Peran Mineral Tambang dalam Pengembangan Industri Batere di Indonesia

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Disampaikan pada

Mining Talk Webinar

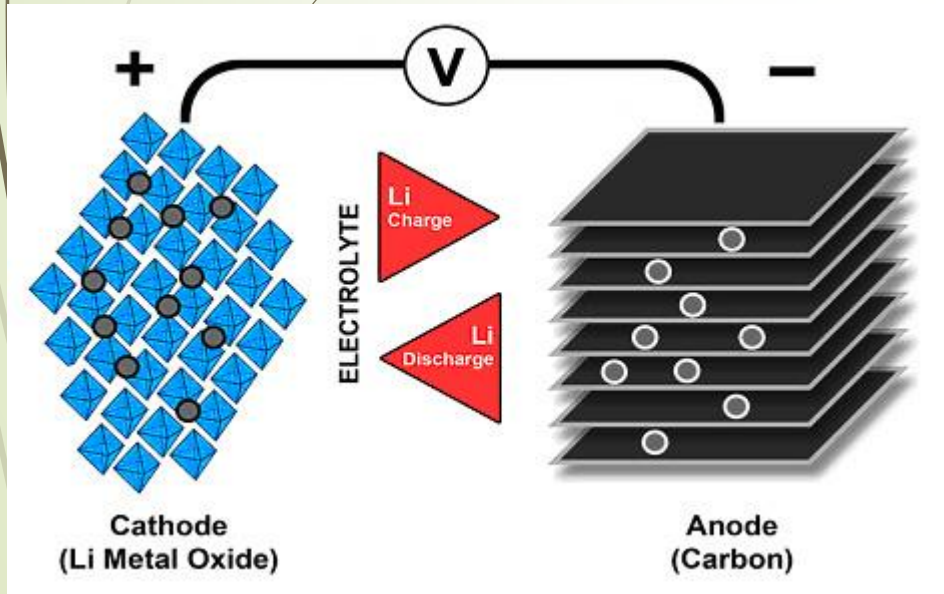
The Role of Mining Commodities in Development of Indonesia Battery Industry

22 April 2021

Information Classification: General

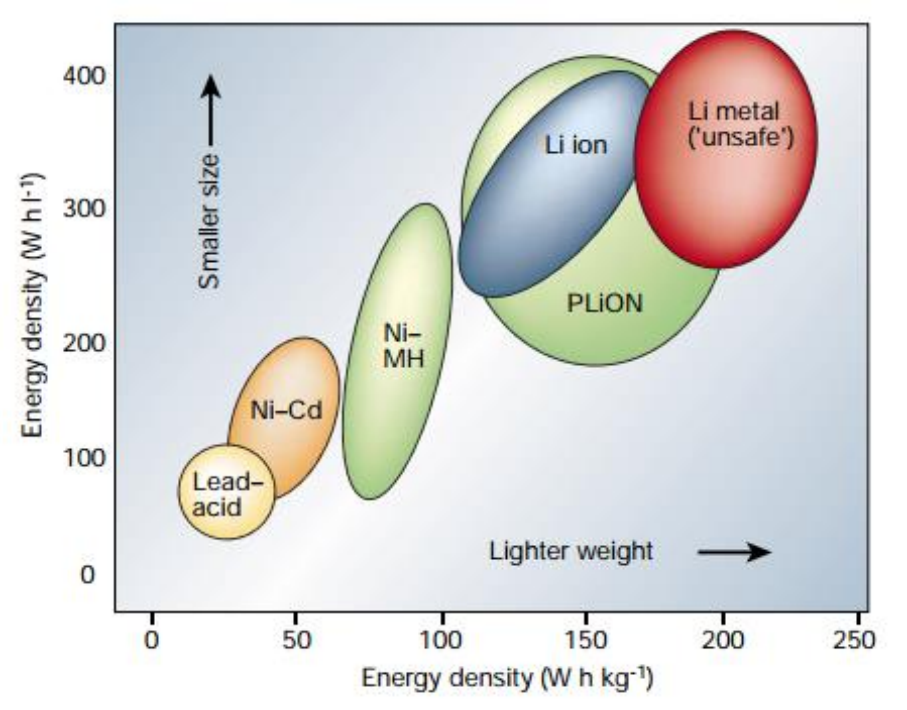
Type battery

1. Lead acid
2. Nickel Cadmium (Ni-Cd)
3. Nickel Metal Hydroxide (Ni-MH),
4. **Li-ion**



Ion flow in lithium-ion battery

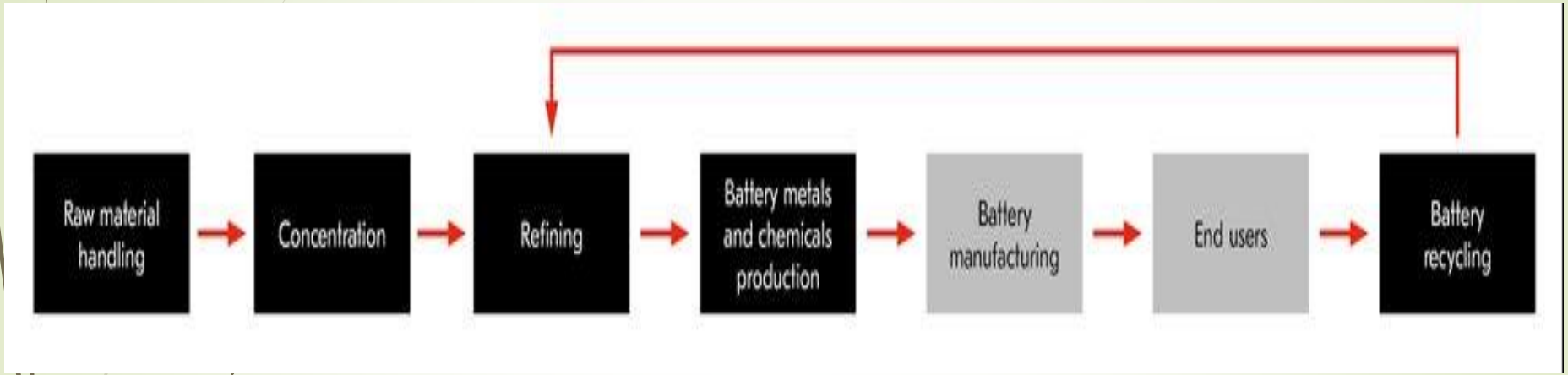
https://batteryuniversity.com/learn/archive/understanding_lithium_ion



Energy density of different batteries

Smith, K. A, "Electrochemical Control of Lithium–Ion Batteries," Control Systems, IEEE 30, no.2 (2010), pp. 18-25

Information Classification: General



Flow material processing

https://www.mogroup.com/commodities/battery-metals/#:~:text=Along%20 the%20 critical%20metals%20 Nickel,%2C%20copper%2C%20magnesium%20and%20iron.

Information Classification: General

The materials involved in Li-ion batteries consist of carbon which is porous in nature, usually graphite, as the anode, and metal oxide for the cathode.
Some of the most common cathode components are:

1. **Lithium Nickel**
2. **Manganese Cobalt Oxide**
3. Nickel Oxide, Cobalt Oxide
4. Manganese spinel
5. Iron Phosphate, and Titanate

Lithium Nickel and Manganese Cobalt Oxide have a higher energy density and cell voltage.

Information Classification: General

Metals that used in batteries production

1. Cobalt
2. Lithium
3. Nickel
4. Manganese,
5. Copper
6. Aluminum
7. Iron
8. Titanium

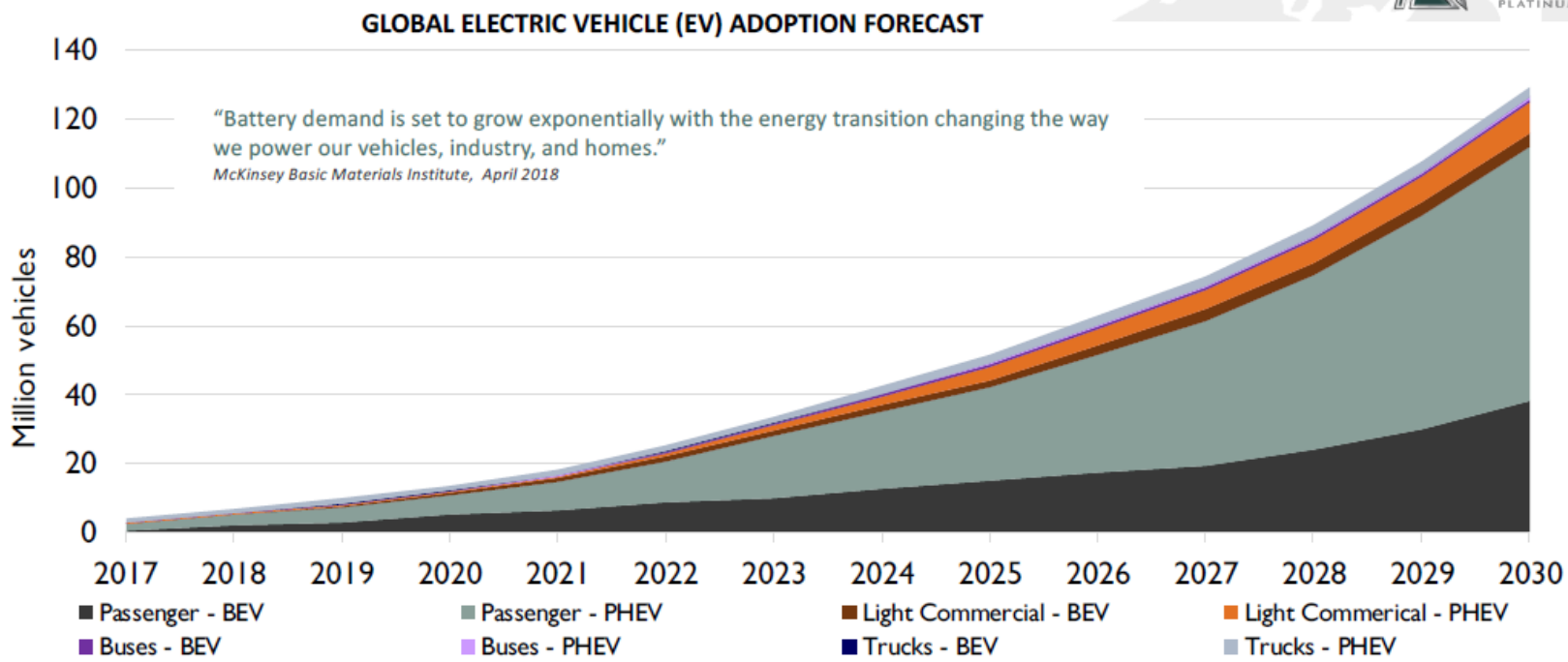
Non-Metals used in battery production

1. Graphite
2. Sulphur
3. phosphorus

Information Classification: General

NICKEL, COPPER & COBALT – COMMODITIES FOR THE FUTURE

INTRODUCTION TO THE ELECTRIC VEHICLE MARKET



Source: International Energy Agency – Global EV Outlook 2018

BEV = Battery Electric Vehicle PHEV = Plug-in Hybrid Electric Vehicle

Information Classification: General

NICKEL, COPPER & COBALT – COMMODITIES FOR THE FUTURE

GOVERNMENTS & CORPORATIONS ARE IMPLEMENTING AGGRESSIVE TARGETS FOR ELECTRIC VEHICLES

NICKEL CREEK PLATINUM

COUNTRY EV TARGETS

CHINA

- **$20 BB/yr in EV subsidies** by 2020
- NA emission standards by mid-2020
- **7 MM EV sales by 2025**

KOREA

- 30% EV adoption rate by **2020**

GERMANY, IRELAND, NETHERLANDS

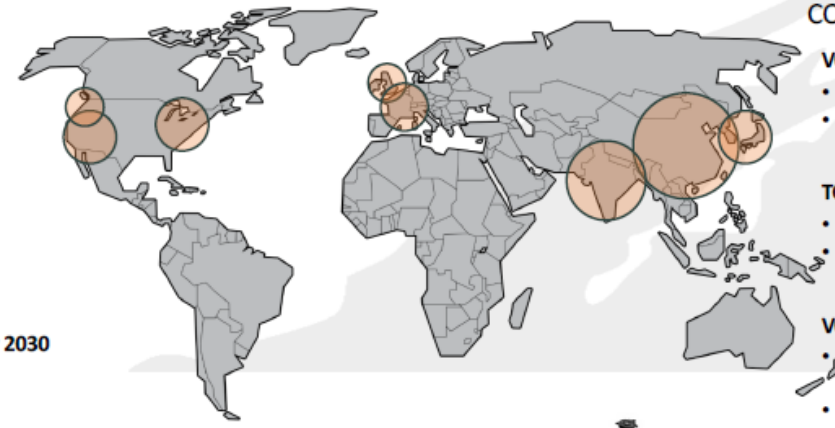
- Ban internal combustion (IC) engines by **2030**

UK & FRANCE

- Ban sale of all IC engines by **2040**

UNITED STATES

- California: **1.5 MM EVs by 2025** and 5 MM EVs by 2030
- 8 States targeting 12 MM zero emission vehicles by 2030



CORPORATION EV TARGETS

VOLKSWAGON

- **$48 BB** battery purchase contract in 2017
- 50 electric models by 2025

TOYOTA

- **$13 BB** in R&D by 2030
- 50 electric models by 2025

VOLVO

- **Stopping design of internal combustion** cars by 2019
- Target of 1 MM electrified cars by 2025

GENERAL MOTORS

- 20 electric models by 2023

CHANGAN AUTOMOBILE

- **$15 BB** investment in EVs by 2025
- 100% electric models by 2025

Information Classification: General

NICKEL, COPPER & COBALT – COMMODITIES FOR THE FUTURE

NICKEL IS THE MOST IMPORTANT METAL BY MASS IN LI-ION BATTERIES

NICKEL CREEK PLATINUM

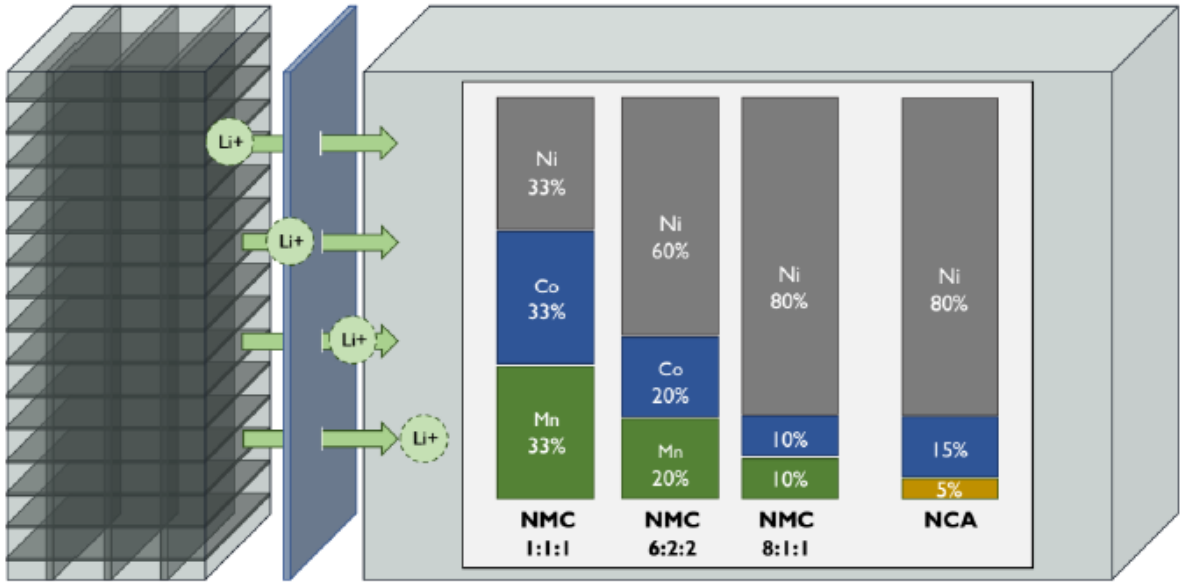
THE LI-ION BATTERY

"Our cells should be called Nickel-Graphite, because primarily the cathode is nickel ..."

Elon Musk

↑ Nickel = ↑ Energy density

- Higher life span, higher power



ANODE

Graphite

CATHODE

Nickel-Manganese-Cobalt (NMC)

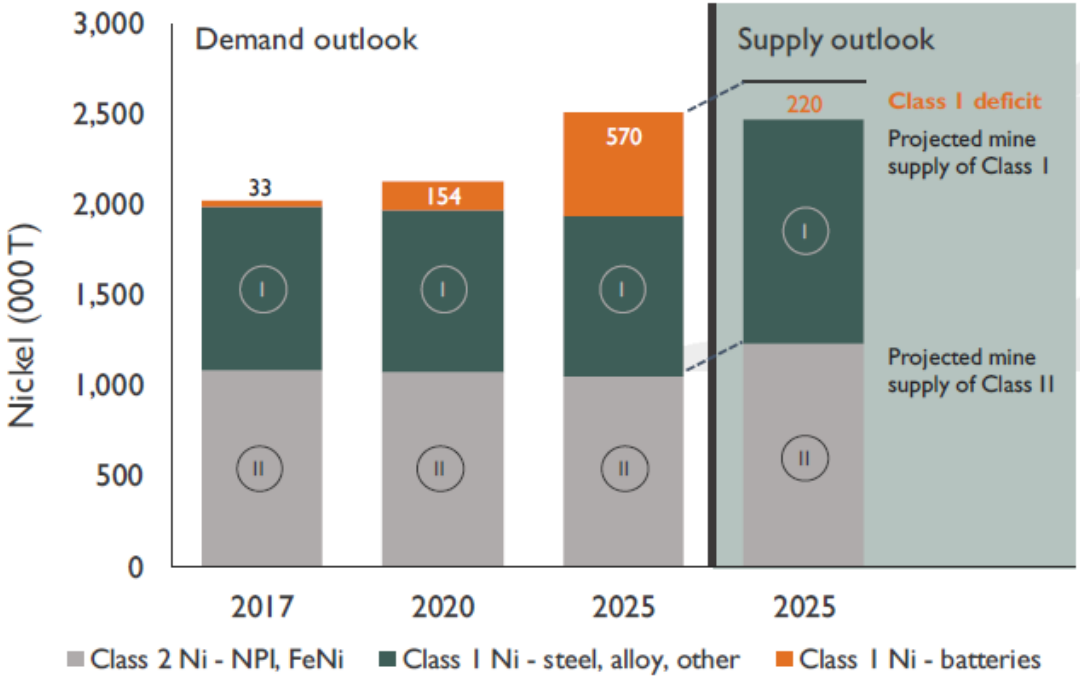
Nickel-Cobalt-Aluminum (NCA)

Information Classification: General

NICKEL, COPPER & COBALT – COMMODITIES FOR THE FUTURE

BATTERY DEMAND FROM CLASS I NICKEL WILL OUTSTRIP SUPPLY

NICKEL DEMAND & SUPPLY



Sources: McKinsey & Company "The future of nickel: A class act", McKinsey Basic Materials Institute

Class 1 nickel required for batteries

- Only nickel sulphide and select HPAL nickel laterite mines produce Class 1 Ni
- Over 50% nickel production unsuitable for battery manufacturing

Battery segment today only accounts for ~2% of total nickel demand

- Expected to grow to > 20% by 2025
- Stainless steel demand has been growing at between 2-4% per year

Nickel sulphide deposits account for 25-30% of global nickel production today

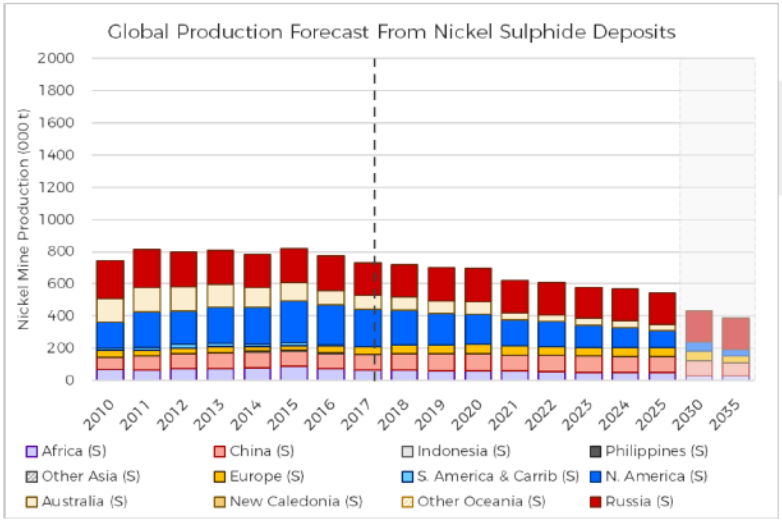
Low prices have limited exploration spending and development over last 10 years

Information Classification: General

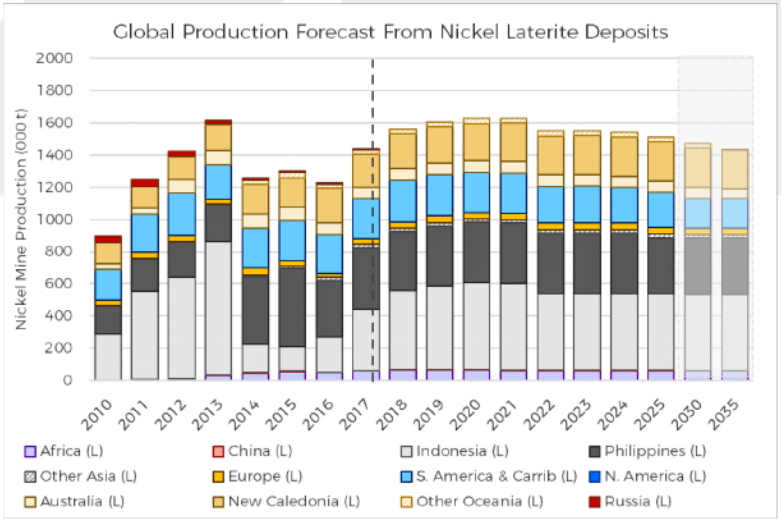
NICKEL MARKET

NICKEL SULPHIDE PRODUCTION EXPECTED TO DECLINE

- Extended period of low prices has resulted in few opportunities for new supply
- Collapse of expansionary and sustaining capital spending over the last few years will have a material impact on supply
- Nickel sulphide projects are declining due to an absence in new project discovery since the Voisey's Bay discovery
- Supply growth is limited to laterite mines in higher political risk jurisdictions (ex. Philippines and Indonesia)
- Laterite projects by their nature are extremely high cost and require significant processing to produce a higher value concentrate

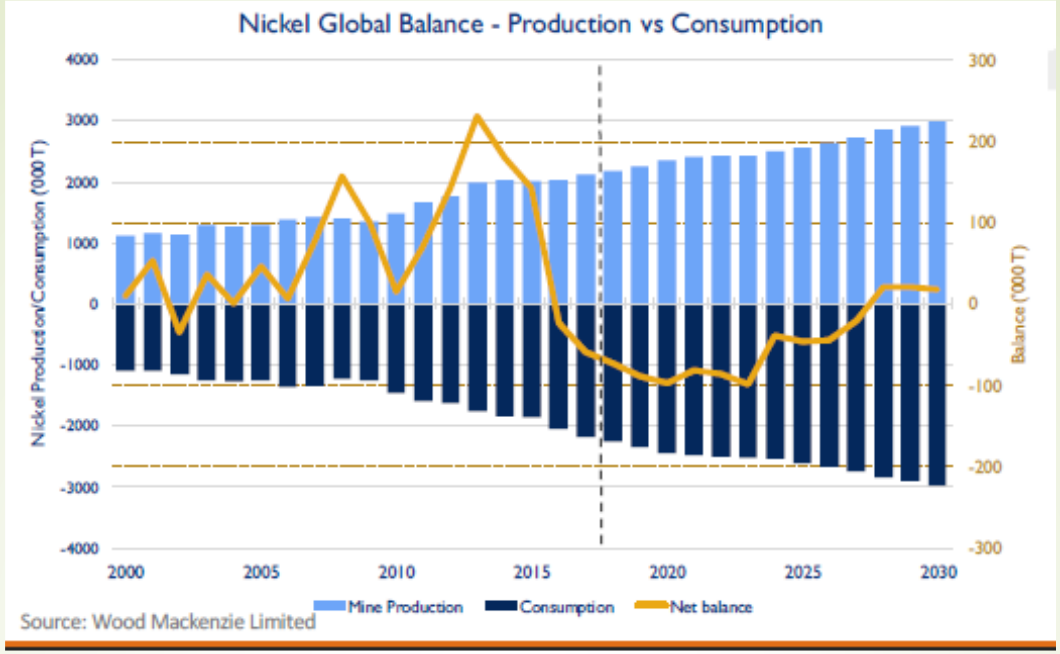


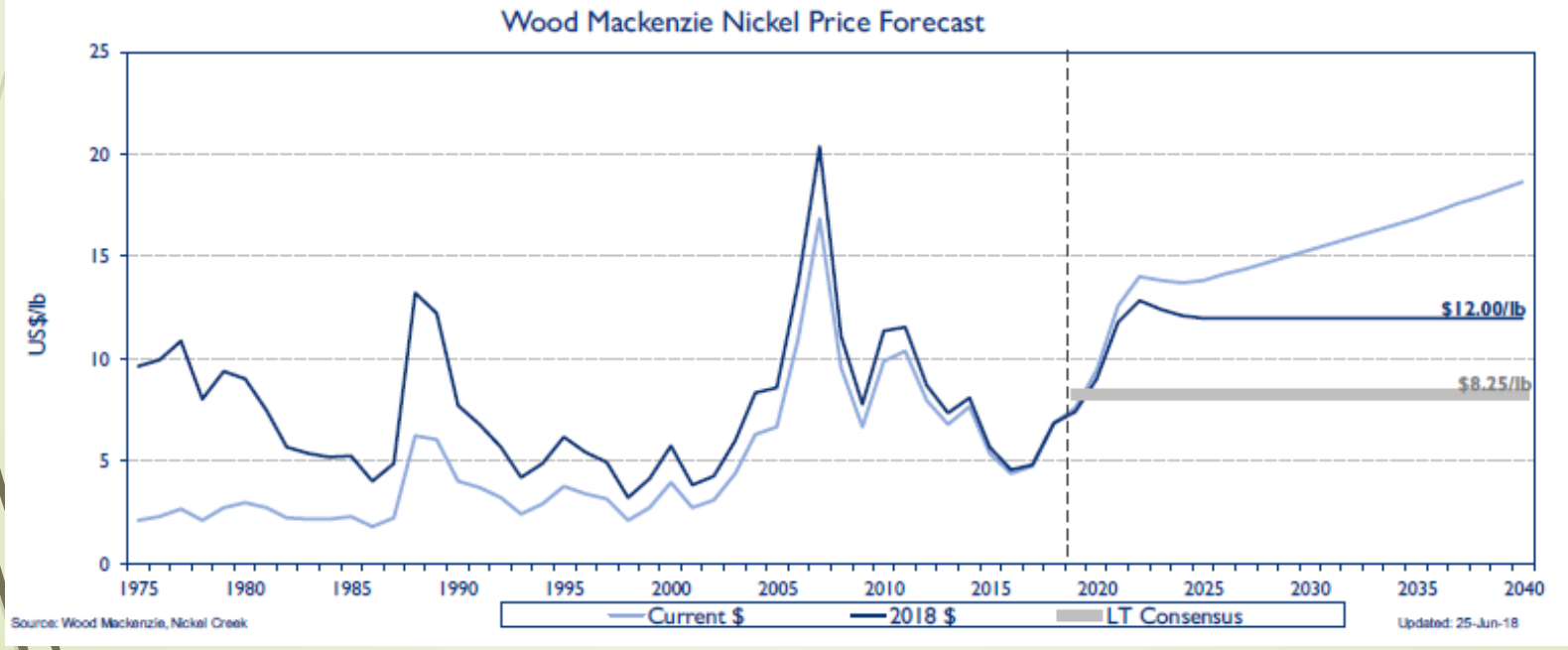
Source: Wood Mackenzie Limited

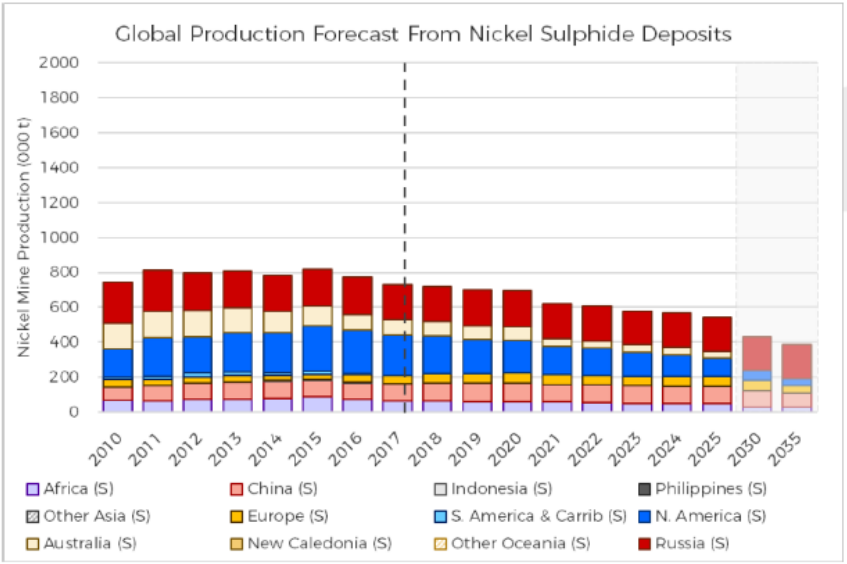


Source: Wood Mackenzie Limited

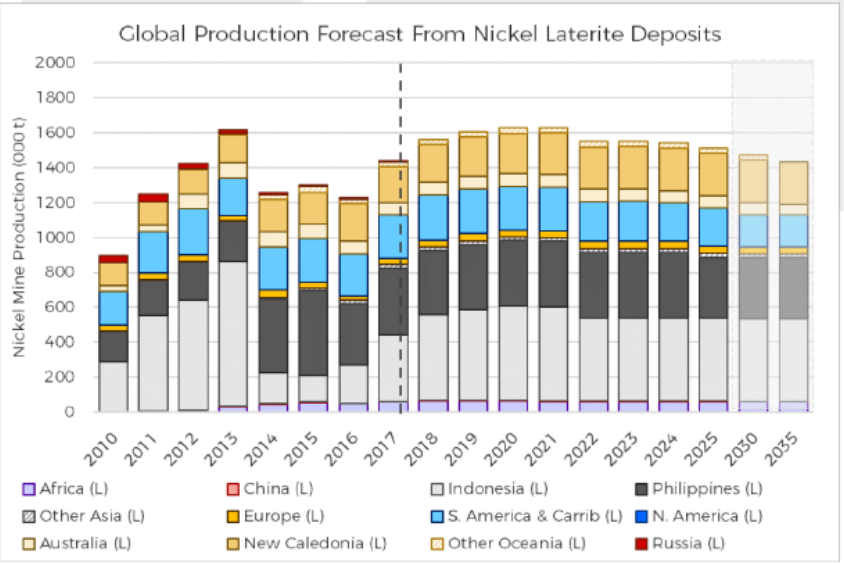
Information Classification: General


Nickel Global Balance - Production vs Consumption
Nickel Production/Consumption ('000 T)
Balance ('000 T)
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
300
200
100
0
-100
-200
-300
2000
2005
2010
2015
2020
2025
2030
Mine Production
Consumption
Net balance
Source: Wood Mackenzie Limited


Wood Mackenzie Nickel Price Forecast
US$/lb
25
20
15
10
5
0
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
$12.00/lb
$8.25/lb
Current $
2018 $
LT Consensus
Source: Wood Mackenzie, Nickel Creek
Updated: 25-Jun-18



Source: Wood Mackenzie Limited



Source: Wood Mackenzie Limited

Information Classification: General

Tabel Status Sumber Daya dan Cadangan Mineral Logam Strategis (Sumber: KESDM)

No	Komoditi	Total Sumber Daya (Ton)		Total Cadangan (Ton)	
		Bijih	Logam	Bijih	Logam
1	Emas Primer	8.357.714.559,00	7.454,98	2.807.161.814,13	2.575,22
2	Bauksit	1.347.638.206,68	648.479.376,64	585.721.415,00	239.598.060,26
3	Nikel	3.711.588.997,00	54.449.501,35	1.155.234.951,40	21.378.312,61
4	Tembaga	18.284.523.144,94	108.698.062,96	2.719.650.376,80	25.603.197,33
5	Besi	712.464.366,32	401.771.218,67	65.579.511,00	39.825.354,30
6	Pasir Besi	2.121.476.550,10	443.732.971,69	173.810.612,00	25.412.652,63
7	Mangan	15.557.048,77	6.305.298,42	4.429.029,00	2.834.916,25
8	Seng	670.658.336,00	7.487.775,86	19.864.090,90	2.274.982,50
9	Timah	3.945.572.597,87	2.349.989,64	1.322.471.947,00	280.956,00
10	Xenotim	23.165.947,00	356,00	0,00	0,00
11	Monasit	1.569.312.847,40	25.920,80	0,00	2.715,00
12	Perak	14.468.642.881,00	837.949,53	15.114.023.114,43	1.949.929,05

Information Classification: General

Posisi Indonesia

Pada 2019

- 1. Ekspor Ni Indonesia USD1,7 M atau 37,2 % nilai ekspor dunia.
- 2 Zimbabwe 16%
- 3. Filipina *market share* 13 %
- Pada semester I-2020, produksi FeNi *smelter* Indonesia 60 % produksi 2019 sebesar 667 ribu ton (75% ekspor, 25% lokal)
- Produksi NPI pada 2019 mencapai 419 ribu ton, 25 % ekspor, 75 % konsumsi industri lokal.
- Cadangan Indonesia teregister 21 juta ton setara nikel murni.
- Australia 20 juta ton
- Brazil 11 juta ton,
- Rusia 6,9 juta ton,
- Kuba (5,5 juta ton,
- Filipina (4,8 juta ton).

Information Classification: General

Produksi Indonesia

Pada 2020

- PT Aneka Tambang (Antam) Tbk, produksi 65 ribu ton feronikel per tahun.
- PT Arthabumi Sentra Industri produksi 73 ribu ton NPI per tahun.
- PT Elit Kharisma Utama 97,45 ribu ton NPI ton per tahun.
- Kini ada 22 unit *smelter* nikel yang beroperasi dari rencana 29 unit pada 2022/2023.
- Kapasitas produksi nikel olahan dari semua turunannya (feronikel Ni 17-24%, nikel matte Ni 70-78%, NPI Ni 4-10%, dan nikel-sulfat), **mendekati 2 juta ton per tahun.**

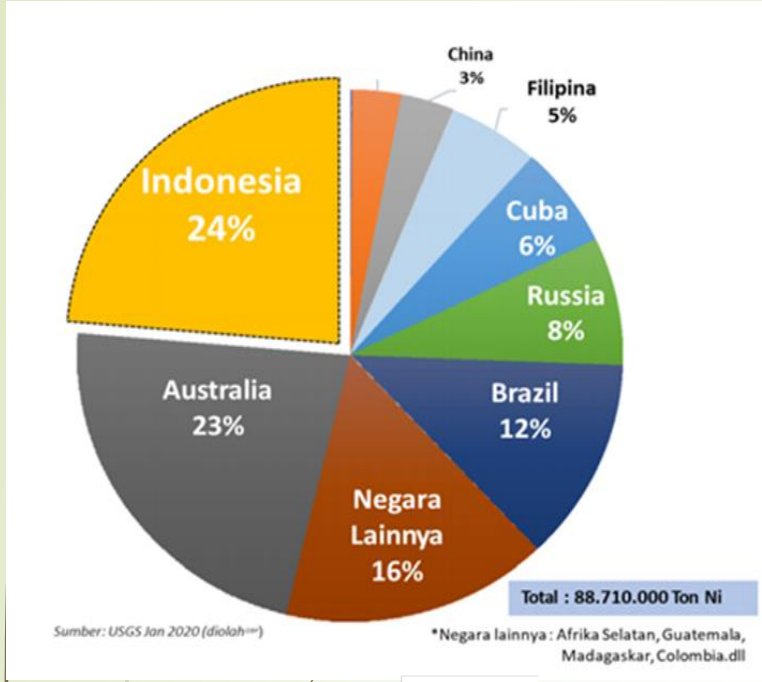
Information Classification: General

Harga Nikel

- September 2019 harganya pada level USD17.600 per metrik ton
- Oktober 2019 USD16.300
- Desember 2019 USD15.200
- Pandemi Maret 2020 USD11.200
- September 2020 kisaran USD14.800.
- Pasar berjangka di LMX (London Metal Exchange), mencapai USD15.400 untuk penyerahan Desember 2021

Information Classification: General

NPI
Ferro Nickel
Nickel Matte
NiOH
Kawasan Industri
11 Smelter
43 IUP
Maluku Utara
BULI
4 IUP
Papua Barat
1 IUP
Papua
2 IUP
Maluku
Sulteng
81 IUP
COR
MOROWALI
smi
VALE
KONAWE
VDNi
4 IUP
Sulsel
antam
155 IUP
Sultra
BANTAENG
Century Metalindo
Gebe Industry Nickel
PRODUKSI 2019
1.Nickel Matte : 72 rb Ton
2.FeNi : 1,1 Juta Ton
3.NPI : 781 rb Ton
4.NiOH : - rb Ton
5.MHP : - rb Ton
Total : 290 IUP
Sumber: Ditien Minerba .DBP 2020



Kebutuhan Bijih Nikel Saphrolite

10,7 Juta Ton/Tahun

Produk dari Teknologi RKEF

❶ **1.100.000** Ton

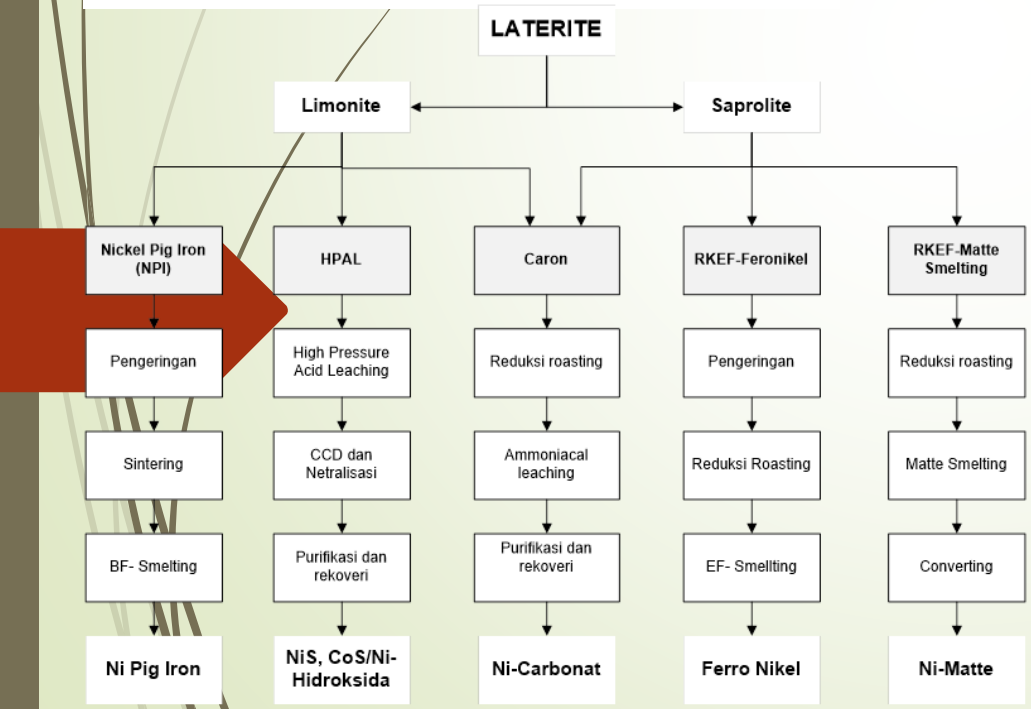
FeNi (Ni > 10%)

Sisa Pengolahan Slag:

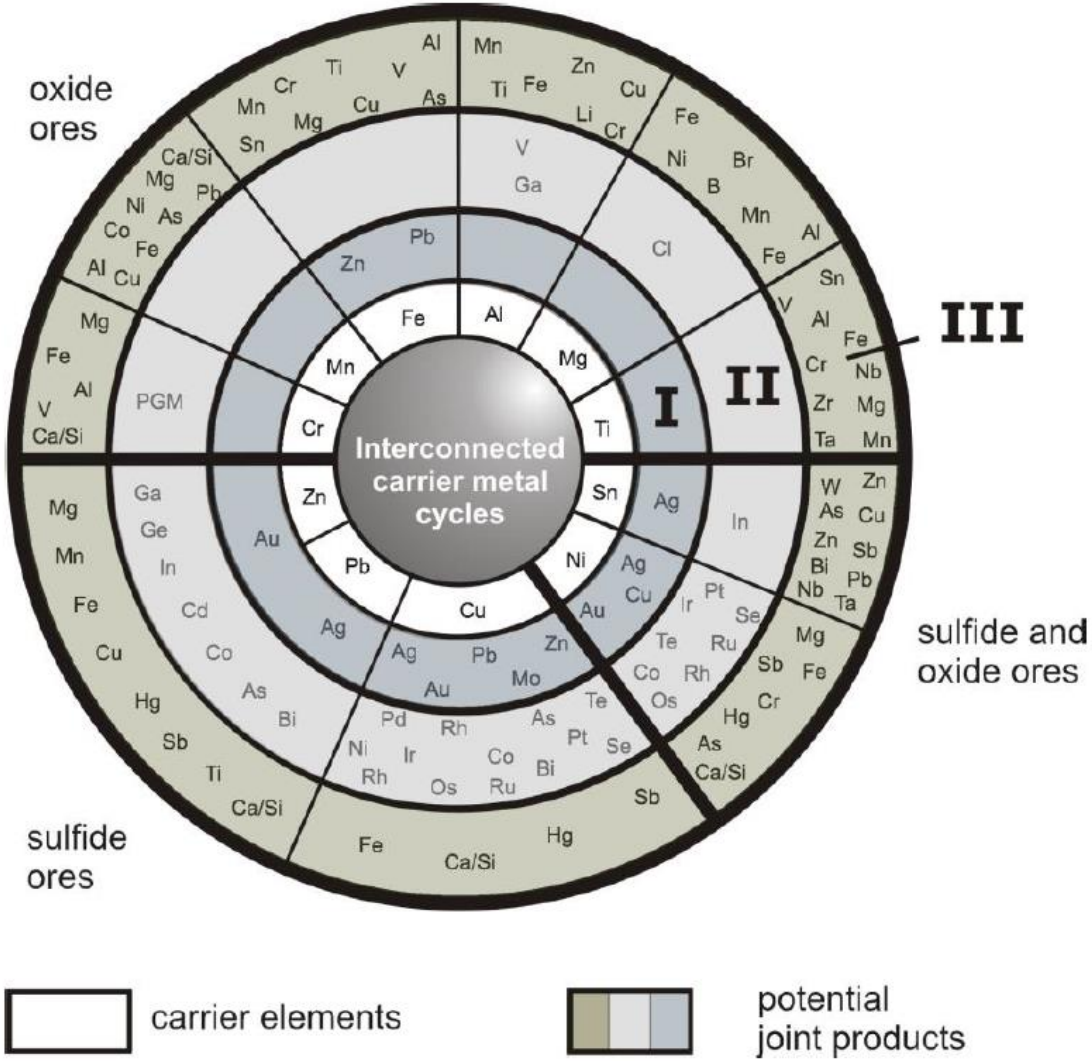
6,1 Juta Ton/Tahun

- **Kandungan → Mg dan Si tinggi + Logam berharga lainnya (Ni,Co,Cr,Fe, LTJ)**
- **Produk 1,1 Juta Ton Feni menghasilkan Terak Feni ± 6,1 Juta Ton**

Sumber : Ditjen Minerba



Information Classification: General



Ring I: Co-elements that also have considerable own production infrastructure. Valuable to high economic value; some used in high tech applications.

Ring II: Co-elements that have no, or limited own production infrastructure. Mostly highly valuable, high-tech metals e.g. essential in electronics.

Ring III: Co-elements that end up in residues, or as emissions. Costly because of waste management or end-of-pipe measures.

Reuter, M.A.; Boin, U.M.J.; van Schaik, A.; Verhoef, E.V.; Heiskanen, K.; Yang, Y.; Georgalli, G. *The Metrics of Material and Metal Ecology, Harmonizing the Resource, Technology and Environmental Cycles;* Elsevier: Amsterdam, The Netherlands, 2005; 706pp.

Information Classification: General

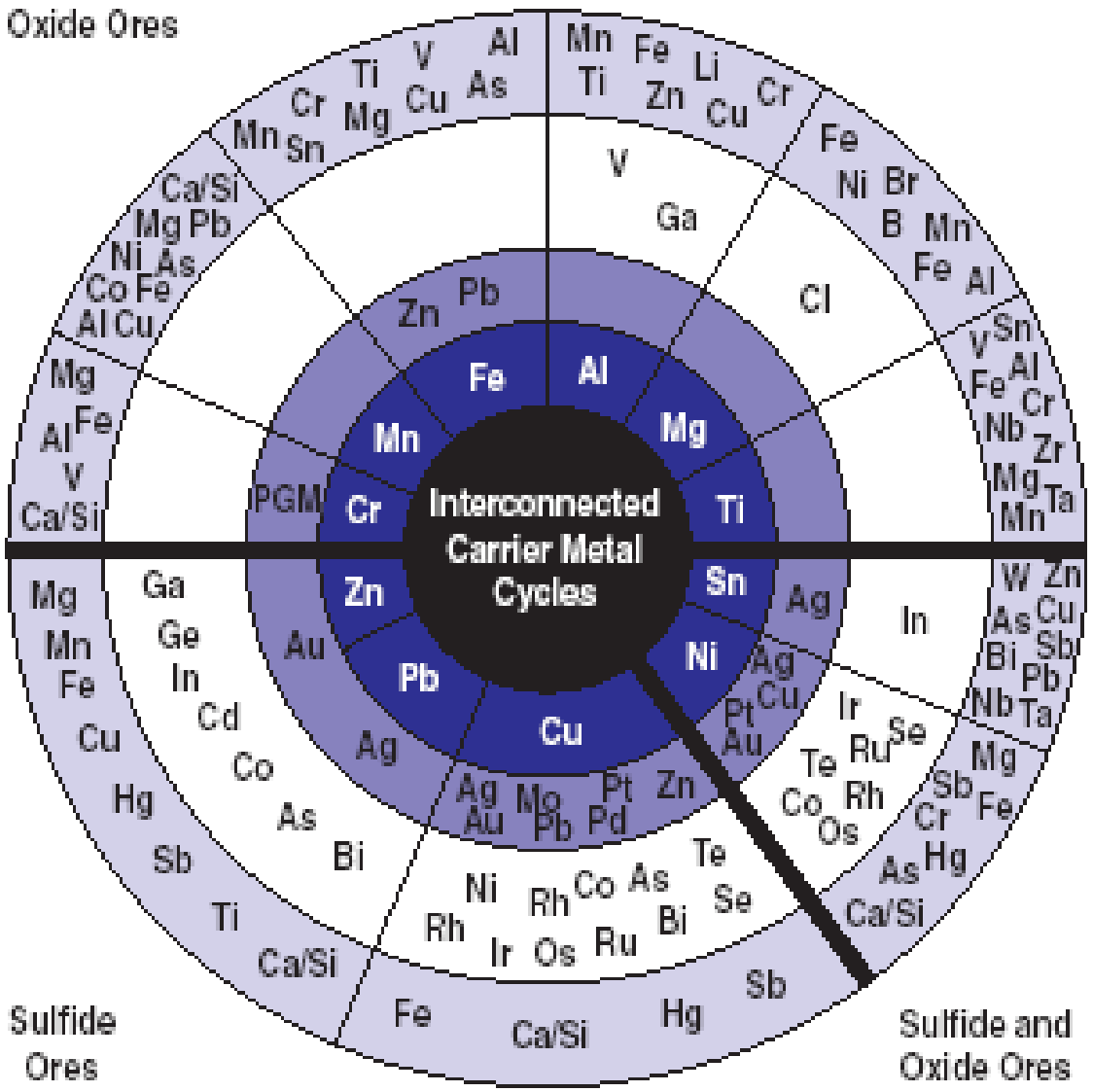


Figure 2: The Feedback Control Cycle of Mineral Supply, Increase of Raw Material Efficiency, and Sustainable Development, F.-W. Wellmer and C. Hagelüken, *Minerals* 5 (4), 2015

Information Classification: General

Nikel / Terak

	Produksi (ton)	Nilai (US$)
Nikel	56 jt	784 M
Cobalt	718	34,5 M

Terak 6,1 jt ton

Kandungan Ferronickel Slag berdasarkan ICP-OES di PTBGN BATAN

Element	Kadar	Element	Kadar	Element	Kadar
Si	25,02%	S	402 ppm	Pr	70.9 ppm
Al	3,61%	Cl	267.1 ppm	Zn	142.1 ppm
Na	0,22%	Sc	40.6 ppm	Y	102.1 ppm
P	0,09%	V	218.5 ppm	La	346.7 ppm
K	0,10%	Zr	211 ppm	Ce	1109 ppm
Ca	0,65%	Co	64 ppm	Nd	303.3 ppm
Ti	0,09%	Mn	5511 ppm	Nb	26.1 ppm
Fe	7,20%	Ni	430.6 ppm	Sm	116.7 ppm
Cr	9505 ppm	Ba	62.7 ppm	Sr	39 ppm

Disertasi Agus B. Prasetio (2021)

Information Classification: General

Tembaga (area Grasberg)

Kompas, 12 Maret 2019, Produksi sejak 1990 (harga dalam US$/ Cu 9.200/ton; Emas 66,64 /gr; Perak 0,83 /gr)

	Jumlah (ton)	Nilai (US$)
Tembaga	11,8 juta	108,56 M
Emas	4.600	295,147 M
Perak	6.450	5,353 M

1 ton bijih tembaga → 9,9 Kg Cu; 1,59 Gr Au; 2,23 Gr Ag

Cadangan 1,8 M ton

Information Classification: General

Mineral Ikutan Industri Sn

Monazite $(Ce, Nd, Pr, La)PO_4 + Th_3 (PO_4)_4$

- Cadangan 600.000 ton ore
- Thorium 6,81 % (40.428 ton)
- Rare earth 52 % (313.200 ton)

Ilmenite $(FeTiO_2)$

- Cadangan 2,1 juta ton ore
- Titanium oksida 23,46 % (493.021 ton)

Information Classification: General

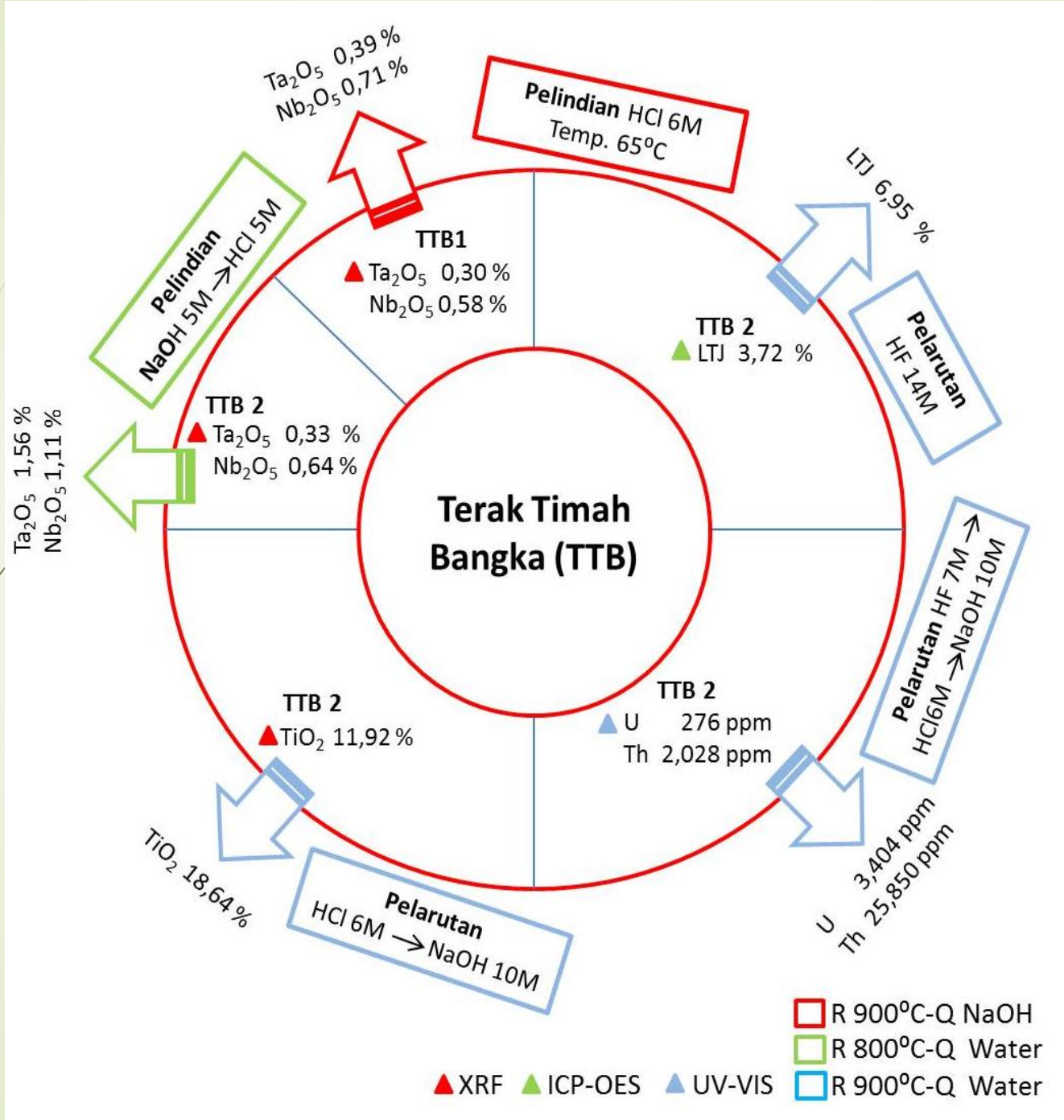
Kandungan Terak Timah

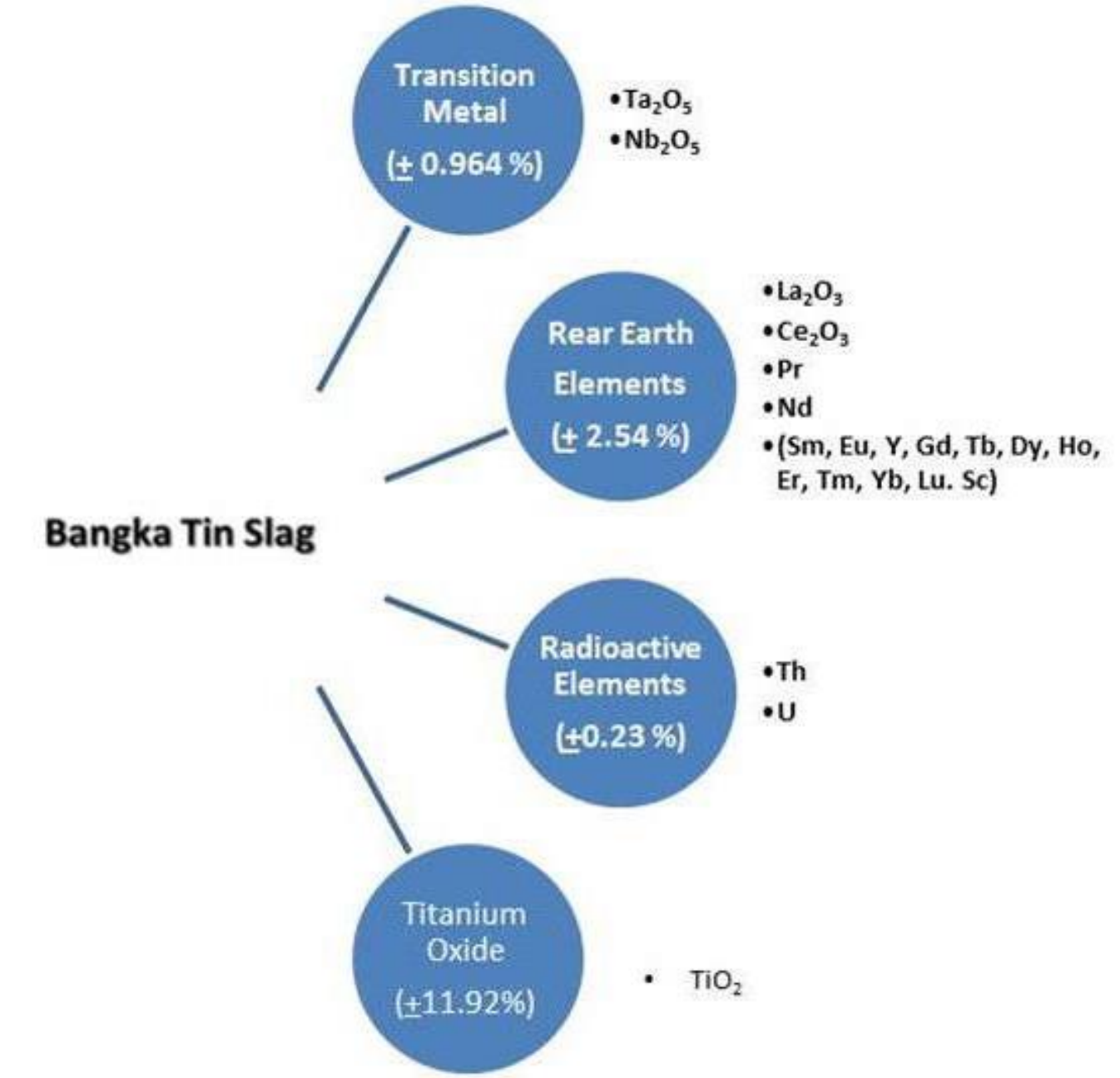
REE (%)	Ca (%)	Fe (%)	Si (%)	Ti (%)	Al (%)	Zr (%)
3.724	33.09	6.92	6.48	6.02	4.03	1.26

	Element	Content (ppm)
heavy rare earth (ppm)	Ce	12,376.3
	Y	5,948.8
	La	5,763.8
	Nd	4.432.5
	Pr	1,770.0
	Dy	1,119.8
	Sm	1,044.6

	Element	Content (ppm)
light rare earth (ppm)	Er	3,323.8
	Eu	1,375.0
	Gd	699.8
	Yb	650.6
	Lu	77.38
	Ho	34.9
	Tb	N/A
	Tm	N/A

Information Classification: General


Terak Timah Bangka (TTB)
Pelindian HCl 6M Temp. 65°C
TTB1
Ta2O5 0,30 %
Nb2O5 0,58 %
Ta2O5 0,39 %
Nb2O5 0,71 %
TTB 2
LTJ 3,72 %
LTJ 6,95 %
Pelarutan HF 14M
TTB 2
Ta2O5 0,33 %
Nb2O5 0,64 %
Pelindian NaOH 5M → HCl 5M
Ta2O5 1,56 %
Nb2O5 1,11 %
TTB 2
U 276 ppm
Th 2,028 ppm
Pelarutan HF 7M → HCl6M → NaOH 10M
U 3,404 ppm
Th 25,850 ppm
TTB 2
TiO2 11,92 %
TiO2 18,64 %
Pelarutan HCl 6M → NaOH 10M
R 900°C-Q NaOH
R 800°C-Q Water
R 900°C-Q Water
XRF
ICP-OES
UV-VIS


Transition Metal
(± 0.964 %)
• Ta_2O_5
• Nb_2O_5
Rear Earth Elements
(± 2.54 %)
• La_2O_3
• Ce_2O_3
• Pr
• Nd
• (Sm, Eu, Y, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu. Sc)
Bangka Tin Slag
Radioactive Elements
(±0.23 %)
• Th
• U
Titanium Oxide
(±11.92%)
• TiO_2

Terak Industri Emas

Hasil ICP OES (ppm)															
Kode sampel	Al	**Au**	B	Ca	**Ce**	Fe	K	**La**	**Li**	Mg	Na	**Nb**	**Nd**	**Pr**	**Y**
A1 (sampel awal)	3821,084	**138,331**	52271,907	4258,332	**6,279**	4750,489	50,843	**1,322**	**1,525**	1135,572	8494,039	**6,050**	**0,905**	**4,508**	**2,044**
A2 (stlh leaching air)	27565,727	**626,386**	43839,088	37282,230	**132,246**	23732,974	126,703	**5,551**	**33,259**	14206,525	8829,585	**96,151**	**58,521**	**75,863**	**12,583**
Filtrat	98,670	**8,860**	489541,000	2649,800	**5,910**	19,250	593,700	**1,003**	**130,764**	92,456	66226,900	**4,990**	**2,193**	**2,414**	**0,270**

Kode sampel	**Au**	**Ce**	**La**	**Li**	**Nb**	**Nd**	**Pr**	**Y**
A1 (sampel awal)	**138,331**	**6,279**	**1,322**	**1,525**	**6,050**	**0,905**	**4,508**	**2,044**
A2 (stlh leaching air)	**626,386**	**132,246**	**5,551**	**33,259**	**96,151**	**58,521**	**75,863**	**12,583**
Filtrat	**8,860**	**5,910**	**1,003**	**130,764**	**4,990**	**2,193**	**2,414**	**0,270**

Information Classification: General

Rare earth Oxide	Specification	price in USD / Kg January 2020	price in USD / Kg December 2019	Change to Previous month in%	pricing
Cerium oxides	99.9% min	1,65	1,63	1,06	Jan 2 20
Dysprosium oxides	99.5% min	251,11	235,70	6,54	Jan 2 20

English

ISE

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Our Service Metal News Rare earths and metals Abo

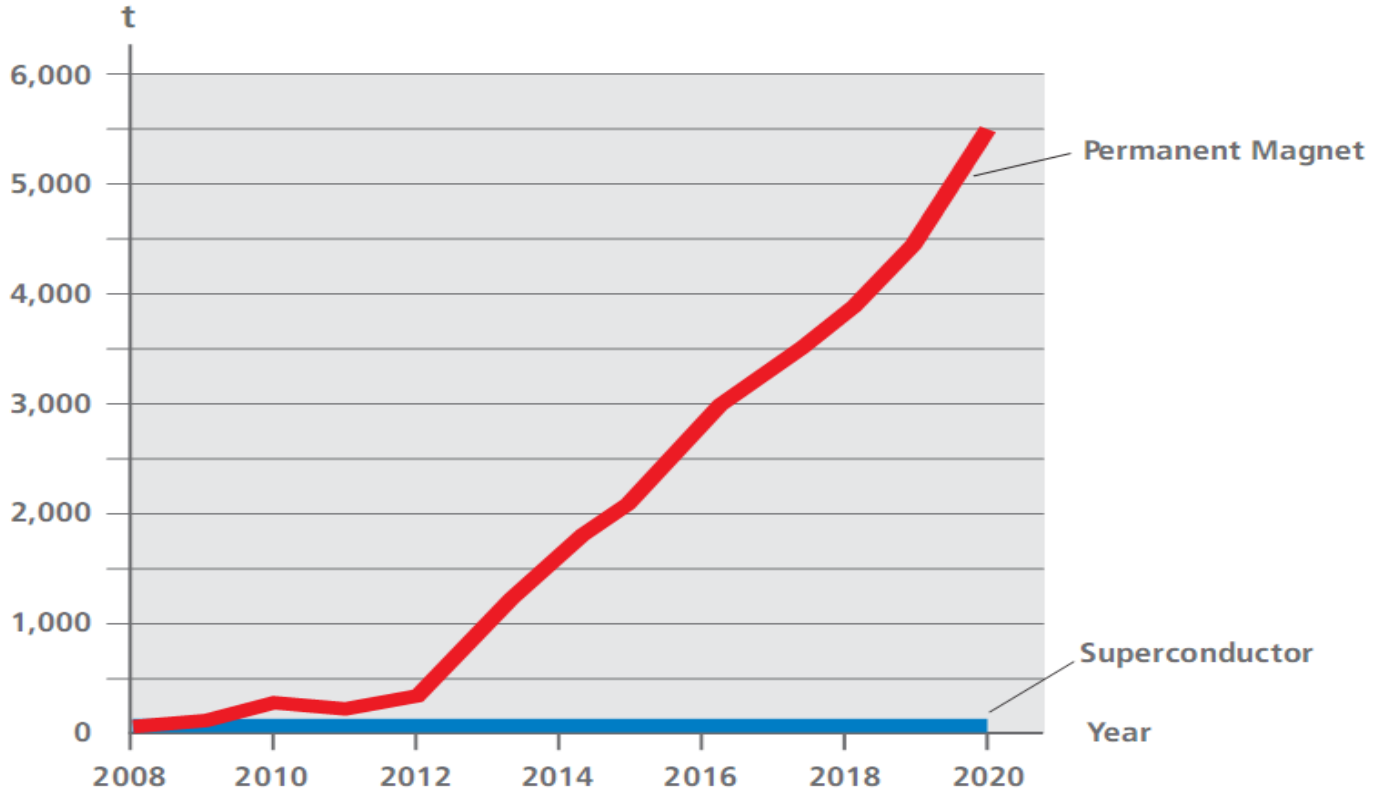
Holmium oxides	99.5% min	44,48	44,37	0,25	Jan 2 20
Lanthanum oxides	99.9% min	1,69	1,67	1,06	Jan 2 20
Lutetium oxides	99.99% min	571,10	567,94	0,56	Jan 2 20
Neodymium oxides	99.5% min	41,76	40,96	1,94	Jan 2 20
Praseodymium oxides	99.5% min	48,43	47,56	1,82	Jan 2 20
Samarium oxides	99.9% min	1,79	1,77	1,06	Jan 2 20
Scandium oxides	99.99% min	48,07	46,86	2,59	Jan 2 20
Terbium oxides	99.99% min	506,53	489,14	3,56	Jan 2 20
Yttrium oxides	99.999% min	2,87	2,84	1,06	Jan 2 20
Ytterbium oxides	99.99% min	20,66	20,16	2,49	Jan 2 20

Information Classification: General

		Solar Cells	Wind Turbines
	MATERIAL	*PV films*	*Magnets*
Rare Earth Elements	Lanthanum		
	Cerium		
	Praseodymium		●
	Neodymium		●
	Samarium		●
	Europium		
	Terbium		
	Dysprosium		●
	Yttrium		
	Indium	●	
	Gallium	●	
	Tellurium	●	
	Cobalt		
	Lithium		

Information Classification: General

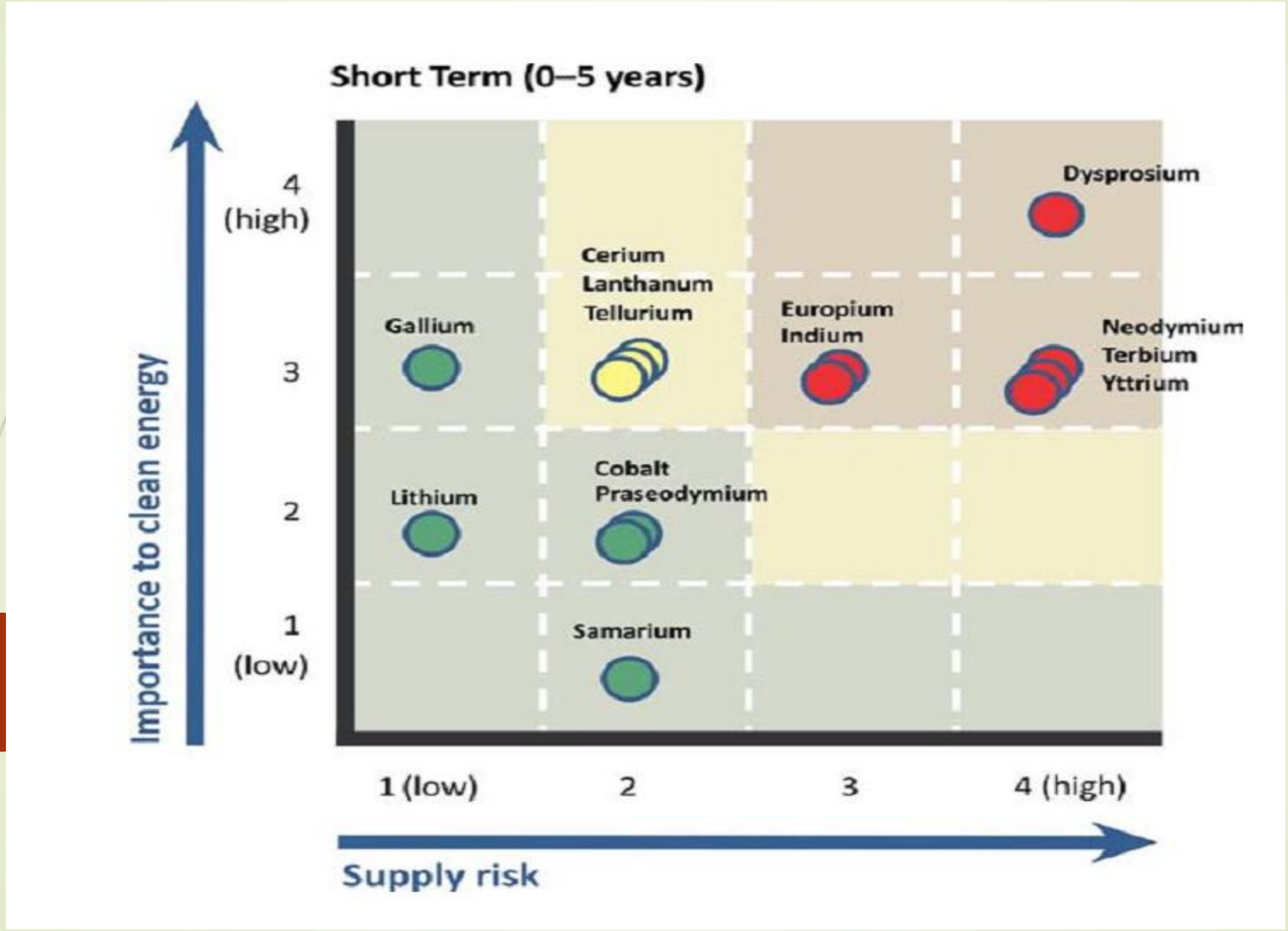
Rare Earth Element Demand for Wind Turbines



Superconductors are solving supply problem with rare earth elements for wind turbines

Sources: Converteam: Demand for the production of direct drive permanent magnet generators and superconductor generators; Zenergy Power: Demand for the production of Superconductors; Wind energy data: AMSC, EWEA and GWEC

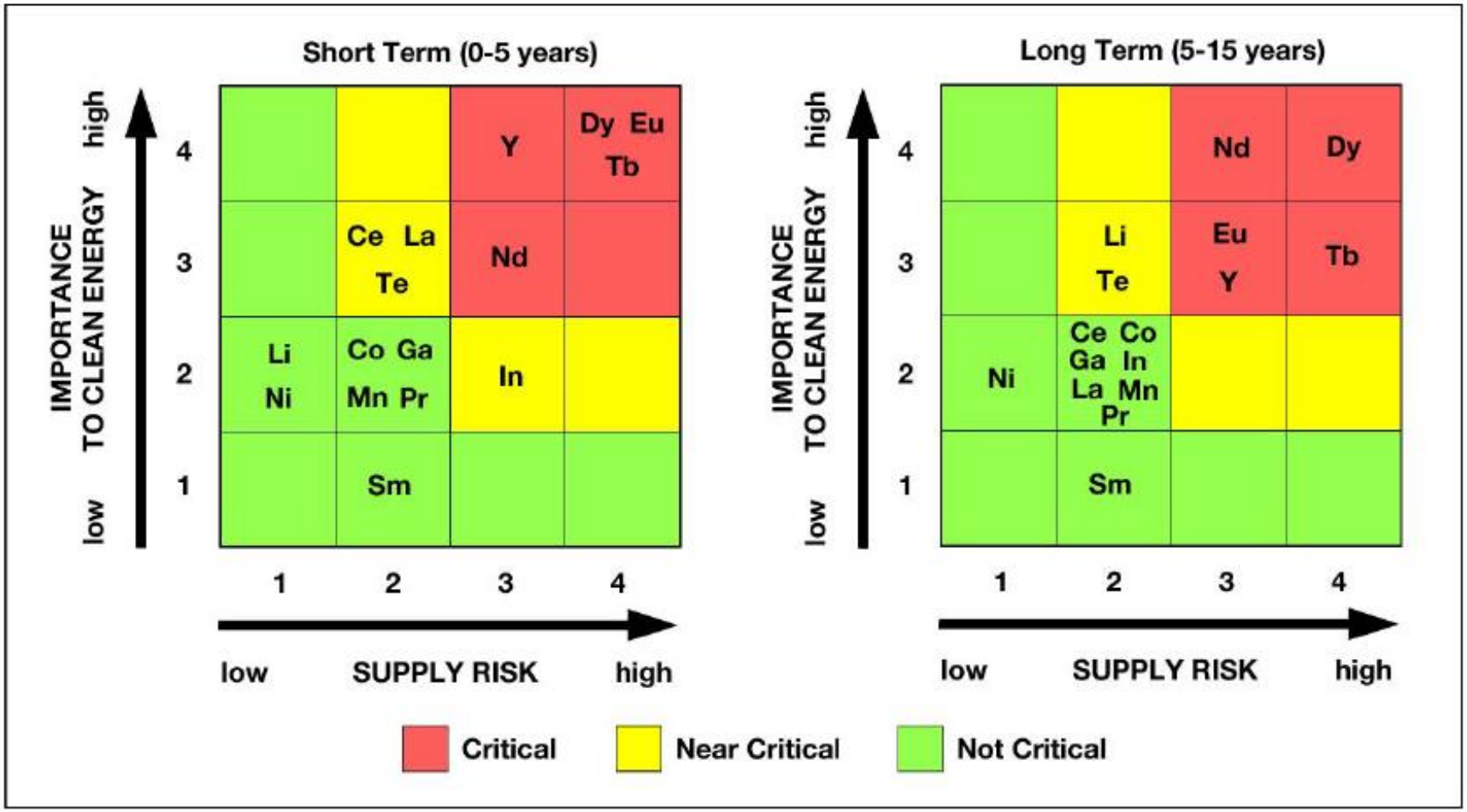
Information Classification: General



NAS (National Academy of the Sciences). 2008. Minerals, Critical Minerals and the U.S. Economy.

Information Classification: General

Supply & Demand Issues



Sources: US Department of Energy, TMR

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TMR technology metals research

Information Classification: General

Kesimpulan

1. Commodities (now) for the future : **Nickel, Copper dan Cobalt**
2. Demand sangat tinggi (industry battere)
3. Mineral ikutan **(Rares Earth)** sangat strategis (industry solar cell dan wind turbine/magnit industry)

Information Classification: General

TERIMA KASIH

Information Classification: General