Tapio Halkoaho (Geological Survey of Finland) 27 November 2022

Commodity	**Nickel (Ni)**	**Data source**
Significance for the EU (2023)	*Critical; Strategic if battery grade*	
Uses of the commodity	Main uses: *Stainless steels (>65 %)* Minor uses: *Superalloys, non-ferrous alloys, batteries, coatings, catalysts, foundry products* Major future uses: *Stainless steels, batteries (strong demand increase forecasted), alloys*	Eynard et al. (2020), IEA (2021), Mudd & Jowitt (2022)
Resources and potential in Nordic countries	*Known resource figures are minimum estimates, as Ni grades are not known or are only partially known for many shale, PGE and talc deposits which contain potential by-product Ni.* Finland: *Known resources at 5,644,000 t Ni, 'undiscovered resources' at regional scale estimated to 5.9 Mt Ni. Additional major potential in Talvivaara-type Ni-Zn-Cu-Co deposits.* Greenland: *Several promising exploration projects for Ni are active but no resource estimates yet available. 'Undiscovered resources' at regional scale estimated to 3.8 Mt Ni.* Norway: *Known resources at 113,000 t Ni (Ni-Cu magmatic deposits).* Sweden: *Known resources at 2,600,000 t Ni, plus extensive potential, particularly in shale-hosted deposits.*	Rosa et al. (2013), Boyd & Gautneb (2016), Rasilainen et al. (2017), Stensgaard et al. (2018), Eilu et al (2021, 2022), Rosa et al. (2023)
Anthropogenic resources and potential in Nordic countries	*Nickel-containing alloys and stainless steel scrap.*	
Main deposit types in Nordic countries	*Orthomagmatic Ni-Cu-Co-PGE deposits, black shales, black schists*	Kolb et al. (2016), Makkonen et al. (2017), Stensgaard et al. (2018)
Main global deposit types	*Orthomagmatic Ni-Cu-Co-PGE deposits, Ni-Co laterites; of local importance are shale-hosted and hydrothermal types*	Mudd & Jowitt (2022)
Global production (2022)	*3,300,000 t Ni (mine production, roughly equals to refinery and smelter production)*	USGS (2023)
Nordic production (2022)	*Mine production: Finland 42,163 t. Smelter production: Finland 68.006 t, Norway 91,100 t*	INSG (2021), Tukes (2023)
Main producing countries (2020, 2022)	*Mining (2022): Indonesia 48.5 %, Philippines 10 %, Russia 6.7 %, New Caledonia 5.8 %,*	BGS (2022), USGS (2023)

	Australia 4.8 %, Canada 3.9 %, China 3.3 %, Brazil 2.5 % *Smelting & refining (2020): China 29 %, Indonesia 25 %, Russia 6.7 %, Japan 6.6 %*	
Technological challenges in production	*Mature production technology, mostly. However, the green transition will increasingly require more nickel, so there probably will be shortages in the future. Extraction from laterites is capital- and operating-cost intensive.*	IEA (2021), Mudd & Jowitt (2022)
Recycling	Present: *Nickel is recovered in connection with the treatment of nickel-containing waste. Nickel-containing alloys and stainless steel scrap are smelted and used to make new alloys and stainless steel.* Future: *The aim is to recover nickel more efficiently from various nickel-containing products, such as recycled batteries. Stainless steel recycling will remain an important nickel recycling route.*	USGS (2022)

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