Pasi Eilu (Geological Survey of Finland), 22 May 2019
Update by Jakob Keiding (Geological Survey of Denmark and Greenland), 10 January 2023

Commodity	**Hafnium (Hf)**	**Data source**
Significance for the EU (2023)	*Critical, not strategic*	
Uses of the commodity	Main uses: *Superalloys. Mainly used in rods for nuclear reactors and as structures in water-cooled reactors.* Minor uses: *Filament in incandescent lights, cathodes in X-ray tubes, electrodes in high-pressure discharge tubes, ceramic materials, microchips, and nozzles for plasma arc cutting.* Future uses: *Solar cells (CIGS), IR and fibre optics, thermoelectric materials, radiative cooling materials, radiation oncology.*	Perks & Mudd (2019), USGS (2023), Ecclestone (2020), Latunussa et al. (2020)
Resources and potential in Nordic Countries	*There are no ores with Hf as a major commodity in the Nordic countries or elsewhere in the world. Known resources: Greenland 108,000 t; Sweden 6,800 t.* *Resource potential: A potentially very large resource at Sokli, Finland. For Greenland, Norway, Sweden: Potential in all Zr-rich mineral resources.*	Short et al. (2015), Lauri et al. (2018), Latunussa et al. (2020), Eilu et al. (2022), Rosa et al. (2023)
Anthropogenic resources and potential in Nordic countries	*None known*	
Main deposit types in Nordic countries	*Hafnium occurs in zirconium minerals in alkaline intrusions and carbonatites.*	Eilu et al. (2022), Jonsson et al. (2022)
Global production (2021)	*The metal is a by-production of zirconium production. Refinery production of about 70 t.*	Ecclestone (2020), Latunussa et al. (2020), USGS (2022)
Nordic production	*None*	
Main producing countries (2022)	*Assumed based on zircon, mine, production; Australia 35.7 %, South Africa 22.9 %, China 10 %, USA and Mozambique 7.1 %. Refined production mostly(?) from imported zircon: France 50 %, USA 44 %, China 3 %, Russia 3 %.*	USGS (2023)
Main global deposit types	*Hafnium occurs in all zirconium minerals. It is a by-product from zircon and baddelleyite mining. No deposits with Hf as a major commodity are known. Heavy mineral sands dominate. The only hard-rock Zr mine in the world is in the Kovdor carbonatite, Russia, which may also produce raw material for Russian Hf refining.*	Perks & Mudd (2019), Latunussa et al. (2020)

Technological challenges in production	*There are environmental issues related to zircon treatment. Expensive and difficult extraction from zircon and baddelleyite due to the chemical similarity of Hf and Zr.*	Perks & Mudd (2019), USGS (2019)
Recycling	Present: *Current recycling less than 1 % of annual demand.* Future: *Potentially recoverable from recycled zircon. Contamination in the nuclear industry and the low content in super alloys are the major hinders for current and future recycling.*	Latunussa et al. (2020)

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