

# Extractive resources & the circular economy?

Tony Knight

Chief Government Geologist

July 2023



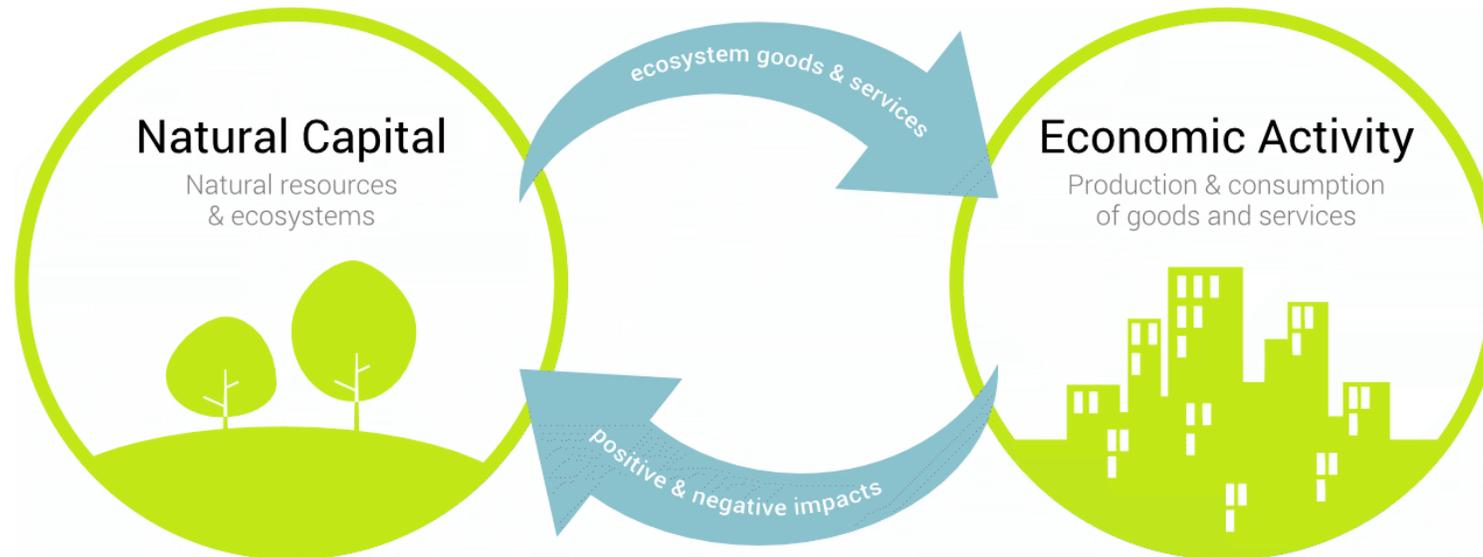
# Natural resources & mineral resources

## Natural capital

....the global stock of renewable and non-renewable resources....plants, animals, air, water, soils, minerals.. that combine to yield a flow of benefits and services to people

## Mineral resources are part of our natural capital

....essential for industrial and economic development of civilisation



# Mineral resources have long been fundamental to civilization & development



**Copper age**  
10,000 years ago



**Bronze age**  
5,500 years ago

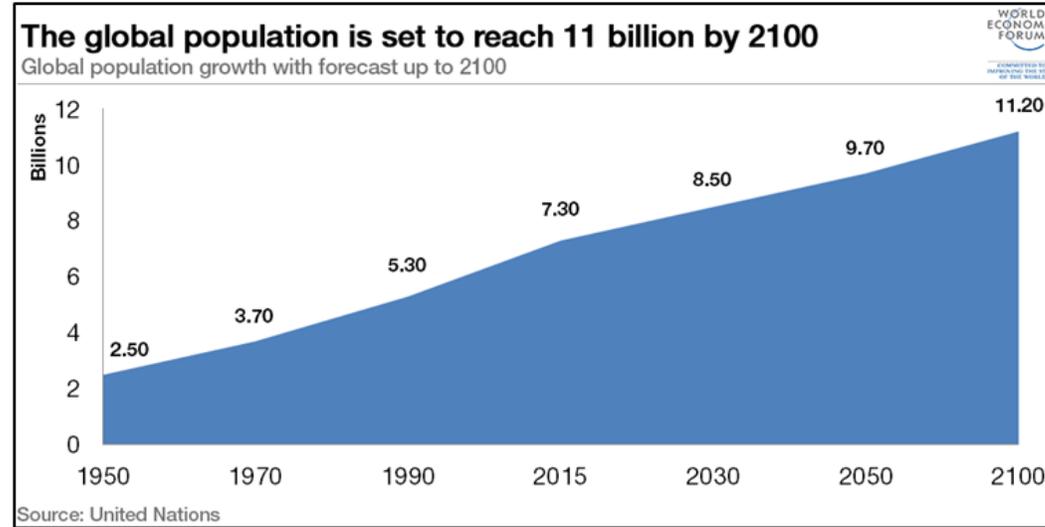


**Iron age**  
2,000 years ago

# Mineral resources: demand and limits of sustainability

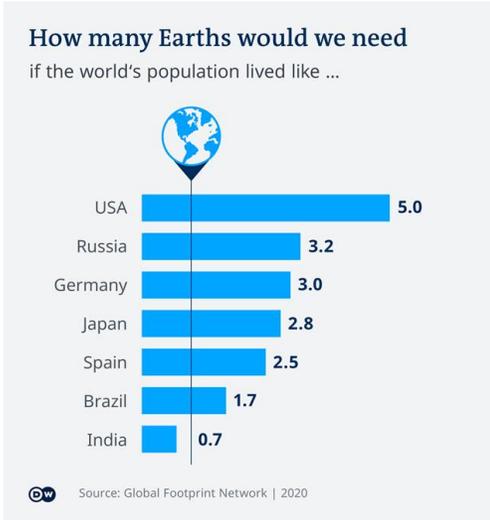
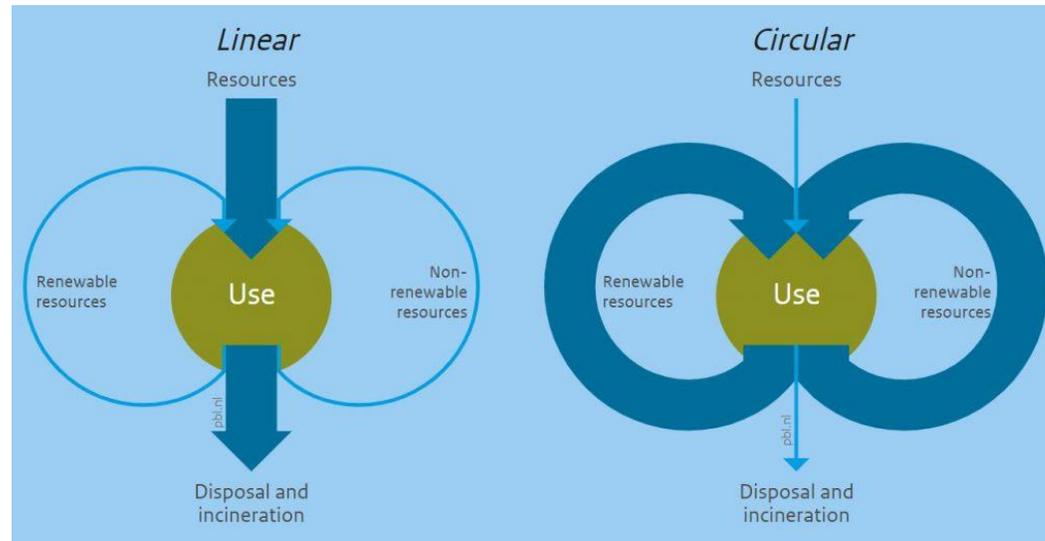
## Demand growth

- Global population
  - 1800 ~ 1 billion
  - 2100 ~11 billion

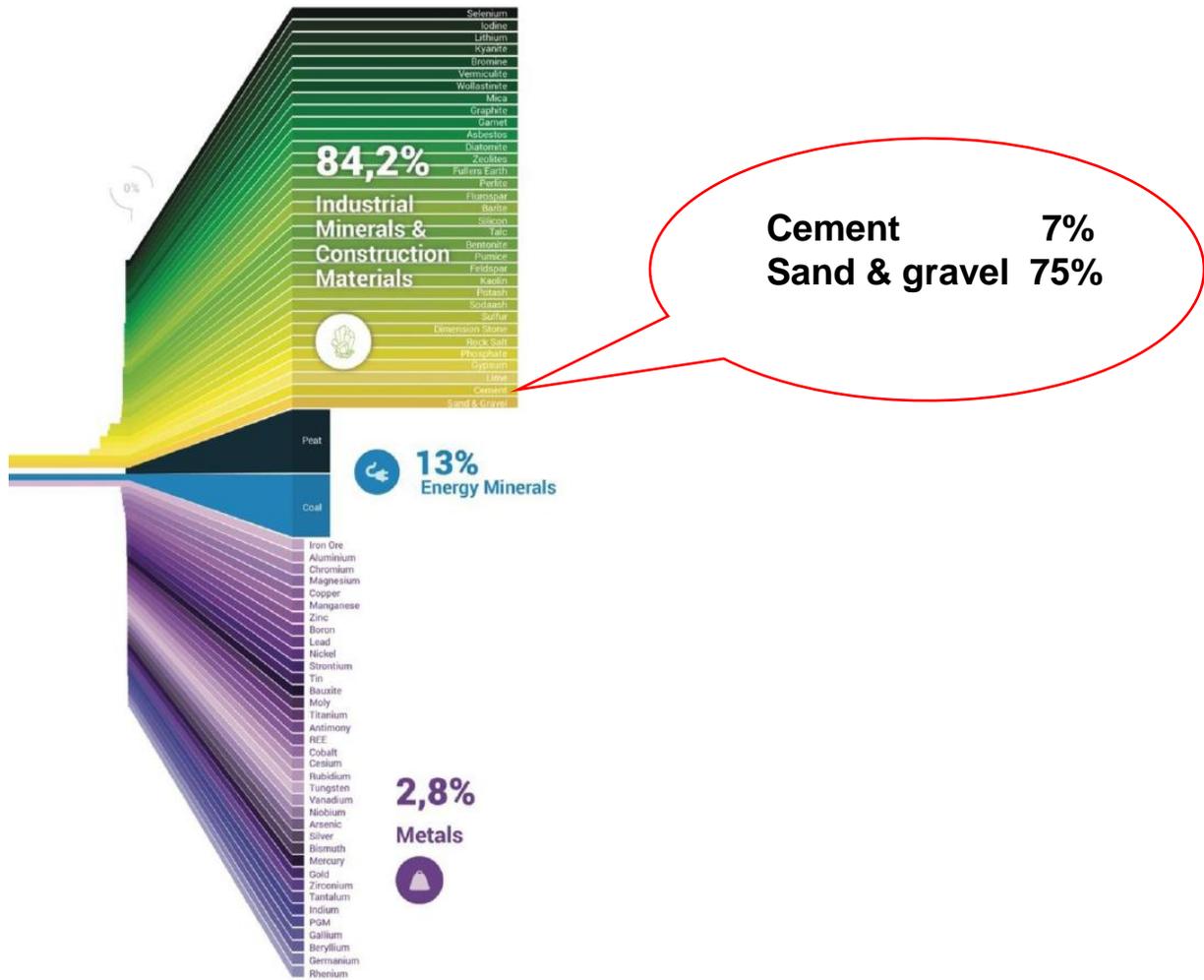


## Economic growth ~ consumption

- Linear economy – “take, make, waste”, deplete natural capital
- Circular economy – “take, make, re-use, recycle”, sustain natural capital



# Construction materials: dominate world production & use



- Sand and gravel comprise >75% of geological resources used globally
- Primary uses are in concrete
- An average new house needs 100t of sand, gravel and cement
- Each kilometre of a 2-lane asphalt road needs 14,000t of gravel
- Each Queenslander needs ~ average 10t/p.a for roads, houses & infrastructure



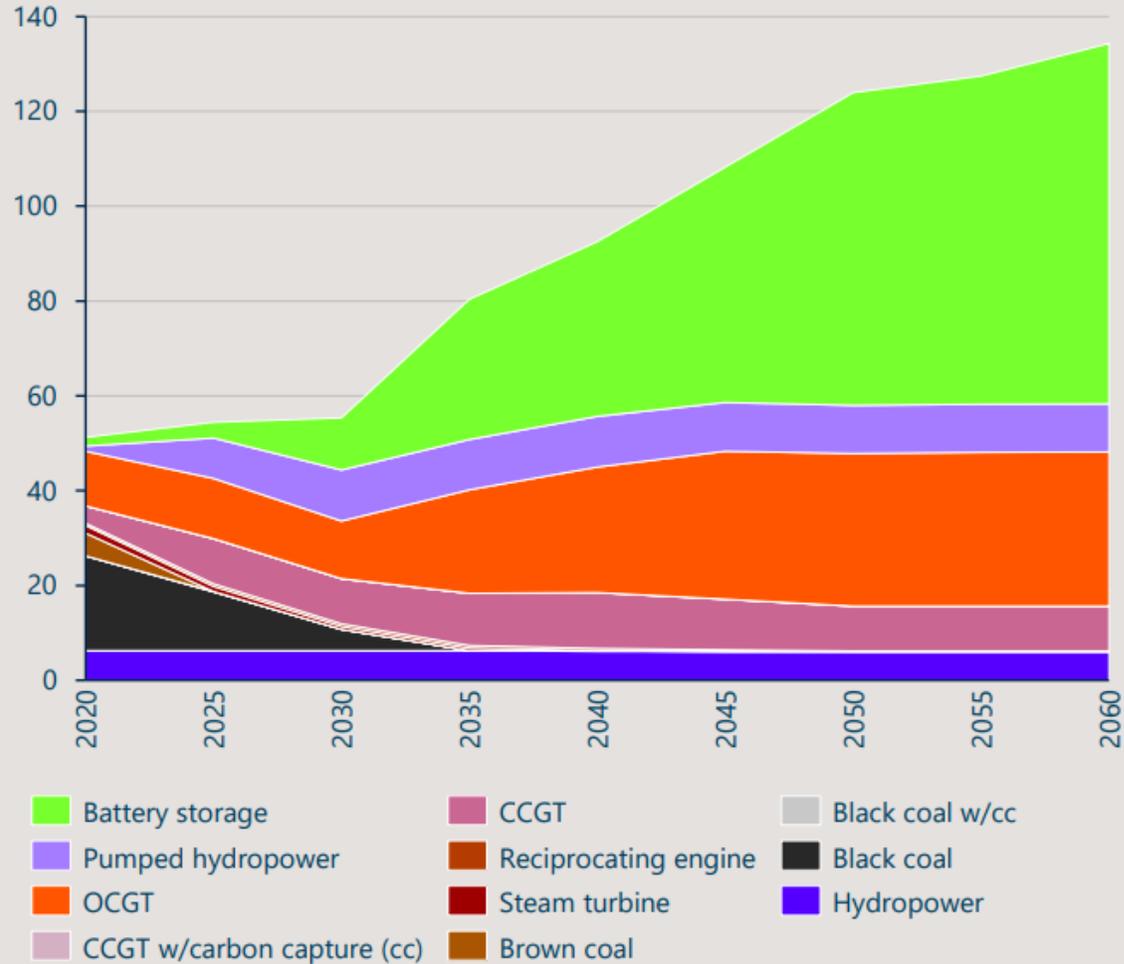
## Queensland: Construction materials

- **Queensland Resources Industry Development Plan** was released on 24 June 2022
- It included an action to “*develop a fit-for-purpose extractive industry assessment framework....to balance the impacts of extractive industries with local and state need for construction materials to support infrastructure priorities.*”
- **Key issues**
  - Identification of Resources and Forward Planning
  - Assessment
  - Approvals and Compliance



## Significant domestic storage and generation capacity is needed to firm renewables.

Projected domestic firm electric & storage capacity by technology (GW, E+ Scenario).<sup>1</sup>



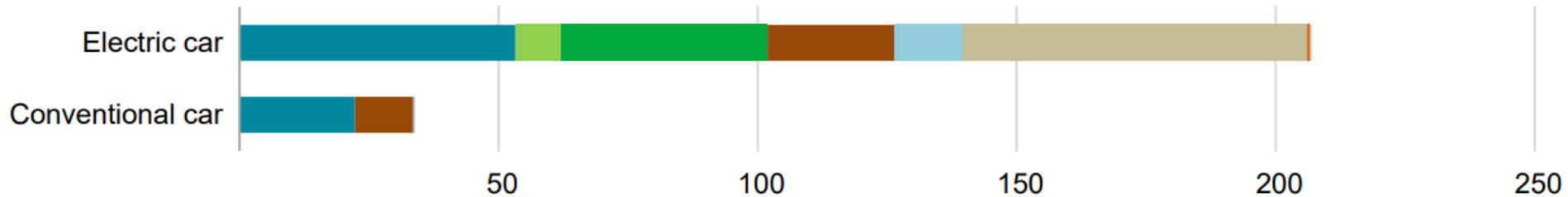
1. Net Zero Australia, 2023, [Downscaling – Firm generation and pumped hydro energy storage](#).  
 2. Clean Energy Council, 2022, [Clean Energy Australia Report](#).



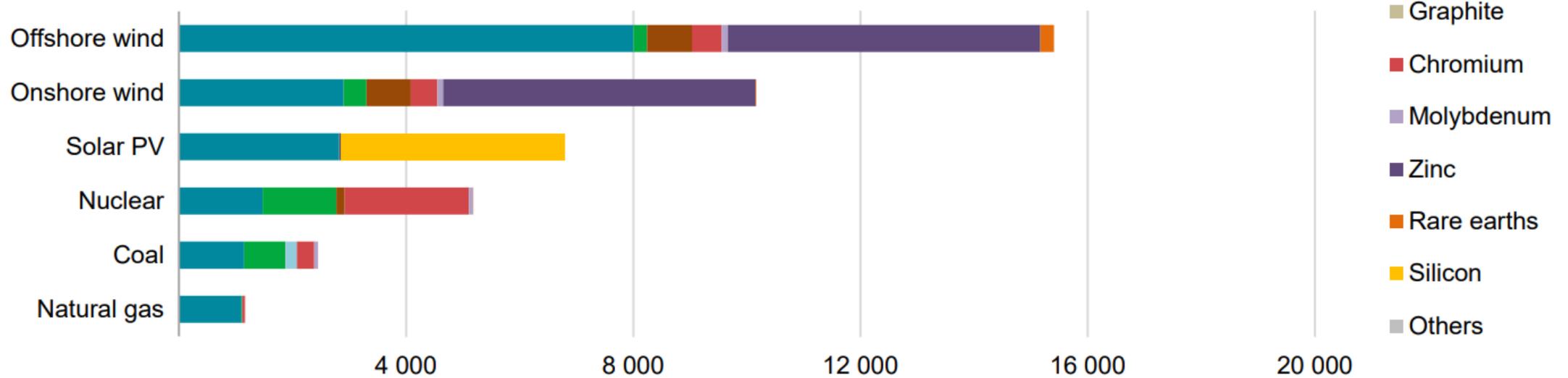
# The rapid deployment of clean energy technologies as part of energy transitions implies a significant increase in demand for minerals

Minerals used in selected clean energy technologies

## Transport (kg/vehicle)

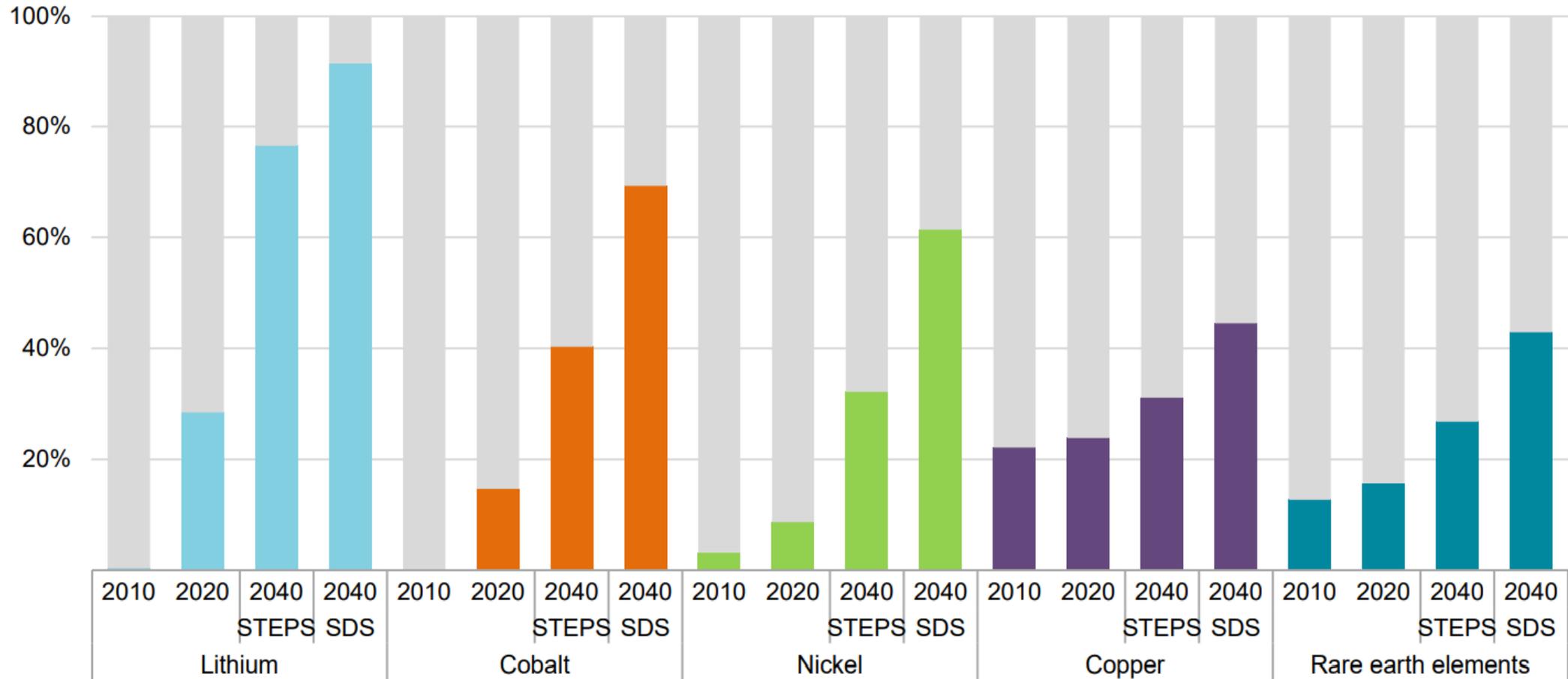


## Power generation (kg/MW)



## The energy sector becomes a leading consumer of minerals as energy transitions accelerate

Share of clean energy technologies in total demand for selected minerals



IEA. All rights reserved.

STEPS = Stated Policies Scenario  
 SDS = Sustainable Development Scenario



Queensland Government

## Circular economy principles: extractive resource management

CE strategy	CE applications in mining
<b>Refuse</b>	<ul style="list-style-type: none"> <li>• Avoid investments in new mine sites</li> </ul>
<b>Rethink</b>	<ul style="list-style-type: none"> <li>• Rethink mining low grade ores</li> <li>• Sharing infrastructure at the mine site or between co-located mines (e.g., water pipeline networks, minerals processing and smelting facilities)</li> <li>• Standards development to define economic secondary reserves and resources</li> </ul>
<b>Reduce</b>	<ul style="list-style-type: none"> <li>• Increased efficiency in the mining process and waste reduction</li> <li>• Reduce demand for virgin materials by replacing with secondary materials</li> <li>• Improving efficiency – resource use, minerals processing</li> </ul>
<b>Reuse</b>	<ul style="list-style-type: none"> <li>• Resource maximisation by reusing ores and tailings</li> <li>• Reopening old mine sites</li> </ul>
<b>Repair</b>	<ul style="list-style-type: none"> <li>• Repairs of mine site equipment to increase lifespan and improve performance</li> <li>• Extending lifetime of infrastructure</li> </ul>
<b>Refurbish</b>	<ul style="list-style-type: none"> <li>• Refurbishment of mine site equipment</li> <li>• Utilising the mine site for an alternate use</li> <li>• Extending lifetime of infrastructure</li> </ul>
<b>Remanufacture</b>	<ul style="list-style-type: none"> <li>• Remanufacturing equipment for use in mining or other sites</li> <li>• Remanufacturing products along the supply chain</li> </ul>
<b>Repurpose</b>	<ul style="list-style-type: none"> <li>• Transforming mine site for new applications (e.g., GENEX in Queensland have transformed an old gold mine into pumped hydro)</li> </ul>
<b>Recycle</b>	<ul style="list-style-type: none"> <li>• Reprocessing mineral waste</li> <li>• Recycling activities to transform mine residue for use in other sectors (construction, roads)</li> </ul>
<b>Recover and Restore</b>	<ul style="list-style-type: none"> <li>• Resource recovery from by-products and waste</li> <li>• Restoration of a mine’s geological environment during decommissioning</li> <li>• Environmental remediation</li> <li>• Topsoil management</li> <li>• Best management practices for infrastructure and equipment at the end of life</li> </ul>

# Vanadium

## Emerging suppliers (company & project)

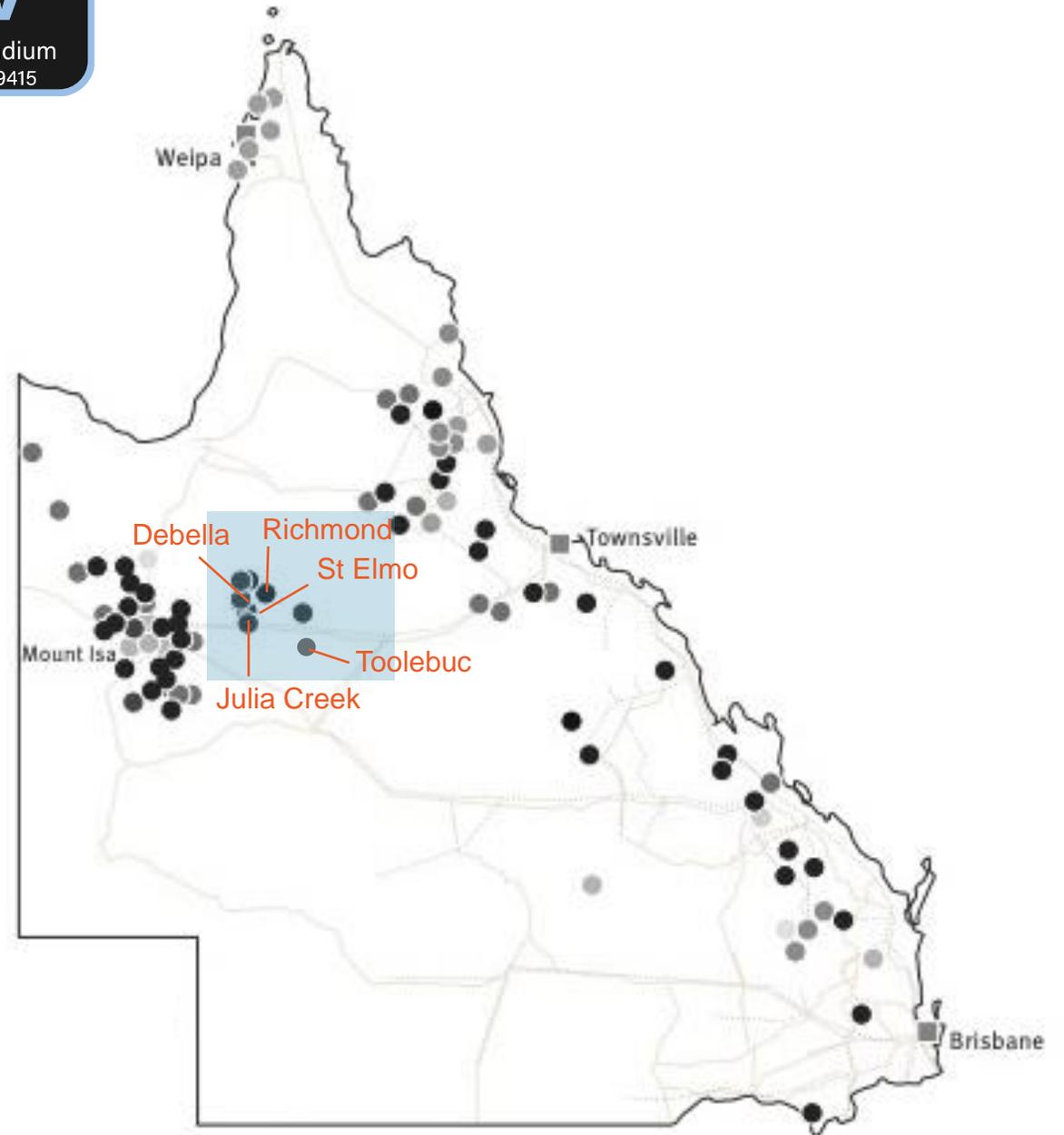
- Multicom – St Elmo
- Vecco – Debella
- QEM Pty Ltd – Julia Creek
- Vanteq Minerals – Julia Creek
- Critical Minerals Group – Julia Creek
- Currie Rose (TSXV) – Toolebuc
- Horizon Minerals – Richmond
- V2O5 Pty Ltd

## Mineral processing

- Townsville – common-user demonstration scale facility being developed by Qld Government

## Current primary supplies of vanadium

- Russia, China, South Africa





Actions for key focus area 1: **Grow and diversify the industry**

ACTION	LEAD AGENCY AND TIMELINE	DESCRIPTION
<p>2. \$22.6 million to deliver Queensland's Collaborative Exploration Initiative</p>	<p>Lead: Government (Department of Resources) When: 2022–27</p>	<p>Finding the deposits that will deliver the needs to decarbonise is a key opportunity. The Queensland Government will invest \$22.6 million over five years in the Collaborative Exploration Initiative (CEI) to \$22.6 million over five years to help companies to discover the future minerals that the world needs.</p>
<p>3. \$10 million for Geophysics for Discovery</p>	<p>Lead: Government (Department of Resources) When: 2022–24</p>	<p>It is essential that prospective investors in Queensland have a strong 'big picture' view of the state's mineral potential. The Queensland Government will invest \$10 million over five years in geophysics, aeromagnetics, gravity, and magnetic mineral systems underground (such as iron ore) to help build a picture for developers and investors. The data will be freely and publicly available on the Open Data Portal.</p>
<p>4. \$5 million for better defining our new economy mineral potential</p>	<p>Lead: Government (Department of Resources) When: 2022–24</p>	<p>The Queensland Government will invest \$5 million over five years to help understand the occurrence and distribution of copper, cobalt, rare earth, indium and lithium. This will help the tools they need to overcome challenges and develop new techniques to aid exploration, discovery, and extraction of minerals. It is increasingly essential as the frontier for discovery moves into deeper and more difficult terrains, while the demand for new economy minerals increases exponentially.</p>
<p>5. \$5 million for circular economy in mining</p>	<p>Lead: Government (Department of Resources) When: 2022–24</p>	<p>The circular economy works to use resources at their highest value for as long as possible, and design out waste. This initiative will include programs to determine the extent to which valuable minerals can be extracted by reusing waste from existing resources-related activities—for example, the tailings of current and previously operated mines. The Queensland Government will invest \$5 million to help prepare Queensland miners to optimise their ability to access mineral markets, customers and investors who are coming under increased pressure to demonstrate with rigour that their raw material inputs have been obtained consistent with high ESG standards, in particular with minimal environmental disturbance and maximum environmental sustainability.</p>

**QUEENSLAND resources industry development plan**

June 2022

resources.QLD.GOV.AU

Queensland Government