Panu Lintinen (Geological Survey of Finland) 19.1.2023

Commodity	**Phosphorus (phosphate, phosphate rock)**	**Data source**
Significance for the EU (2023)	*Critical, not strategic*	
Uses of the commodity	Main uses: *Fertilisers (90 %)* Minor uses: *Metallurgic industry, electronics, pyrotechnics, organic synthesis, feed for livestock, cleaning and fire-resistant substances, matches, medicines, insecticides, herbicides, flotation reagents, matt glasses, ceramics* Future uses: *Fertilisers to remain the by far dominant use, with a demand is in a constant increase directly linked to human population growth. Use in batteries and electronics is assumed to increase but remain minor compared to the demand in fertilisers.*	Latunussa et al. (2020), USGS (2023)
Resources and potential in Nordic countries	Estonia: *Known resources 300 Mt P in sedimentary phosphorites.* Finland: *Known resources 267 Mt P. 210 Mt of known resources are contained in the speculative Sokli hard-rock resource of 12 Gt @ 4 % P_2O_5.* Greenland: *Known resources 11.5 Mt P in carbonatites.* Norway: *Known resources 24 Mt P. Resources include the AMCG-hosted Bjerkreim P-Ti-V deposit, with high-tonnage JORC compliant resources, the 50 Mt Kodal Fe-Ti-P deposit (JORC), the metasomatic Ødegården deposit, and the ultrapotassic Misværdal deposit in Nordland. The potential resources of apatite are large but unconstrained.* Sweden: *Known resources 36 Mt P (27 Mt is included in iron oxide–apatite deposits of Kiruna and Gällivare-Malmberget metallogenic areas)*	Gustafsson (1979), Noholt et al. (2005), Lauri et al. (2018), Yang et al. (2021), FODD (2022), LKAB (2022), Rosa et al. (2023)
Anthropogenic resources and potential in Nordic countries	*Animal manure, sewage, and food waste; minor volumes recovered from municipal waste solids.*	
Main deposit types in Nordic countries	*Sedimentary phosphorites (Estonia), igneous carbonatite intrusions (Finland), iron oxide–apatite deposits (Sweden), mafic intrusions (oxide-apatite gabbros) (Norway, Finland)*	Lauri et al. 2018
Main global deposit types	*Sedimentary phosphorites. Igneous alkaline and carbonatitic intrusions.*	Latunussa et al. (2020), USGS (2023)
Global production (2022)	*Mine production 220 Mt of phosphate rock (equals to 29–40.7 Mt P). No accurate phosphorus content is available of the 'phosphate*	(IFDC 2010), Latunussa et al. (2020), USGS (2023)

	rock' in the global statistics, as the grade varies (from 30 % to 42 % P_2O_5), and companies and countries commonly do not disclose the details. About 0.5 % of mined phosphorus is refined to elemental P.	
Nordic production (2021)	*180,000 t P (mine production at Siilinjärvi, Finland). No commensurable data about Nordic refinery production is available.*	
Main producing countries (2021)	*China 38.6 %, Morocco and West Sahara 18.2 %, United States 9.5 %, Russia 5.9 % (mining). No commensurable data about refinery production is available.*	USGS (2023)
Technological challenges in production	*None*	
Recycling	Present: *There are "natural" waste flows substituting some of the use of mineral phosphate fertilizers. However, no useable data exists on the rate of effective reuse of phosphorus for manures, other organic forms, and from municipal waste, which replace the use of fertiliser or other phosphate rock derived chemicals.* Future: *Processes of producing elemental phosphorus from phosphorus-rich waste streams are expected to become operational sometime in the future. Experimental bacteriological recycling of phosphorous are under development in Norway, with struvite as a synthetic P-bearing mineral.*	Latunussa et al. (2020) www.hias.no/prosjekter/prosjekter-i-hias/gjodselfabrikken/nytt-biologisk-rensetrinn-i-full-skala-drift/

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