UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

A2D Accelerate to Demonstrate Facility

MARKET ASSESSMENT ON CRITICAL MINERALS INNOVATION IN DEVELOPING COUNTRIES

Introduction

Critical minerals are essential for solar panels, wind turbines, batteries, electric vehicles (EVs), and other **technologies needed for just energy transitions and the Sustainable Development Goals (SDGs)**. This assessment examines **technological innovation in critical minerals value chains in developing countries,** focusing on the **midstream** (processing and refining) and **downstream** segments (manufacturing, extraction from secondary sources, and end-of-life treatment). It navigates the nexus of stakeholders, policies, initiatives, financial mechanisms, technologies, and SDG impacts. Starting from an analysis of 30 countries, deep-dives were conducted in three from each developing region: **Africa, Asia and South Pacific (ASP), and Latin America and the Caribbean (LAC)**. The findings will be useful for activities and organizations focused on accelerating innovation in critical minerals in developing countries. Initiatives, such as the Accelerate-to-Demonstrate (A2D) Facility, are instrumental in facilitating the development, deployment, and scale-up of technological innovation in developing countries.

Policy readiness insights across 30 developing countries

The 30 developing countries initially selected **were rated according to their policy readiness level**, providing an overview of relative strengths and areas for improvement.

rated **high** in renewable energy targets and policies for technological innovation, research and development (R&D), and critical minerals processing and refining

rated **high** in policies for assembly and manufacturing

rated **high** in policies for circular economy, recycling, and waste management

List of Critical minerals analysed

- Lithium
- Nickel
- Manganese
- Cobalt
- Graphite
- Rare Earth Elements (REEs)
- Copper
- Platinum Group Metals (PGMs)

Stakeholders, initiatives, and financing mechanisms

Initiatives by international organizations, governments, industry, and other stakeholders support technological innovation in critical minerals in developing countries. A total of **100** global, regional, and national initiatives were analysed, including financing mechanisms **(53%)** and other initiatives **(47%)**; they seek to either finance innovation projects or build up the enabling environment for mid- and downstream activities.

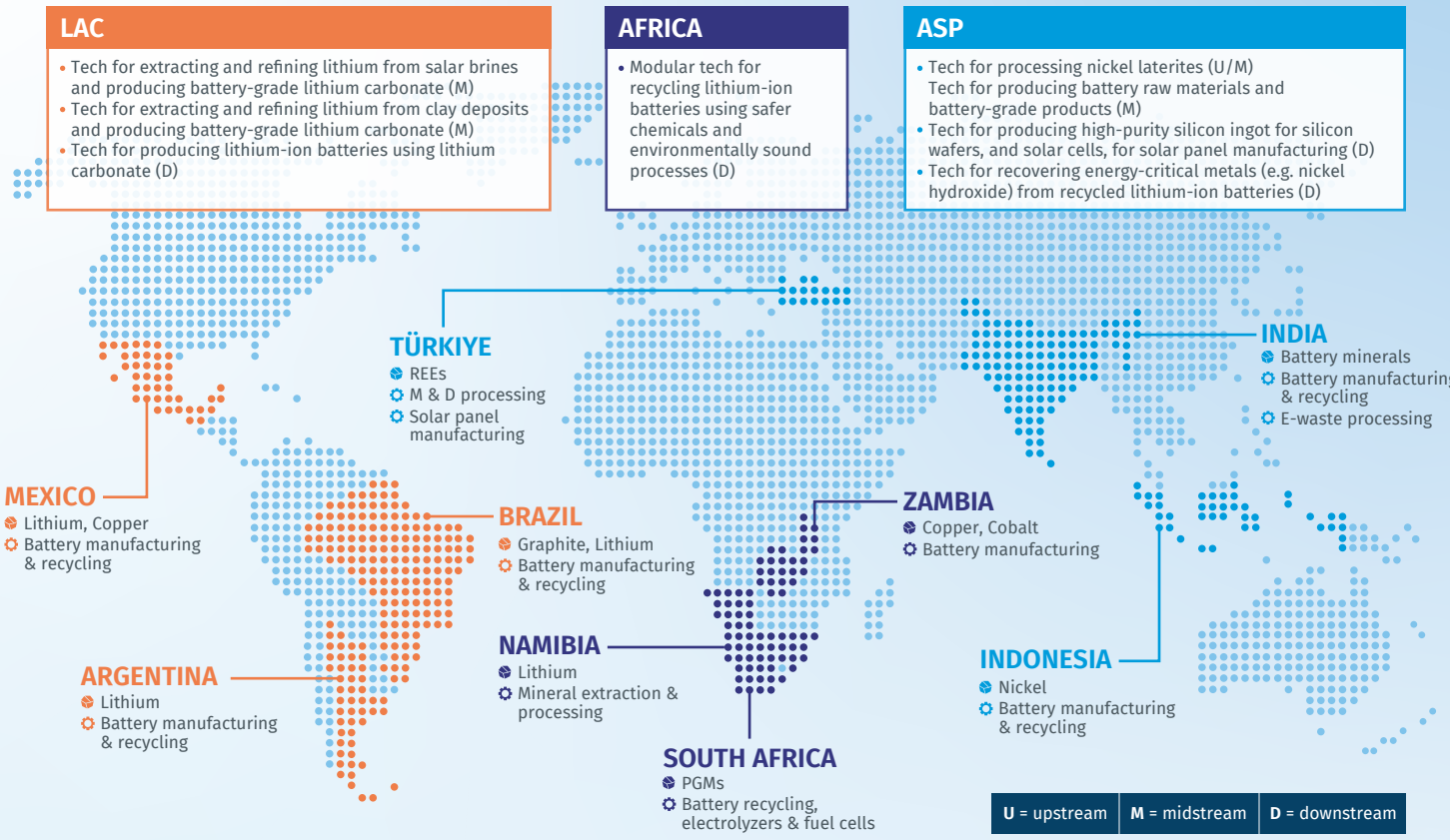
Gaps in these initiatives include the need for greater scale; finer coordination among them as to policy interventions, minerals, and segments to be prioritised in different markets; and increased sharing of knowledge and data on technologies and their drivers and barriers.

Noteworthy global financial mechanisms

UNIDO's A2D Facility	GBP 65 million
World Bank	
• Resilient and Inclusive Supply-Chain Enhancement (RISE) Partnership	USD 75 million
• Climate-Smart Mining Initiative	USD 50 million
• Energy Sector Management Assistance Program (ESMAP)'s Energy Storage Partnership (ESP)	Broader USD 1 billion battery storage programme
European Union (EU)'s Horizon Europe	Broader EUR 95.5 billion innovation programme

Technological innovation in developing countries

Technological innovation in critical minerals value chains in developing countries relies primarily on technology transfer from developed countries. With that said, **homegrown technological innovation in the mid- and downstream segments is slowly emerging in developing countries**, supported by policy frameworks, incentives, and initiatives implemented largely within the last half-decade. The map indicates noteworthy technologies, minerals of focus, and technological trends in the nine deep-dive developing countries.



Advancing SDGs through technological innovation in critical mineral value chains

Mid- and downstream activities offer **substantial opportunities for developing countries** to advance decarbonisation, poverty eradication, gender equality, affordable and clean energy, industrialisation, technological innovation, infrastructure development, circularity, and environmental stewardship.

DIRECT LINKAGES	
1 NO POVERTY	Mid- and downstream activities can drive poverty alleviation and economic growth by creating jobs, fostering skill diversification, and increasing government revenues.
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	Investment in R&D and mid- and downstream facilities promotes industrial development, technological innovation, and expansion of resilient infrastructure.
13 CLIMATE ACTION	Mid- and downstream activities produce components essential for renewable energy systems and decarbonisation technologies, reducing local and global emissions.

INDIRECT LINKAGES	
5 GENDER EQUALITY	Targeted interventions can promote gender equality by encouraging women's participation in technical and leadership roles and reducing time poverty for women.
7 AFFORDABLE AND CLEAN ENERGY	Mid- and downstream activities produce components essential for clean energy technologies. Local operations support just transitions and renewable energy deployment.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	Mid- and downstream activities can promote responsible consumption and production by enabling efficient refining, manufacturing, and recycling practices that minimise impacts.
15 LIFE ON LAND	Innovation in the mid- and downstream segments can reduce the impact on terrestrial ecosystems by minimising emissions, waste, and stress on water, land, and biodiversity.

Enabling environment in the deep-dive countries

	STRENGTHS	AREAS FOR IMPROVEMENT
AFRICA	• Mineral beneficiation strategies • Bilateral cooperation with developed countries (e.g. EU-Namibia Strategic Partnership on Raw Materials Value Chains and Renewable Hydrogen [USD 1.1 billion]; South Africa-UK Minerals for Future Clean Energy Technologies Partnership; partnership between Zambia and the Japan Organization for Metals and Energy Security) • Regional initiatives (e.g. African Green Minerals Strategy and DRC-Zambia Battery Council) • Industrial development agencies • Policies advancing SDGs	• Circular economy, recycling, and waste management policies • Power and logistics infrastructure constraints to industrial development • Government institutional capacity to build up and enforce regulatory frameworks • Policies advancing SDGs
ASP	• Circular economy, recycling, and waste management policies • Tax incentives for technology development • Special Economic Zones (SEZs) for industrialisation and downstream activities • Cooperation with developed countries: Minerals Security Partnership • National financial mechanisms (e.g. Make in India; Indonesia Battery Corporation; Turkish Growth and Innovation Fund [USD 218 million]) • Policies advancing SDGs	• Regional cooperation and initiatives • Reliance on imported fossil fuel–based energy • Policies advancing SDGs
LAC	• Financial incentives for companies in mid- and downstream segments (e.g. tax rebates and exemptions) • State-owned company for lithium value chain • R&D frameworks and initiatives • Industry-led initiatives to coordinate stakeholders: Mining Hub • Multilateral development bank (MDB) support (e.g. International Finance Corporation [IFC] loans and Inter-American Development Bank [IDB] programmes) • Policies advancing SDGs	• Stringent circular economy policies on critical minerals • Policies governing mid- and downstream activities are fragmented across different ministries and minerals, lacking cohesive national frameworks • Regional cooperation and initiatives • Policies advancing SDGs

TEN RECOMMENDATIONS TO RAMP UP TECHNOLOGICAL INNOVATION IN THE MID- AND DOWNSTREAM SEGMENTS

International support to developing country governments and stakeholders in the innovation ecosystem should be increased, including through technical assistance, capacity building, policy advice, and access to finance.

International and regional organizations and development finance institutions should build on initiatives for the **enabling environment** (e.g. World Bank's RISE Partnership) and **specific innovation projects** (e.g. UNIDO's A2D Facility).

A global multi stakeholder platform should be created to coordinate initiatives, foster collaboration, and share knowledge and data on technological innovation. UNIDO is well-positioned to house such a platform.

UNIDO should lead in ensuring the **continuous gathering, transparency, and analysis of data on innovation**—for example, through rolling surveys and public databases—going beyond the discrete exercise of this assessment.

Developing country policy should provide regulatory guidelines, support domestic collaborations, and offer innovation incentives; **developed country policy** should promote international cooperation, facilitate knowledge transfer, and provide access to finance.

Developing countries should prioritise the **development of energy, communications, and logistics infrastructure** to address broader industrial development constraints, in line with the SDGs and national priorities and strategies.

Special programmes should be created to **support small and medium enterprises (SMEs)** involved in technological innovation in developing countries to partner with other stakeholders and access funding opportunities, including UNIDO's A2D Facility.

Policymakers should **incentivise circular policies and practices** through regulations, incentives, and innovation funding; the private sector should **strengthen the business case for circularity** by showcasing cost savings, new revenue streams, and improved resource efficiency.

Industry-led initiatives to coordinate mining value chain stakeholders around common challenges and priorities for innovation—such as Brazil's Mining Hub and other initiatives led by mining associations—should be encouraged.

Besides fostering technological innovation in developing countries, international organizations and governments should put in place **regulatory and financial conditions to facilitate technology transfer** from companies based in developed countries.

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