

# WMF CRITICALITY ASSESSMENT

by BRGM, CRU & MCKINSEY

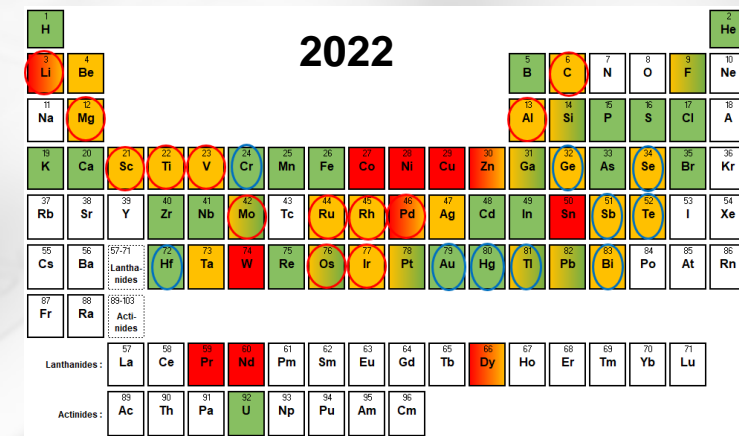


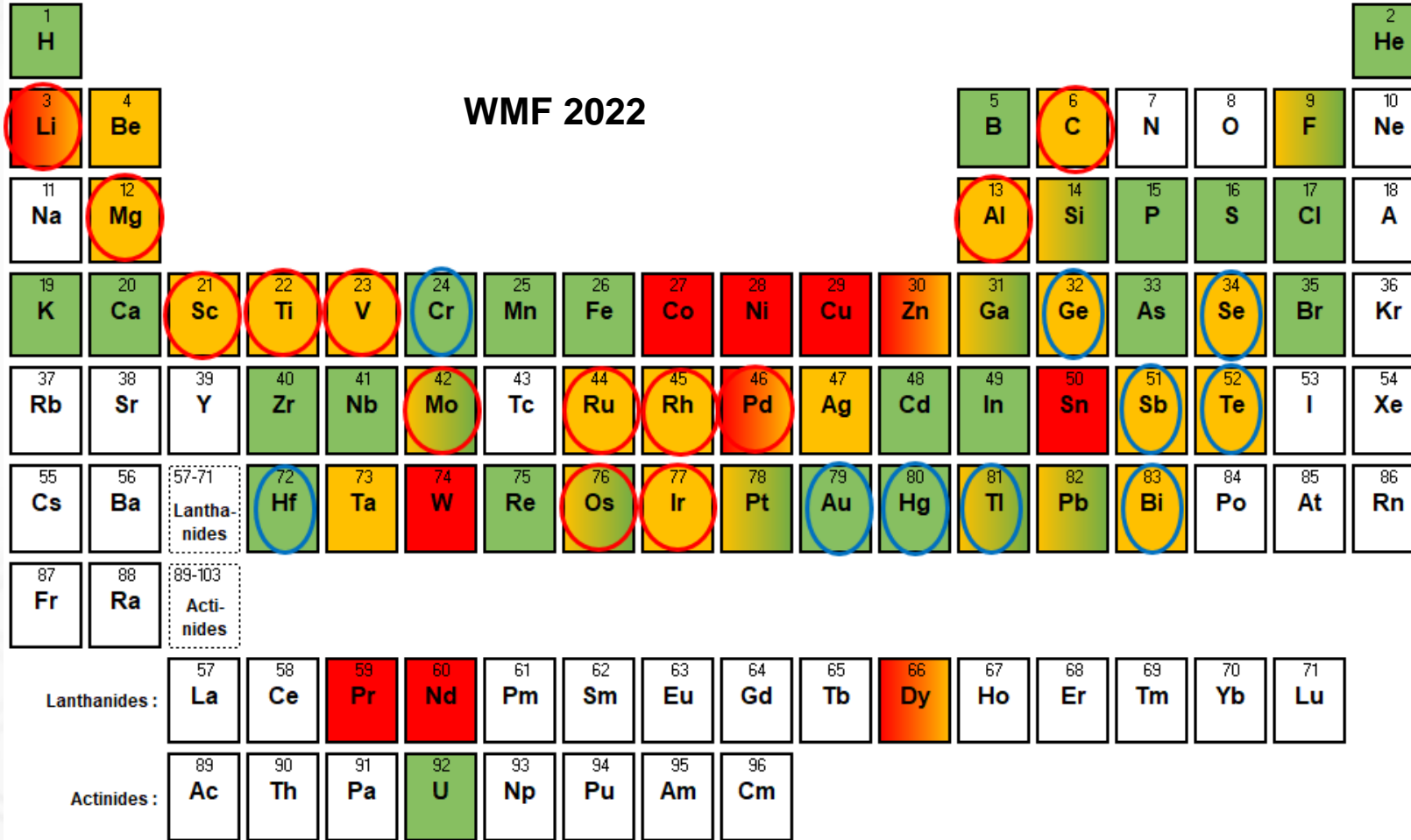
**Christophe POINSSOT,**  
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# WMF Criticality assessment methodology

- Robust and traceable KPIs for identifying critical raw materials for industry
- Methodology is based on 7 quantitative and qualitative KPIs, with Environmental Performance introduced in 2021
- In 2022, change of Political exposure indicator from Fraser to World Bank WGI

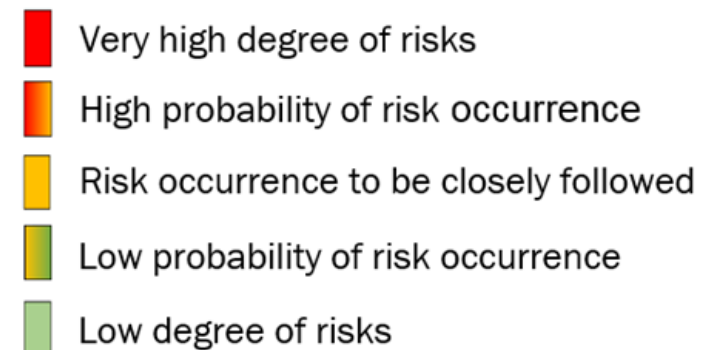
1	<b>Lifespan of known reserves</b>	<i>Based on reserves and production by USGS</i>
2	<b>Uncertainty of supply</b>	<i>Anticipated deficit based on demand/supply scenarios</i>
3	<b>Political exposure of supply</b>	<i>Weighted WGI on main production countries</i>
4	<b>Supply chain recycling</b>	<i>Qualitative assessment of current recycling technologies</i>
5	<b>Uncertainty of demand</b>	<i>Qualitative assessment of the predictability of main demand drivers</i>
6	<b>Vulnerability to the absence of substitution</b>	<i>Qualitative assessment of the availability of alternative materials</i>
7	<b>Environmental Performance</b>	<i>Averaged measurable indicators on water&amp;energy footprint</i>





## Red elements combine:

- Role in electrification & energy transition
- Long term uncertainties
- Short term supply chain bottlenecks
- Limited substitution possibilities



**Less critical in 2022:** 10 elements – Cr, Ge, Se, Sb, Te, Hf, Au, Hg, Tl, Bi



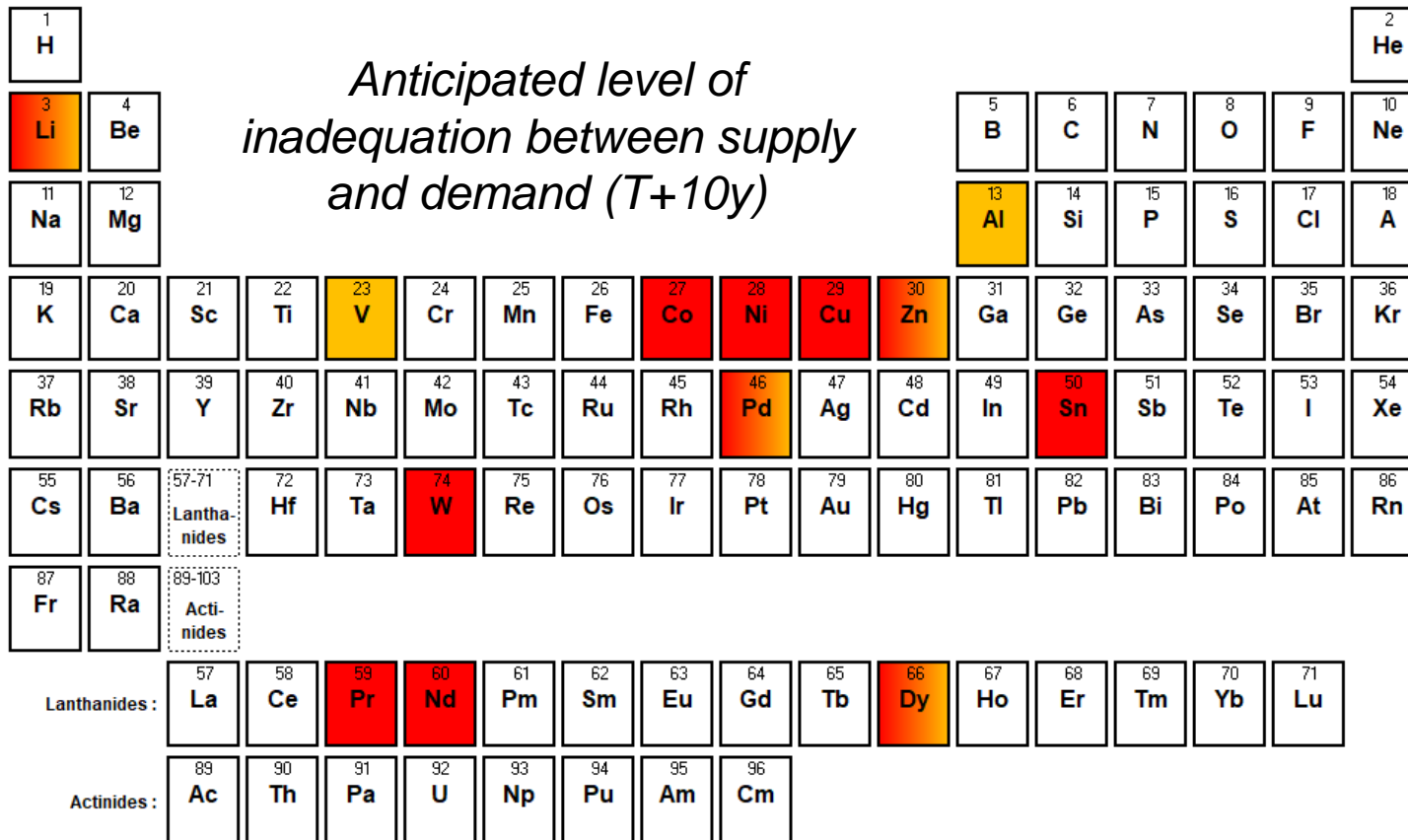
**More critical in 2022:** 13 elements – Li, C, Mg, Al, Sc, Ti, V, Mo, Ru, Rh, Pd, Os, Ir

Note: Elements in white have not been assessed

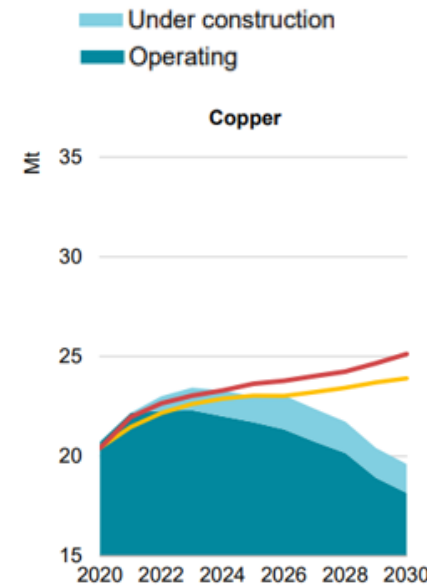
# 2022 : focus on criteria 2: Uncertainty of supply

- Supply cliffs anticipated for energy transition metals due in particular to:
  - Development time for new mining projects (especially grassroots)
  - Financing challenges

*Anticipated level of inadequation between supply and demand (T+10y)*

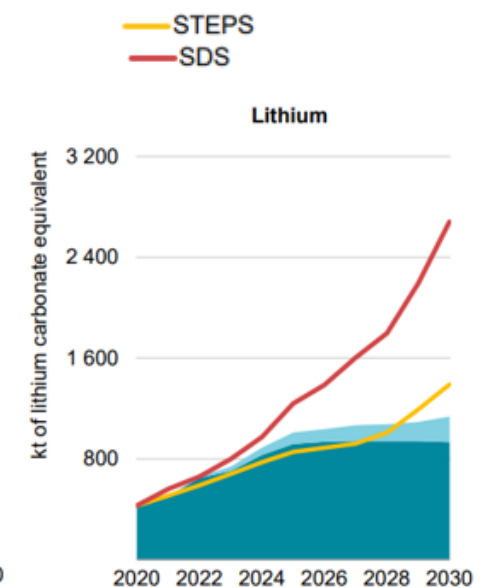


Production outlook



Source : IEA – 2021

Primary demand scenarios



STEPS = Stated Policies Scenario  
SDS = Sustainable Development Scenario

# Global impacts of Ukraine's invasion by Russia

- **Russia = strategic position on several supply chains**

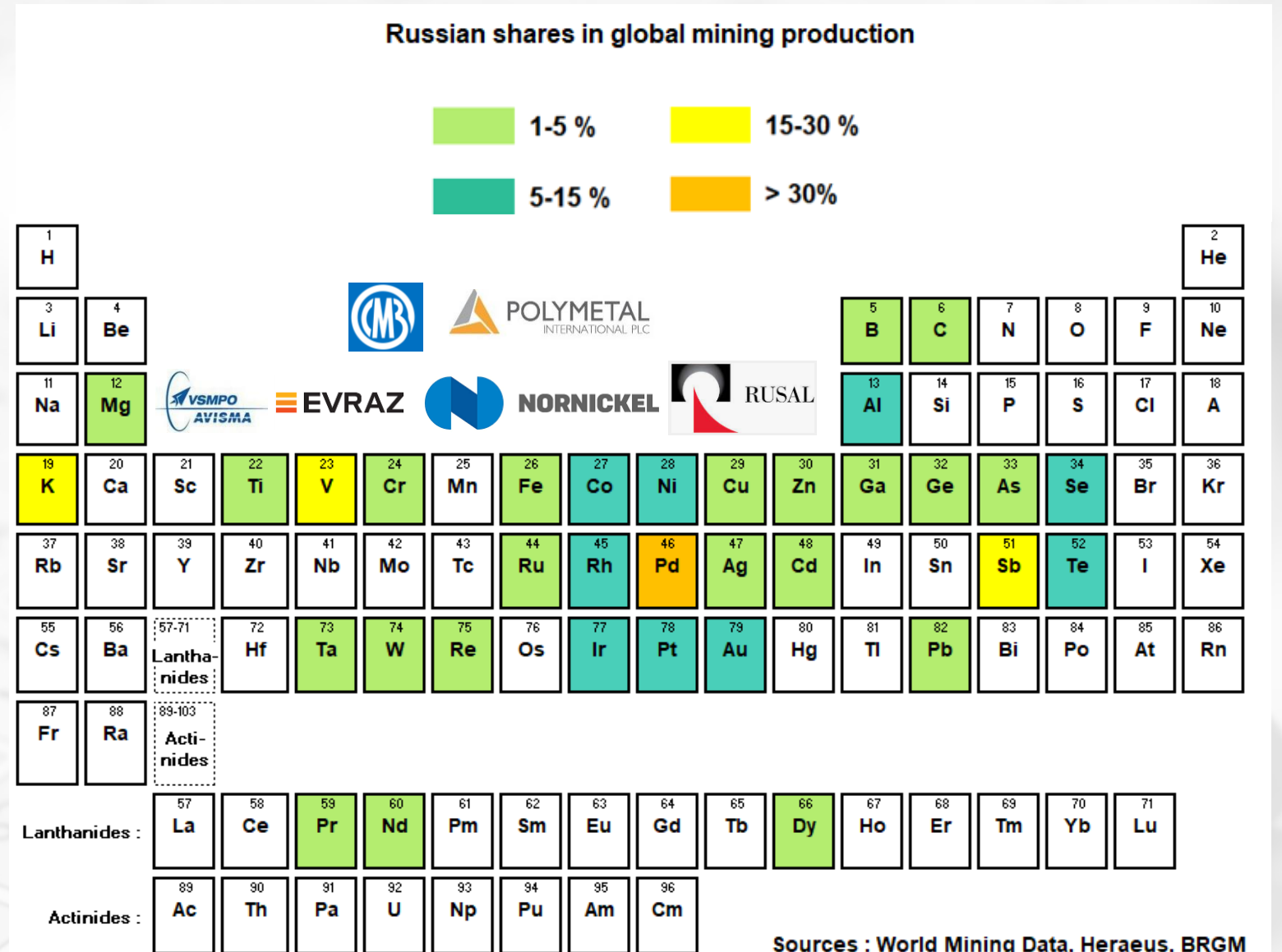
- Although <30% at the world level, Russia is responsible for a great diversity of metals production
- The highest is for palladium (37%)

- **Large number of integrated companies and key role on bottlenecks**

- Palladium, Nickel, Cobalt (Nornickel)
- Aluminum (Rusal)
- Titanium (VSMPO AVISMA)
- Vanadium (Evraz)

- **Long term potential risks**

- Impact of continued escalation of sanctions (EU oil imports ban) and Russian responses (exports bans on metals, nationalizations...)
- Large scale mining projects in Russia are put at risk
- Commercial routes affected in CIS countries (e.g. Kazakhstan)





## ■ Geopolitical exposure and sanctions

- Russia 2<sup>nd</sup> supplier of Pd in 2021 after South Africa
- April 2022: London Platinum and Palladium Market (LPPM) and CME Group removed 2 Russian refiners from accredited lists → exclusion of newly minted ingots → **price reaction**

### PGM production in Russia in 2021 (Heraeus)

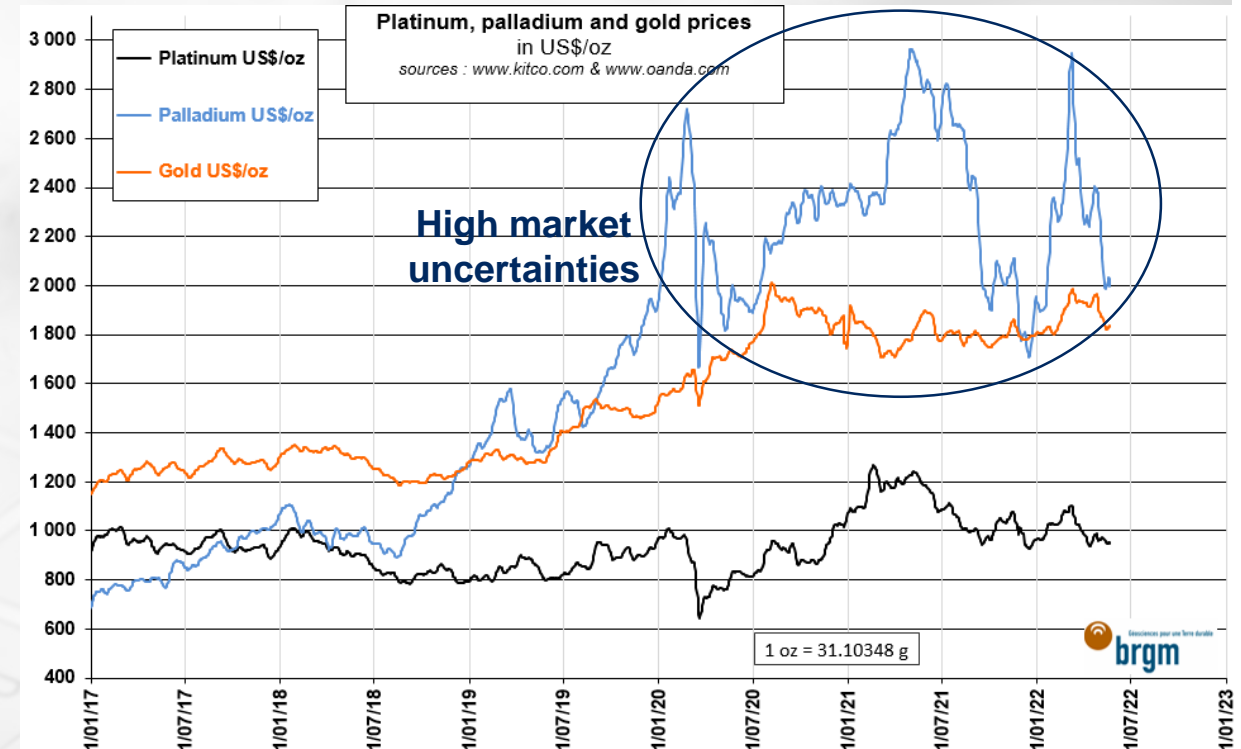
PGM	Pd	Pt	Rh	Ir	Ru
Global rank	2 <sup>nd</sup> (37%)	2 <sup>nd</sup> (9,5%)	2 <sup>nd</sup> (9,1%)	3 <sup>rd</sup> (6,8%)	3 <sup>rd</sup> (3,3%)

## ■ Future supply-demand balance at risk

- **Global uncertainty** on future conventional ICE automotive market
- **Limited geological alternatives for new deposits** except for South Africa with risks associated:
  - Threats of strikes in the PGM mines
  - Risk of power failure with Eskom
  - Mining production costs are increasing

## ■ Impacts on Platinum Group Metals (PGMs) supply

- Anticipated tightness on associated markets with high demand profile (especially Ir and Ru)
- Same geological problematics combined with supply inelasticity (by-products)



# Specific impacts of Ukraine's invasion on EU supply chains

- **EU dependency exposure highlighted**

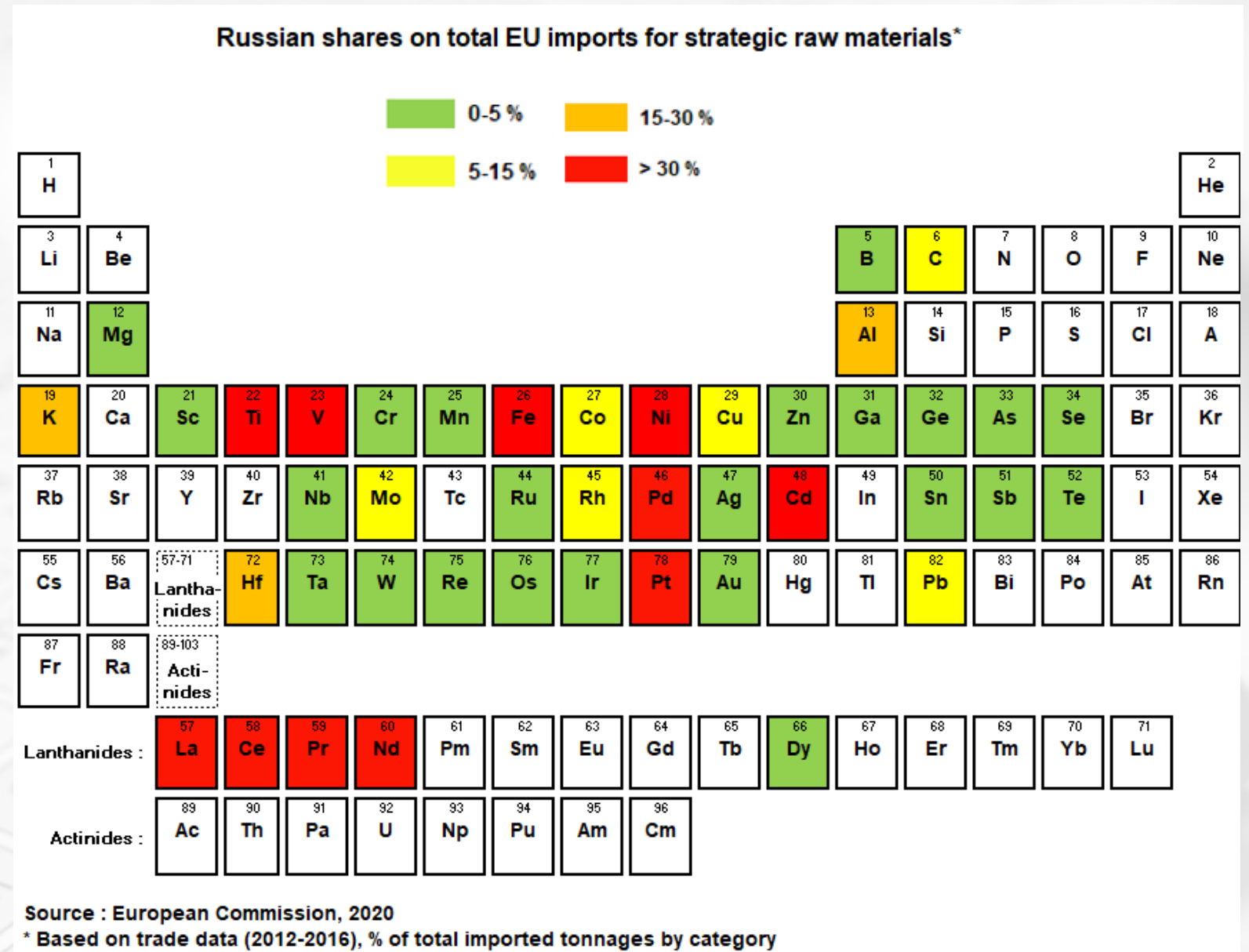
- Many industrial EU supply chains highly dependent on Russia on metals' supply

- **Increased pressure on supply chains**

- Difficult pre-existing context for several OEMs
  - Covid crisis
  - Semiconductors crisis
  - Energy crisis
  - Inflationary pressures
- LT trends impacting supply disruptions have been reinforced

- **Collective reactions needed**

- Positive consensus on EU economic sanctions
- New national initiative on mineral intelligence (OFREMI)
- Need to integrate responsible mining in EU taxonomy



## ■ EU Geopolitical exposure on alumina and aluminium products

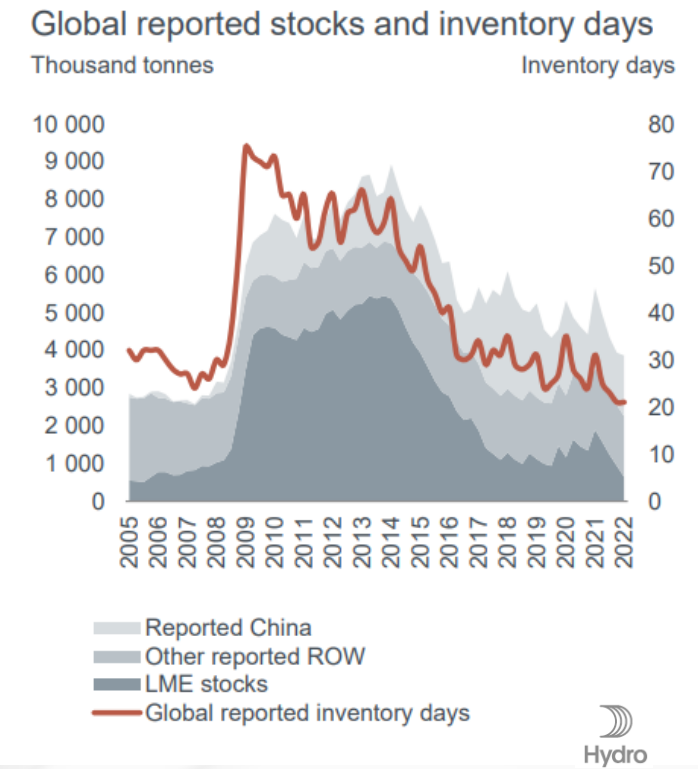
- Russia : 15%-20% of EU imports of primary Al products (~1 Mt/y of Al)
- Rusal's positioned as a key supplier of alumina, mainly through the Aughinish refinery in Ireland (~85% of France supply) used by aluminium producers

## ■ Reinforced tightness on the aluminium market

- Prior to Russia's invasion:
  - Supply cuts in China to contain CO<sub>2</sub> emissions
  - Prohibitive production costs in Europe linked to higher energy prices leading to cuts (close to 750 kt off the market)
  - LME stocks at the lowest since 17 years - Global stocks continuous decrease

## ■ Short term consequences of the war

- March 2022 : fears from financial sanctions → Aluminum price rally
  - Sanctions materialized by UK asset freeze on Rusal's owner Deripaska
  - Rusal's Nikolaev Al-refinery in Ukraine halted
  - Continued closures in Europe (Essen plant, Trimet, Germany – 35 kt)
- According to Goldman Sachs "900 kt/year production at risk due to loss of alumina supply as result of eventual suspension of primary smelting capacity in Russia"





THANK YOU



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Experts in Mineral intelligence