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Commodity	**Titanium metal (Ti)** ***Only Ti metal is regarded as a critical commodity, TiO_2 pigments are not critical***	**Data source**
Significance for the EU (2023)	*Critical and Strategic*	
Uses of the commodity	Main uses: *Aerospace (Ti metal) Inorganic pigment for paints, plastic, polymers (titanium oxide)* Minor uses: *Medical equipment, automotive, steam generators, hardmetal, other alloy uses (all Ti metal)* Future uses: *Alloy use to increase (aerospace, automotive, construction); this means a potentially large increase in Ti metal demand*	Latunussa et al. (2020), JRC (2022), USGS (2022)
Resources and potential in Nordic countries	Finland: *Known resources: 21.1 Mt Ti. Otanmäki deposit: 14 Mt @ 40 % Fe, 7.6 % Ti, 0.26 % V; Koivusaarenneva: 14 Mt @ 0.13 % V, 9.7 % Ti. 'Undiscovered resources' at regional scale estimated to 380 Mt Ti.* Greenland: *Known resources: 12.1 Mt Ti. Isortoq N dyke 70.3 Mt @ 6.53 % Ti, 0.081 % V, 26.9 % Fe; Moriusaq heavy-mineral sand: 117 Mt @ 1.7 % Ti. 'Undiscovered resources' at regional scale estimated to 65 Mt Ti.* Iceland: *Minor potential for on- and offshore heavy-mineral sands derived from gabbro intrusions, Lón district, SE Iceland.* Norway: *Known resources: 99.4 Mt. In the multi-commodity Bjerkreim-Sokndal intrusion, in total 2 Gt JORC-compliant resources have been defined with varying tonnage-grade ratios. Of these, the Storeknuten area is constrained to: 420 Mt @ 2.85 % Ti, 0.04 % V, 3.4 % P_2O_5; Selvåg intrusion: 44 Mt @ 2.5 % Ti, 0.15 % V; Engebøfjellet eclogite: 133.2 Mt @ 2.1 % Ti (rutile) (measured and indicated). The Engebø reserve base is 57 Mt. Tellnes: 500 Mt @ 10.8 % Ti, Storgangen 60 Mt @ 10.2 % Ti.* *Very large potential for further hard-rock hosted rutile deposits in the Sunnfjord region, also hosting the Engebø deposit.* Sweden: *Known resources: 6.1 Mt Ti. Routivare malmfält 140 Mt @ 5.7 % Ti, 0.2 % V*	Eilu et al. (2021, 2022), Rosa et al. (2022)

Anthropogenic resources and potential in Nordic countries	*Steel-plant slag and old scrap*	Newman (2015)
Main deposit types in Nordic countries	*AMCG-hosted ilmenite-rich massive and layered intrusions. Rutile-bearing eclogites with gabbroic precursors. Layered mafic-ultramafic intrusions, V-Ti-Fe ± apatite ore bodies in mafic intrusions. Heavy-mineral sands in Greenland and Iceland.*	Eilu et al. (2021, 2022)
Main global deposit types	*Main source for Ti is heavy-mineral sand deposits (rutile, ilmenite). Other sources of Ti are the layered mafic-ultramafic intrusions and V-Ti-Fe ± apatite ore bodies in mafic intrusions.*	USGS (2022)
Global production (2020; 2021, 2022)	*2020: 3.89 Mt (BGS) or 5.05 Mt (Reichl & Schatz). 9,5 Mt (USGS, 2023)* *2021: 5.42 Mt (USGS 2022); all values as Ti content in mined ore.* *2020: 245,000 t Ti metal* *2021: 210,000 t Ti metal* *2022: 260,000 t Ti sponge metal production*	BGS (2022), JRC (2022), Reichl & Schatz (2022), USGS (2022, 2023)
Nordic production (2021)	*No Nordic Ti mineral production is used for Ti sponge. 189,000 t Ti (mine production for pigment, all from Norway); 36,000 t TiO_2 (refinery to titan slag from imported ore, all from Norway).*	Eilu et al. (2021), Vasara et al. (2022)
Main producing countries (2022)	*Mining (2021): China 38.2 %, Mozambique 13.5 %, South Africa 10.1 %, Australia 7.4 %, Canada 5.3 %, Norway 4.8 %* *Ti sponge (2022): Total production 266,000 t China 56 %, Japan 20 %, Russia 13 %*	Savtchenko (2022), USGS (2023)
Technological challenges in production	*No major issues with technology in TiO_2 production. On the other hand, titanium sponge (Ti metal) production is energy intensive, and an overwhelming majority is produced in China with energy from coal-fired power plants. In addition, aerospace-quality Ti sponge production is restricted to very few countries pointing towards technology issues.*	JRC (2022)
Recycling	<u>Present:</u> *Scrap and slag recycling is relatively easy, longstanding practice. The recycling input rate for titanium is estimated to 19 %. Very little recycling of used titanium oxide?* <u>Future:</u> *In the future, recycled titanium will only cover a small share of the demand, due to a fast-rising consumption.*	UNEP (2011), Newman (2015), Latunussa et al. (2020)

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