, anatase, ilmenite, rutile, synthetic rutile and calcium.

3. Supply Risk Assessment

3.1. Supply risk methodology

The 79 minerals on the Long List were subject to a global market supply risk assessment to determine their criticality. From this process, the essential minerals which have a high risk of supply disruption will be included on the Critical Minerals List.

Supply risk for rare earth elements (REE) and platinum group metals (PGM) were considered collectively, as they are generally grouped on international partner country Critical Minerals Lists.

The supply risk assessment assessed each mineral identified in the Long List against 6 supply risk criteria, culminating in overall supply risk scores for each mineral. The supply risk assessment methodology was developed based on consideration of factors which are likely to indicate a heightened risk for New Zealand's mineral sourcing, as well as considering how various partner nations developed their respective critical minerals lists. All the six metrics used for the New Zealand supply risk assessment have been used by one or more international partner countries: trade data and import dependence (Australia, USA), mineral market balance outlook (US, EU), reserve availability (EU), supply concentration (Australia, USA) and supply country risk (USA).

The six selected metrics for the supply risk assessment quantify the risks to the New Zealand and the global supply chain for each mineral:

1) New Zealand import dependence
2) New Zealand net import dependence
3) Global 2029 market balance
4) Global reserve availability
5) Global supply concentration
6) Global supply country risk

These six metrics were each given a weighting based on their likelihood of causing a supply disruption. A score was calculated for each metric for every mineral. When combined with the weightings these were summed to provide an overall supply risk score for each mineral as outlined in Table 3.

Table 3: Supply risk assessment score weightings and calculations

Mineral	Score	Weighting[1]	Total Score
Mineral #1	New Zealand import dependence	7.5%	Score x Weighting
	New Zealand net import dependence	7.5%	Score x Weighting
	Global 2029 market balance	42.5%	Score x Weighting
	Global reserve availability	5.0%	Score x Weighting
	Global supply concentration	25.0%	Score x Weighting
	Global supply country risk	12.5%	Score x Weighting
Mineral #1	Total	100%	Total of the Score x Weightings

Note: 1. Weighting sensitivity analysis has been undertaken and is described below.

1. New Zealand import dependence

To measure how reliant New Zealand is on imports for each mineral, a score was produced considering the domestic consumption (direct and indirect) versus the imports (direct and indirect) for each mineral. The imports (direct and indirect) relative to the domestic consumption (direct and indirect) determined the import dependence score.

Table 4: Import dependence score

Import dependency (%)	Score
0%	0
10%	1
20%	2
30%	3
40%	4
50%	5
60%	6
70%	7
80%	8
90%	9
100%	10

2. New Zealand net import dependence

Similar to the previous score but the net import dependency factors in the domestic production of minerals, with the score determined according to the same scale presented in Table 4, following comparison of percentage of the net imports (imports minus exports) to the domestic demand.

The rationale for including the two metrics, import dependence and net import dependence, is to differentiate the impacts for minerals that New Zealand imports and secondly, the minerals that New Zealand exports (and produces), which may act as an offset to limit any supply disruption to imports.

3. Global 2029 market balance

Global shortages of minerals are expected to have a significant impact on the ability for New Zealand and international partners to secure required minerals. A 5-year time horizon has been selected to keep the current edition of the New Zealand Critical Minerals List focused on near-term supply risk.

A global market balance percentage has been calculated for each mineral where data is available, calculated from the global market balance (surplus or deficit) as a percentage of global annual demand. Scores have then been assigned based on the market balance percentage, with a high score indicating a forecast deficit, and low score indicating a forecast surplus (Table 5).

Table 5: Market balance score

Market balance (%)	Score
-12.5% (and less)	10
-10.0%	9
-7.5%	8
-5.0%	7
-2.5%	6
0%	5
2.5%	4
5.0%	3
7.5%	2
10.0%	1
12.5% (and greater)	0

For minerals where an adequate market balance forecast for 2029 was not available, price volatility over the previous 10 years (2014-2023) was used as a proxy. As price spikes usually indicate market tightness, this is a reasonable indicator of markets which experience shortages. A price spike was defined as price movement of greater than 50% in a 12-month period, with the score given according to the number of spikes, as detailed in Table 6.

Table 6: Price spike history score

No. of price spikes (>50% move over 12-month period) in last 10 years (2014 onwards)	Score
0	0
1	2
2	4
3	6
4	8
5 (and greater)	10

4. Global reserve availability

The availability of large global reserves for a mineral provides additional security against supply disruptions, as identified reserves can be extracted to increase supply to mitigate expected shortages, though usually with significant lead times. Global reserves as a multiple of current annual global production have therefore been assessed for each mineral as an additional measure of supply risk, with scores attributed as per Table 7.

Table 7: Global supply availability score

Global reserves / production multiplier	Score
<= 5	10
<=10 and > 5	9
<=15 and > 10	8
<=20 and > 15	7
<=25 and > 20	6
<=30 and > 25	5
<=35 and > 30	4
<=40 and > 35	3

<=45 and > 40	2
<=50 and > 45	1
> 50	0

5. Global supply concentration

The assessment of supply concentration was undertaken globally, except in two cases where high-volume minerals are sourced domestically due to market economics (aggregate & sand, and lime). The 2023 market share of the top 5 countries producing the relevant mineral was assessed, based on data availability.

Measurement of supply was based on a combination of refined supply (where available), or mined production. Refined supply was prioritised to account for processing concentration/bottlenecks.

Wood Mackenzie has used the well-known Herfindal Hirschman Index (HHI) approach to determine a supply concentration score for each mineral. The score is calculated by squaring the relevant market share and tallying up the squares of market shares to derive a score between 1 and 10,000.

Industries that are highly concentrated, e.g. where individual countries produce a significant portion of the mineral are classified as having a high industry concentration and are given a score of 10. At the other end of the spectrum, where production of minerals is highly diverse, and as a result has a low industry concentration, these are given a score of 0.

The HHI ranks supply concentration, and scores adopted by Wood Mackenzie for this metric of assessment are as follows:

Table 8: HHI and global supply concentration score

HHI score	HHI industry concentration	Score
1 – 1,500	Low	0
1,500 – 2,500	Medium	5
<=15 and > 10	High	10

6. Global supply country risk

Wood Mackenzie assessed supply country risk by extending the analysis for global supply concentration. Wood Mackenzie utilised the Fraser Institute's Investment Attractiveness Index (2023) as a proxy for supply risk. The Fraser Institute is a Canadian research NGO which conducts a Mining Survey to assess the relative investment attractiveness across global mining locations. In 2023, 293 senior executives scored 57 countries for their attractiveness for mining investment. A higher score on the index results in lower supply risk, while a lower score on the index results in a higher supply risk.

For each country (top 5) or producer (in New Zealand for aggregate & sand, and lime), Wood Mackenzie utilised the country risk score, which was multiplied by the market share, then divided by the total market share of the top 5 producers, to determine an aggregate supply country risk rating for each mineral as detailed in Table 9.

Table 9: Supply country risk assessment and calculations

Supply country market share	Market share (%)	Country risk score	Market share (%) * country risk score
Country 1	X	Y	X * Y
Country 2	X	Y	X * Y
Country 3	X	Y	X * Y
Country 4	X	Y	X * Y
Country 5	X	Y	X * Y
Total			Sum (X * Y)

The aggregate scores for each mineral were then assessed on the following range to determine whether the mineral was deemed to have low, moderate or high supply country risk, including scores.

Table 10: Supply country risk score

Supply country risk classification	Supply country risk score	Score
>=50	Low	0
<50, >=25	Moderate	5
<25	High	10

Table 11: 2023 Fraser Institute investment attractiveness score

Country	Investment attractiveness score (2023)	Country	Investment attractiveness score (2023)	Country	Investment attractiveness score (2023)
Botswana	76.9	Greenland	53.0	Bulgaria	38.9
United States	75.7	Angola	52.5	Portugal	38.7
Finland	75.7	Spain	50.5	Uganda	38.4
Sweden	75.6	Northern Ireland	48.9	India	38.2
Canada	72.5	Mauritania	48.5	Mali	38.0
Australia	72.4	Turkey	46.7	Colombia	36.9
Morocco	69.6	Tanzania	46.4	Philippines	36.9
Brazil	68.5	Guinea	46.0	Liberia	36.7
Fiji	68.2	South Sudan	45.4	Mexico	36.5
Zambia	64.2	Indonesia	45.2	Vietnam	36.5
Ireland	63.9	PNG	44.9	Cambodia	36.4
Argentina	63.9	Ghana	44.4	Bolivia	36.3
Norway	62.1	Peru	44.0	Kazakhstan	36.1
Chile	59.8	Thailand	43.3	Senegal	35.9
Serbia	56.5	DRC	43.0	Zimbabwe	33.4
Namibia	56.4	South Africa	41.8	Mozambique	31.9
New Zealand	55.8	Mongolia	41.7	Solomon Islands	25.2
Ivory Coast	55.7	Ecuador	40.7	China	19.1
Kenya	55.2	Burkina Faso	39.0	Niger	14.6

Supply risk metrics 5 and 6 (concentration and country risk), look to measure the risk of global economic and trade disruption for each assessed essential mineral, therefore considering the potential impact of changes to global trading conditions or geopolitical events. The supply impact of 'Black swan' catastrophic global events or long-term impacts of climate change on mineral supply (or New Zealand requirements) has not been considered in this assessment, given the 5-year time horizon.

3.2. Supply Risk Assessment Sensitivity Analysis

The relative weighting of the six supply risk assessment scores, detailed in Table 3, was subject to a sensitivity analysis to confirm the robustness of the supply risk assessment. 10 scenarios were run, with each supply risk assessment score's weighting adjusted as outlined in Table 12.

Table 12: Supply risk assessment score sensitivity scenarios

Supply risk assessment score	Original	S1	S2	S3	S4	S5
Market balance	42.5%	**32.5%**	**27.5%**	**50%**	**35%**	**30%**
Import dependency	7.5%	**12.5%**	**15%**	7.5%	7.5%	7.5%
Net import dependency	7.5%	**12.5%**	**15%**	7.5%	7.5%	7.5%
Global reserve availability	5%	5%	5%	5%	5%	5%
Market concentration	25%	25%	25%	**17.5%**	25%	25%
Supply risk country rating	12.5%	12.5%	12.5%	12.5%	**20%**	**25%**
Supply risk assessment score	**Original**	**S6**	**S7**	**S8**	**S9**	**S10**
Market balance	42.5%	42.5%	**40%**	**35%**	42.5%	**32.5%**
Import dependency	7.5%	7.5%	7.5%	7.5%	**10%**	7.5%
Net import dependency	7.5%	7.5%	7.5%	7.5%	**10%**	7.5%
Global reserve availability	5%	5%	5%	**12.5%**	**7.5%**	5%
Market concentration	25%	**30%**	**35%**	25%	**20%**	**30%**

Supply risk country rating	12.5%	**7.5%**	**5%**	12.5%	**10%**	**17.5%**

Throughout the scenarios tested, 29 minerals (including PGM and REE groupings) maintained an overall supply risk score of 5+ in all the scenarios. These include aluminium, antimony, arsenic, bismuth, cadmium, chromium, cobalt, copper, fluorspar, gallium, garnet, germanium, graphite, indium, lead, manganese, molybdenum, nickel, niobium, PGM, REE, selenium, silicon, strontium, tellurium, tungsten, vanadium and zinc. The overall consistency in the scoring of these minerals added additional confidence in the overall process.

An additional 7 minerals received an overall supply risk score of 5+ in at least 8 scenarios (out of 11, including the base case scenario), as described in Table 13. Phosphate and Aggregate & Sand did not gain a score of 5+ in a significant number of scenarios, however their inclusion in the Critical Minerals List is discussed below.

Table 13: Supply risk assessment score sensitivity results for marginal minerals

Mineral	% of scenarios, scored >= 5
Boron	91%
Cesium	91%
Potassium (Potash)	91%
Rubidium	91%
Magnesium	82%
Beryllium	73%
Titanium	73%
Phosphate	18%
Aggregate & Sand	0%

Of the minerals on the Long List which did not make the Critical Minerals List, Table 14 illustrates what proportion of the sensitivity scenarios they scored above or equal to a five.

Table 14: Supply risk assessment score sensitivity results for excluded minerals

Mineral	% of scenarios, scored >= 5
Cadmium	100%
Garnet	100%
Lead	100%
Lithium	73%
Thorium	73%
Thermal Coal	45%
Helium	45%
Rhenium	27%
Hafnium	18%
Tantalum	18%
Barite (Barium)	9%
Gold	9%
Iodine	9%
Tin	9%
Metallurgical Coal	0%
Hydrogen	0%
Iron	0%
Lime (including Limestone and Dolomite)	0%
Silver	0%

The reasoning behind the omission of cadmium, garnet and lead from the Critical Minerals List is below.

The supply risk assessment sensitivity analysis confirmed the consistency in which the process identifies many minerals with an elevated supply risk, independent of the selected weighting. This provides confidence in the overall supply risk process and that the weightings described in Table 3 are appropriate.

3.3. Supply Risk Assessment Outcomes

The supply risk assessment returned the following outcomes, detailed in Table 15 below:

- 35 minerals were recommended by Wood Mackenzie for inclusion on New Zealand's Critical Minerals List.
    - 32 of the included minerals received a supply risk score of 5+, are believed to have an elevated supply risk and were recommended for inclusion in the Critical Minerals List.
    - The 19 minerals which scored below 5 on the supply risk assessment were subject to further scrutiny. Through this process zirconium, phosphate and aggregate & sand were recommended for inclusion in the Critical Minerals List due to their high level of economic importance to New Zealand.
- Wood Mackenzie recommended the exclusion of 3 minerals which achieved a score above 5, cadmium, garnet and lead. These minerals were recommended for exclusion due to their absence from partner critical minerals lists and their toxicity and discouraged use (in the case of cadmium and lead) and due to the availability of substitute minerals (in the case of garnet).
- Rare earth elements (REE) and platinum group metals (PGM) were considered collectively (similar to partner countries critical minerals lists) for the supply risk assessment. The elements included in each grouping are:
    - Rare earth elements: cerium, dysprosium, erbium, europium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, promethium, samarium, scandium, terbium, thulium, ytterbium and yttrium.
    - Platinum group metals: iridium, osmium, palladium, platinum, rhodium and ruthenium.
- Four minerals were identified as out of scope during the initial stages of the supply risk assessment and were eliminated. These minerals are:
    - Carbon: Excluded as graphite, thermal and metallurgical coal are all individually included for assessment, with other hydrocarbons outside of the scope for this analysis. The trade data for sources of carbon not individually addressed focused around carbon black, a manufactured product, which is out of scope.
    - Phosphorous: Capturing the element under Phosphate as it is more pertinent to New Zealand demand. Non-phosphate phosphorus demand, trade and reserve volumes were not able to be accurately quantified.
    - Sulphur: Omitted as a vast majority (>90%) is produced as a by-product of oil and gas and other industries, not extracted from the ground and therefore out of scope.
    - Nitrogen: Omitted as it is not a mined mineral and the major globally traded nitrogen product, ammonia, is a manufactured product of the oil and gas industry, and therefore out of scope.
- As a result of the regulatory constraints limiting new supply opportunities within NZ, particularly near to the major demand centre in Auckland and the lack of cost-effective alternate sourcing arrangements for New Zealand as a whole, Aggregate and Sand has been elevated and deemed a critical mineral.
- Due to zirconium's importance to the global green hydrogen industry and the established and growing production of zircon sand within New Zealand, zirconium has been elevated and is recommended for inclusion on New Zealand's Critical Mineral List. It is also noted that zirconium deposits are associated with REEs in New Zealand and there is an opportunity for co-production of these critical minerals.
- Due to the broad reaching importance of the agriculture industry to the nation, phosphate, a crucial component of fertilizer, has been elevated and deemed a critical mineral. Wood Mackenzie notes that nitrogen and sulphur are also important minerals for New Zealand's agriculture industry, despite not being included on the Critical Minerals List due to being primarily synthetically manufactured.

Table 15: Supply risk assessment results

Mineral	New Zealand import dependence	New Zealand net import dependence	2029 Market balance	Global supply availability	Market supply concentration	Supply country risk rating	Overall supply risk score	Comment	Recommended Adjustment
Gallium	10	10	8	5	10	10	**8.9**		
Fluorspar	10	10	8	5	10	5	**8.3**		
Chromium	10	10	6	8	10	5	**7.6**		
Germanium	10	10	4	5	10	10	**7.2**		
Silicon	10	10	6	0	10	5	**7.2**		
Platinum Group Metals	10	10	6	0	10	5	**7.2**	Score based on Rhodium (highest scoring PGM)	
Tungsten	10	10	4	0	10	10	**7.0**		
Rare Earth Elements	10	10	4	0	10	10	**7.0**	Score based on Neodymium (highest scoring REE)	
Molybdenum	10	10	5	0	10	5	**6.8**		
Antimony	10	10	4	6	10	5	**6.6**		
Indium	10	10	4	5	10	5	**6.6**		
Graphite	10	10	3	1	10	10	**6.6**		
Garnet	10	0	6	3	10	5	**6.6**	Not elemental but produced in NZ. Substitutes are available for key end use (sandblasting, reducing criticality).	Down
Nickel	10	10	4	4	10	5	**6.5**		
Aluminium	10	0	6	0	10	5	**6.4**		
Bismuth	10	10	2	5	10	10	**6.4**		
Tellurium	10	10	4	0	10	5	**6.3**		
Zinc	10	9	6	8	5	5	**6.3**		
Selenium	10	10	6	6	5	5	**6.2**		
Cadmium	10	10	6	5	5	5	**6.2**	Toxic and use discouraged by the UN. Not on partner CM lists	Down
Niobium	10	10	5	0	10	0	**6.1**		
Manganese	10	10	6	0	5	5	**5.9**		
Cobalt	10	9	3	1	10	5	**5.9**		
Arsenic	10	10	2	7	10	5	**5.8**		
Vanadium	0	0	6	0	10	5	**5.7**		
Strontium	10	0	4	0	10	5	**5.6**		

Cesium	10	10	0	5	10	10	**5.5**		
Rubidium	10	10	0	5	10	10	**5.5**		
Boron	10	10	2	0	10	5	**5.5**		
Magnesium	10	0	2	0	10	10	**5.4**		
Titanium	6	0	4	0	10	5	**5.3**		
Lead	10	0	5	10	5	5	**5.3**	Harmful to human health. Not on partner CM lists.	Down
Beryllium	10	10	2	5	10	0	**5.1**		
Potassium (Potash)	10	10	4	0	5	5	**5.1**		
Copper	10	1	5	4	5	5	**5.0**		
Lithium	10	10	0	6	10	5	**4.9**	Lithium market now in surplus globally through the medium term, therefore less supply risk through to 2029. Partner critical mineral lists developed during periods of deficit.	No change
Thorium	10	10	0	5	10	5	**4.9**	NZ potential supplier long term however unlikely. Radioactive product and not on any partner lists.	No change
Helium	10	10	2	0	10	0	**4.9**	Minimal risk in securing NZ demand	No change
Thermal Coal	1	0	3	6	10	5	**4.8**	Market in surplus, minimal risk in meeting import requirements and alternate supply options.	No change
Zirconium	10	10	4	2	5	0	**4.6**	NZ potential to increase zircon sand supply and association with REEs	Up
Phosphate	10	10	2	0	5	5	**4.2**	Given the importance of supply for the agriculture industry in NZ, this becomes critical.	Up
Tantalum	10	10	2	0	5	5	**4.2**	Limited supply risk but recognised as critical by all partner countries	No change
Tin	10	10	4	8	0	5	**4.2**	Limited qualitative data on future market balance however there are concerns for potential market shortages and on several partner's lists. Risk reduced through diversity of supply	No change
Iodine	10	0	2	0	10	0	**4.1**	Not on any partners lists	No change
Rhenium	10	10	0	0	10	0	**4.0**	Limited NZ demand and on limited number of partner's critical minerals lists	No change
Gold	10	0	5	7	0	5	**3.9**	Minimal risk in securing NZ demand and not on any partner list	No change
Hafnium	10	10	2	5	5	0	**3.9**	Limited NZ demand but recognise it is on several partner's critical minerals lists.	No change
Barite (Barium)	10	10	0	5	5	5	**3.6**	Limited qualitative data on future market balance but on a couple of partner's lists	No change
Hydrogen	1	1	5	0	5	0	**3.5**	Limited risk across the board and not on any partners lists	No change
Metallurgical Coal	5	0	1	3	10	0	**3.5**	Low global supply risk	No change
Silver	10	8	2	7	0	5	**3.2**	Minimal risk in securing NZ demand and not on any partner list	No change
Iron	2	0	0	6	10	0	**3.0**	Low global supply risk	No change
Aggregate & Sand	0	0	6	5	0	0	**2.8**	Regulatory constraints limiting new supply in NZ, alternate sourcing at significantly higher cost.	Up
Lime (including Limestone and Dolomite)	0	0	5	5	0	0	**2.4**	Limited domestic supply risk	No change

4. New Zealand Critical Minerals List Recommendation

A Draft New Zealand Critical Minerals List (Table 1) and accompanying report were circulated by MBIE for public consultation from the 15th of September until the 10th of October 2024.

Feedback on the Draft List was broadly supportive (70%). A number of submitters (25%) provided feedback on ways the selection methodology could be improved or clarified. In response to this, further clarifying and explanatory comments have been added to the report above.

Half of submissions (50%) recommended that additional minerals be included in the Critical Minerals List. In response to this feedback, Wood Mackenzie has provided additional detail on a range of minerals which have been excluded from our recommended Critical Minerals List, based on the supply risk analysis described above. This additional context will allow the New Zealand Government to consider whether any of these minerals should be added to this first or subsequent iterations of the New Zealand Critical Minerals List.

4.1 Additional information on key excluded minerals

Several minerals which New Zealand produces were not deemed critical due to low supply risk, despite being essential to New Zealand and important contributors to the country's economy. Wood Mackenzie notes that the Critical Minerals List is being developed within a broader New Zealand Minerals Strategy, which is expected to support a wider range of mineral extraction, processing and recycling projects within New Zealand to deliver economic growth. Continued New Zealand production of these economically important New Zealand minerals is expected to be supported through the wider New Zealand Minerals Strategy. A discussion of the key minerals produced in New Zealand but excluded from the Critical Minerals List are included in Table 16 below:

Table 16: Key minerals produced in NZ and excluded from the Critical Minerals List

Mineral	Overall supply risk score	Comment on exclusion from NZ Critical Minerals List
Thermal Coal	4.78	New Zealand both exports and imports coal used for its thermal properties, with imported thermal coal used for domestic power production. Supply risk for thermal coal is lowered by the global market surplus forecast in the 2029 for the seaborne market, with Wood Mackenzie forecasting a 7% oversupply in 2029. Conversely, supply risk is increased by the high concentration of global supply from Indonesia and New Zealand's reliance on imports for power generation.
Metallurgical Coal	3.45	Metallurgical coal (based on steelmaking use) was assessed to have a low supply risk due to the large seaborne market surplus forecast by Wood Mackenzie for 2029, equal to approximately 10% of the global market. Although NZ imports metallurgical coal, it is a net exporter of the commodity, reducing supply risk further. Strong global reserves of metallurgical coal also help to mitigate supply risk. Metallurgical coal production is concentrated globally, with 49% of seaborne supply coming from Australia, which increased global supply risk slightly, however Australia has a low country risk rating and is a New Zealand partner.
Gold	3.85	The global market balance for gold is anticipated to be at parity in 2029, lowering the minerals supply risk. Significant reserves and resources of gold are dispersed across the globe; however, China does contribute the largest proportion of mined production, marginally ahead of Australia and the Russian Federation, resulting in a low market concentration score but moderate supply country risk score. Similarly to coal, New Zealand imports gold but is a net exporter of the mineral.

Garnet	6.58	Garnet's supply risk was assessed based on limited information on global market supply and demand. Based on this information, garnet's supply risk was deemed to be high due to a small predicted global market shortage in 2029 and high supply concentration. However, Wood Mackenzie recommends that garnet is not included on New Zealand's Critical Minerals List due to the availability of substitutes and the relatively niche applications for the mineral. Its primary uses of abrasive blasting, water jet cutting, and water filtration are all able to be performed using alternative minerals and products, however it is noted that garnet is considered to have safety advantages compared with major alternatives.

New Zealand's Critical Minerals List closely aligns with those of its international partners. However, there are 6 minerals which are included on the Critical Minerals Lists of 2+ international partners, which underwent the supply risk assessment and were excluded based on their overall supply risk score. These minerals and a discussion of the key drivers behind their supply risk scores are included in Table 17.

Table 17: Key minerals excluded from the Draft Critical Minerals List

Mineral	Overall supply risk score	International partner List inclusion	Comment on exclusion from NZ Draft List
Lithium	4.93	USA, UK, EU, Australia and Canada	Current international partner critical mineral lists were generally developed prior to 2023 when global lithium markets were tight, however recent supply growth has moved global lithium markets into surplus, which is forecast to continue through the rest of this decade. Despite expected demand growth of 84% between 2024 and 2029, refined lithium chemical supply is expected to exceed demand until around 2031. Beyond 2031 Wood Mackenzie forecasts refined lithium will move into a market deficit, with additional supply projects required. Wood Mackenzie has assessed supply risk on a 5-year time horizon, therefore the forecast surplus in the global market in 2029 has resulted in a supply risk score below the critical mineral threshold. However, the New Zealand Government may wish to include lithium on the first or subsequent Critical Minerals Lists, if a longer time horizon is considered.
Helium	4.85	EU and Canada	Helium has important medical applications and supply is concentrated. However, there are large reserves, and large volumes are produced by NZ partner countries, resulting in its exclusion from the New Zealand Critical Minerals List.

Tantalum	4.23	USA, UK, EU, Australia and Canada	Tantalum is used in specialist electronics and the global market is small, which may have been factored into partner supply risk assessments. However, relatively diversified production and lack of price volatility results in its exclusion from the New Zealand Critical Minerals List.
Tin	4.23	USA, UK and Canada	Tin is a key metal used as solder in electronics and the global market is small, which may have been factored into partner supply risk assessments. However, relatively diversified production results in its exclusion from the New Zealand Critical Minerals List.
Hafnium	3.85	USA, EU and Australia	Hafnium is a niche but important input to specialist alloys used in aerospace and nuclear industries. The global market is small, which may have been factored into partner supply risk assessments. However, relatively diversified production, including in NZ international partner countries and lack of price volatility results in its exclusion from the New Zealand Critical Minerals List.
Barite	3.63	USA and EU	Barite is an important input for solar cells and the global market is small, which may have been factored into partner supply risk assessments. However, relatively diversified production and lack of price volatility results in its exclusion from the New Zealand Critical Minerals List.

4.2 Inclusion of minerals with indirect NZ demand

During the development of the Critical Minerals List, Wood Mackenzie assessed New Zealand direct and indirect demand for each identified essential mineral. Indirect demand was based on New Zealand demand for key products and technologies which contained relevant minerals. Indirect demand was quantified for 28 essential minerals, many of which also had direct demand identified through mineral imports. New Zealand indirect demand for eight minerals was identified however not able to be reliably quantified. These minerals are required in rapidly developing areas (germanium in semiconductors and, beryllium and niobium in high-temperature steel alloys) and / or in comparatively small quantities compared to other constituents of critical energy transition technologies (indium and gallium in solar cells). Given differences in use and material intensity between products (for example there are a range of solar panel technologies, some use gallium and others do not), it was not feasible to quantify New Zealand's indirect demand for these minerals, however it was acknowledged that New Zealand would have some level of indirect demand.

Ultimately, five minerals with only indirect demand (gallium, germanium, indium, niobium and beryllium) were identified as critical to New Zealand based on their supply risk. These five minerals have been included on the New Zealand Critical Minerals List, because New Zealand, like its international partners, will be consumers of key products containing these minerals, and as a result subject to the supply risk associated with sourcing these minerals.

5. Forward looking considerations for the New Zealand Critical Minerals List

In conclusion, Wood Mackenzie recommends the New Zealand Government works to secure supply and support production of the critical minerals included in Table 1 above. In this section we provide context on ESG issues for critical mineral production globally and future actions which could build on the initial Critical Minerals List.

5.1. Environmental, Social and Governance (ESG) considerations

There are a range of ESG risks associated with mineral production, which also apply to Critical Minerals. Key ESG considerations for New Zealand's Critical Minerals are outlined below, at this stage of the assessment Wood Mackenzie views that ESG risks do not warrant removal of any minerals from the Critical Minerals List.

ESG risks need to be carefully managed when sourcing the critical minerals required to enable economic development and build energy transition technologies. While mineral extraction and processing can have negative environmental and social impacts, these can be minimised through strong environmental, labour and governance legislation and regulation. New Zealand has a strong legislative framework in place in these areas, supported by its high global ranking in the Human Freedom Index (2nd globally, 2023), Transparency International's Corruption Perception Index (3rd globally, 2023) and the Environmental Performance Index (33rd globally, 2024).

ESG concerns related to the minerals on the NZ Critical Minerals List vary dependent on:

1) the locations they are extracted and processed, and;

2) qualities inherent in the deposits within which these minerals are commonly found.

By on-shoring the production and/or recycling of some of the critical minerals New Zealand and its international partners require, New Zealand is expected to be able to minimise the global ESG impacts of mineral sourcing, where these minerals are currently produced under less stringent ESG conditions elsewhere.

Examples of ESG issues related to current production locations:

- The Democratic Republic of the Congo (DRC) is a major miner of cobalt (66% of global mined supply 2023), tantalum (41% of global mined supply 2023) and copper (12% of global mined supply 2023). A significant share of the metal mined (15-20% of cobalt production) in the DRC is produced by small-scale mining operations, often with the use of child labour and poor safety practices. This has led the OECD to classify cobalt as a mineral of concern and for the US to classify tantalum as a conflict mineral.

- Rare earth element (REE) extraction and particularly refining has historically caused significant environmental damage and reported community health issues. This has been driven both by the minerology of some REE deposits (discussed further below) and also by the lack of stringent controls in some production locations. In southern Chinese provinces, methods used to extract and process ion adsorption clay (IAC) type deposits have caused significant environmental damage both locally and regionally through groundwater and land contamination, accelerated erosion and contamination of waterways. Tighter controls and bans on certain refining processes were introduced in 2010 and 2016 in an attempt to combat and limit further damage.

- Indonesia is the largest global producer of nickel (54% of mined and smelted supply in 2023), focusing on mining and smelting of laterite ores. The expansion of the Indonesian nickel industry over the last 10 years has brought economic development to the areas of the country hosting nickel deposits, however, there have also been reports of deforestation and water pollution. In addition, a large share of Indonesia's laterite nickel is processed through energy-intensive rotary kiln electric furnaces (RKEF) which are mostly powered by coal-fired power sources. As result, Indonesian nickel typically has a higher carbon footprint than nickel products produced from sulphide ores in other countries.

Due to the chemistry of certain mineral deposits or processing pathways, environmental and health risks remain associated with the production of some critical minerals, independent of where these are produced. To manage these risks, robust design and operation practices need to be in place when producing these minerals.

Examples of critical minerals specific risks requiring management:

- The natural association of REEs with naturally occurring radioactive material (NORM) at many deposits presents a risk of concentration and release of radioactive materials into the environment if sufficient controls are not implemented. Processing of rare earths mineral concentrates represents a significant challenge for many operators because of the natural association of many rare earth bearing minerals with NORM, including thorium and uranium compounds. Many rare earth processing facilities produce thorium and uranium products during processing, which must be diluted and stored in guidance with local or international standards. If REE production opportunities are developed in New Zealand, further investigation will be required on the level of NORM associated with the deposits of interest, with the management of potential wastes and safe transportation of ores given extensive consideration.

- Metals processing/refining often produces waste products (tailings or slags) which contain toxic or environmentally

damaging chemical compounds. Notable examples of critical minerals which may require more extensive waste management planning include nickel, PGMs and vanadium. These waste management issues are primarily associated with downstream processing when impurities are concentrated in waste streams and are generally less of a concern during ore extraction.

- There are human toxicity risks associated with some critical minerals, which need to be mitigated during processing/refining these minerals. Examples include arsenic, beryllium and chromium. Modern manufacturing best practices and personal protective equipment can be used to protect workers and the community from hazardous materials, significantly reducing risks. As for waste, exposure risk is higher during mineral processing than mining, due to the concentration and reactivity of compounds during processing.

New Zealand's resource management and permitting requirements involve consideration and effective management of ESG risks associated with the mineral industry. These established requirements, applied to critical minerals projects, are expected to ensure ESG risks associated with new critical mineral production in New Zealand are minimised. Specific risks associated with each mineral should be considered for projects targeting minerals not previously produced in New Zealand to ensure any unique associated risks are understood and effectively managed.

5.2. Future Recommendations for the Critical Minerals List

Future updates to the Critical Minerals List

The New Zealand Critical Minerals List is designed to be a current document highlighting essential minerals with risks to supply currently or within the next 5 years. The list will need to be reviewed on a regular basis to ensure it is relevant to New Zealand's needs over time. The 5-year time horizon selected for the current assessment provides a view on near term risks and opportunities. However, a 10-year outlook could be used for future assessments to broaden the analysis to include long-term supply opportunities, given mineral extraction projects often take 10-15 years to develop.

Reviews could be undertaken on a periodic basis or in response to technological, trade, domestic capacity or geopolitical developments, or both. We note that the USA has reported that the US Geological Survey will review the country's list every 3 years. Australia has reported plans to establish a process for updating its list periodically, and the Australian Minister for Resources also added a mineral (nickel) to the country's Critical Minerals List in February 2024.

Wood Mackenzie recommends that New Zealand reassesses its Critical Minerals List on a periodic basis through a reassessment of mineral requirements and supply risk. This could occur on a 2- or 3-year cycle.

Gathering additional data to support decision making

Legislation and policy to support the production of minerals on New Zealand's Critical Minerals List could be usefully informed by additional data on New Zealand's mineral requirements and supply potential. This additional data could also inform future updates to the New Zealand Critical Minerals List. Further investigation into the following areas is recommended:

- Wood Mackenzie quantified New Zealand's 2023 mineral demand related to several key energy transition technologies including electric vehicles, battery storage and wind power. However limited information was available on the quantities and material composition of New Zealand's consumption of solar panels and semiconductors, though typical materials were identified and included in the study, unquantified. Additional research into these sectors could provide insights into the volumes and value of minerals required for these technologies. A more complete view of New Zealand's use of a range of energy transition technologies (EVs, energy storage, solar panels), will also be valuable as New Zealand plans to recycle these products in the future.

- To support additional production of New Zealand's Critical Minerals, it is recommended that further study is undertaken to quantify New Zealand's minerals resources. Exploration activity targeted towards minerals on New Zealand's Critical Minerals List could build upon the valuable data held by GNS, many of which have not been valuable target minerals during historical exploration project.

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