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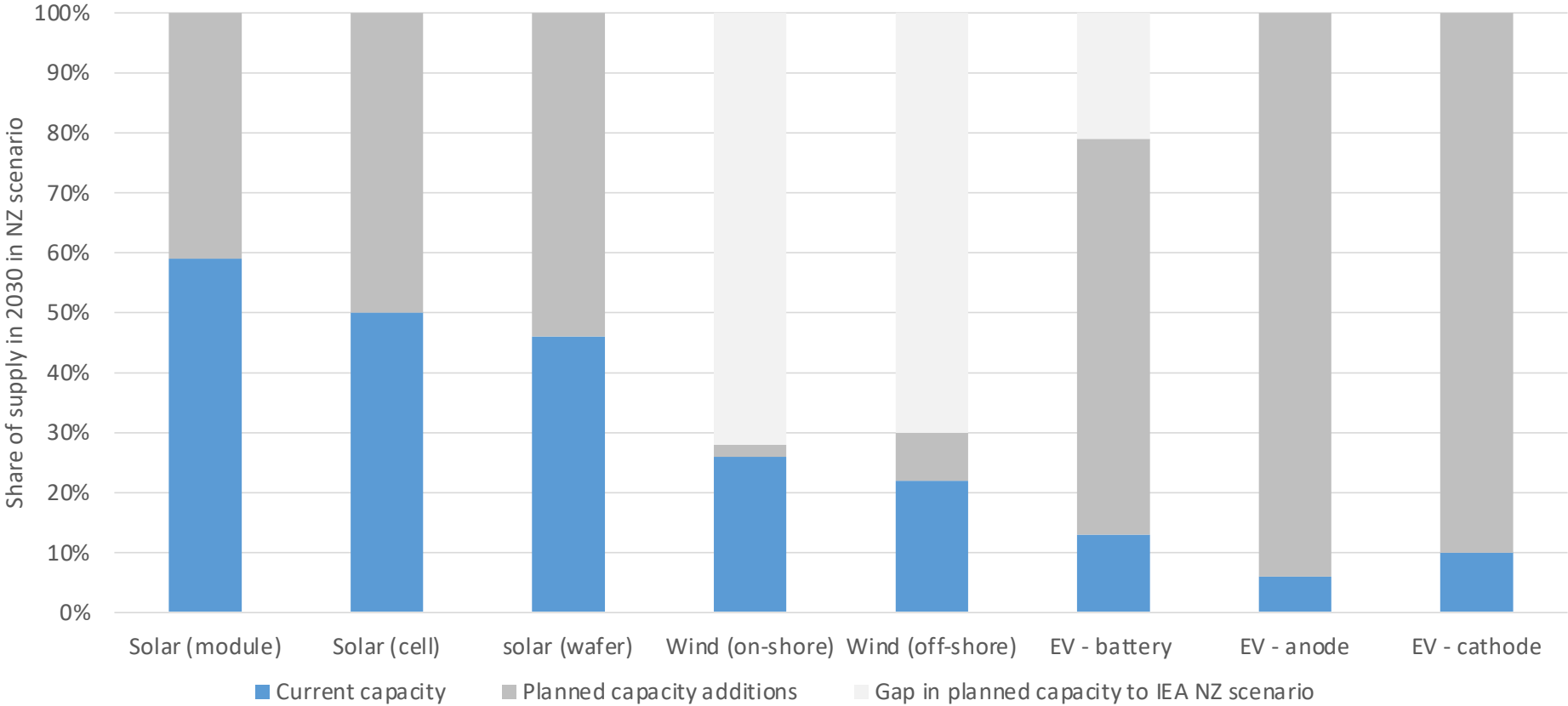


# **Enabling Clean Energy Technology Manufacturing and Supply Chain Development in the Asia Pacific**

**Pradeep Tharakan**  
**Director, Energy Transition**  
**Asian Development Bank**

**10 December 2023**

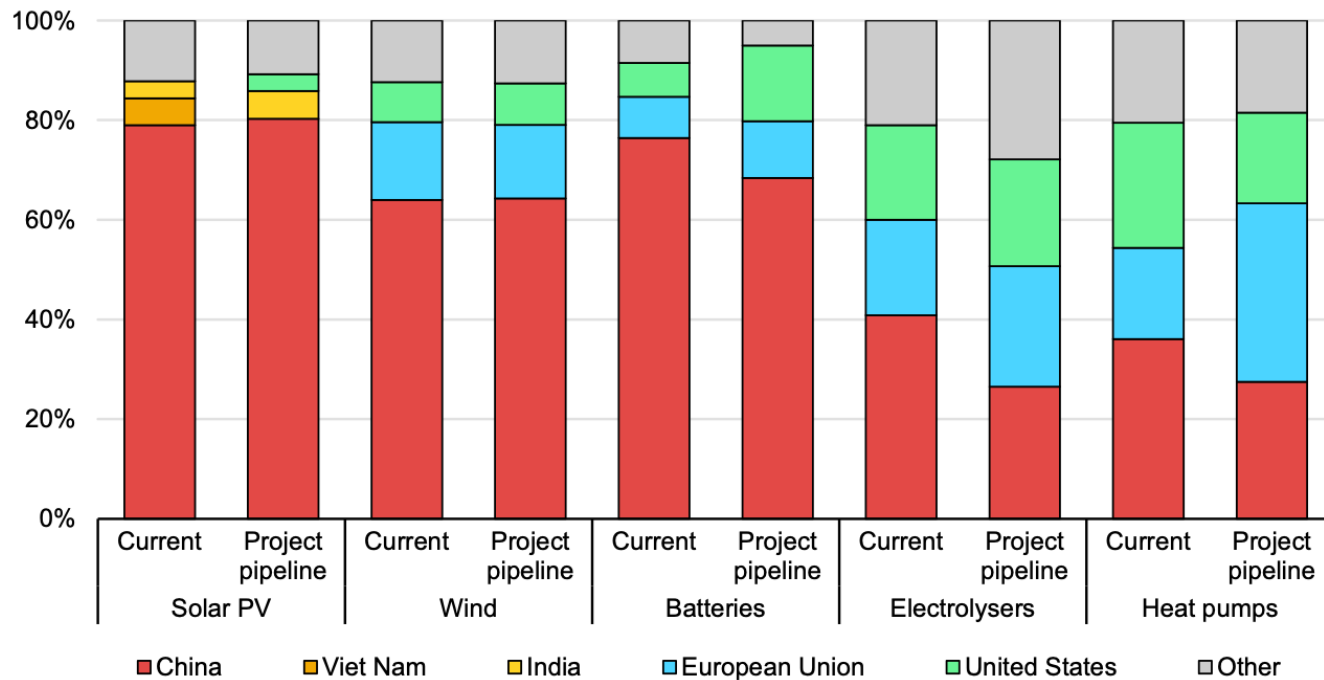
# The world needs a massive build-out of clean energy technology



Source: IEA 2023

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# Geographic concentration of manufacturing operations for key clean technologies expose import countries to supply chain disruption risks



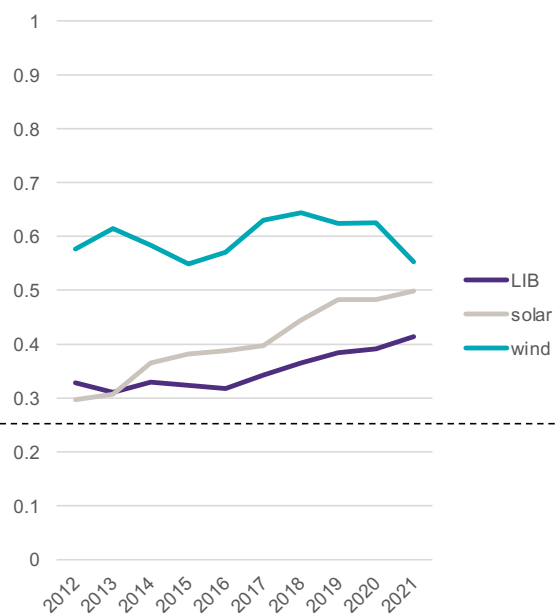
Source: IEA (2023)

**As the world increases its adoption of clean energy technologies, there is a growing need to enhance the domestic energy technology manufacturing ecosystem as well**

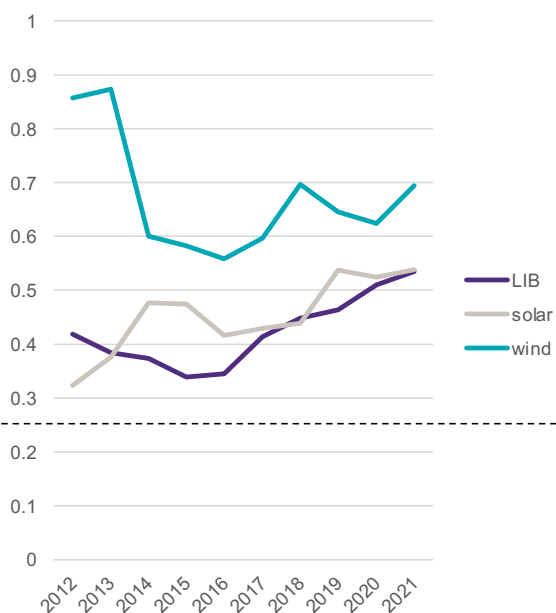
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# APAC countries face high concentration in imports of clean energy technologies, particularly lower-middle-income countries

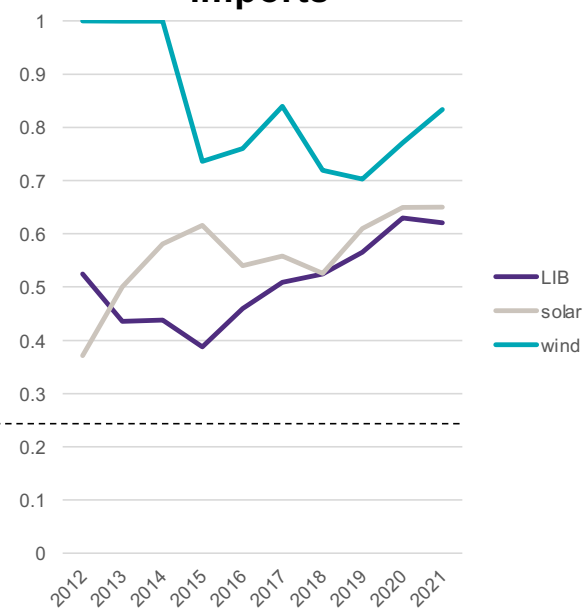
### Global average HHI of imports



### APAC average HHI of imports



### APAC lower-middle-income average HHI of imports

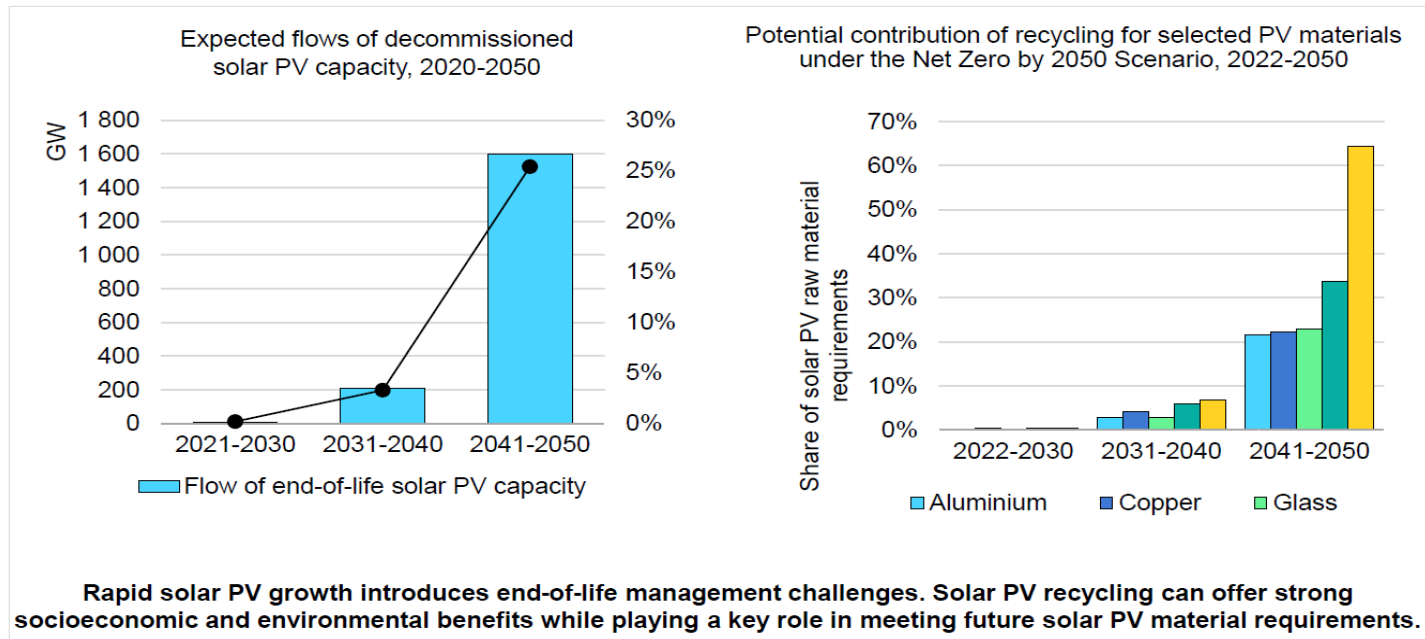


HHI = Herfindahl-Hirschman Index (accepted measure of market concentration)

Note: Importer HHI for any product = [% of imports from country 1]^2 + [% of imports from country 2]^2 + [% of imports from country 3]^2 + ... **For this analysis, an HHI greater than 0.25 is considered concentrated**

# Fostering a circular economy can alleviate strains on supply chains

## Mainstreaming PV recycling can reduce future supply security risks



## Need for an in-depth study examining effective approaches to recycling

<sup>1</sup> Yamamoto, T., Merciai, S., Mogollón, J. M., & Tukker, A. (2022, October). The role of recycling in alleviating supply chain risk—Insights from a stock-flow perspective using a hybrid input-output database. *Resources, Conservation and Recycling*. Volume 185. <https://doi.org/10.1016/j.resconrec.2022.106474>.

# Renewable Energy Manufacturing: Opportunities for Southeast Asia

## \$90-100 bn Revenue Opportunity (2030) in Low-carbon Mobility and Clean Power in Southeast Asia



Renewable Energy Manufacturing  
OPPORTUNITIES FOR SOUTHEAST ASIA



### Key unlocks needed

- **Incentivize Local Demand of Clean Technologies** – *Indonesia has conducive national policies for vehicle electrification (E2W)*
- **Efficient and Cost-effective Infrastructure and Logistics network** – *International freight, inland transportation systems to import materials and export finished products, investment in expansion of grid capacity to enable higher renewables penetration*
- **Availability of Low-cost Production Factors** – *Low Labour costs, availability of skilled talent, tax incentives and other financial support*
- **Access to Export Markets** – *Trade agreements to secure offtake agreements*

#### Solar PV, GW




1A  **Philippines**  
(modules)

1B  **Cambodia** (cells and modules)

#### Batteries, GWh





2A  **Indonesia**  
(mining to battery pack assembly)


2B  **Philippines**  
(mining to battery cathode mfg.)

#### E2W, k units



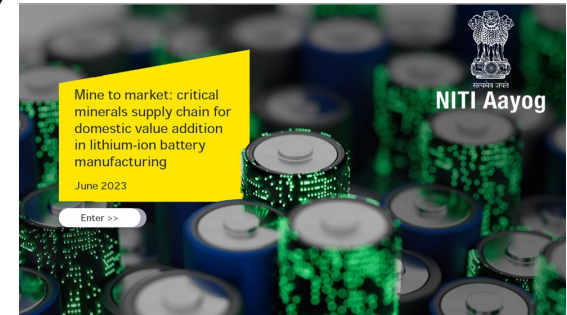
3A  **Indonesia**  
(E2W and components mfg.)

3B  **Vietnam**  
(E2W and components mfg.)

3C  **Thailand**  
(E2W and components mfg.)

# Critical Mineral Supply Chain for Domestic Value Addition in Li-ion Battery (LIB) Manufacturing for India

- The government of India launched a ***National Programme on Advanced Chemistry Cell (ACC) Battery Storage*** in 2021 to create a domestic manufacturing capacity of 50 GWh.
- Budgetary Outlay: \$2 Billion USD
- Total pipeline of battery cell and battery pack manufacturing facilities is estimated to generate ~400,000 direct–indirect employment



## Recommendations

- **Post domain experts** in mineral resources exploration, extraction, asset due diligence and acquisitions in India's foreign missions of critical mineral bearing countries
- **Rationalise customs import duty and IGST** for minerals bearing critical metals - *Exempt critical minerals such as Li, Ni and Co bearing ores from import duties and GST to encourage domestic production and improve competitiveness*
- **Scaling up LIB recycling infrastructure with production linked incentives (PLI)** to complement mining and extraction efforts of critical minerals

# Needs Assessment & Development Roadmap for Diversifying the Clean Energy Supply Chain in the Asia Pacific

## Policy landscape of India and Indonesia's clean energy manufacturing



INDIA 

Government allocation of **39,600 MW** of domestic Solar PV module **manufacturing capacity**, with outlay of **INR 18,507 Crores (USD 2.2 Billion)** under the **Production Linked Incentive (PLI)** scheme



INDIA 

**Concessional Custom Duty Exemption Certificate (CCDC)** are issued along with the **Revised List of Models & Manufacturers (RLMM)** for promoting local wind turbine manufacturing



INDIA 

**Advanced Cell Chemistry (ACC) production-linked (PLI)** incentive scheme for batteries worth **INR 18,100 crores (USD 2.2 billion)**

INDONESIA 

**Export bans on Bauxite and Copper** have caused an **influx of investments (USD 5.15 Billion in foreign direct investment)** for mining and quarrying in 2022)

INDONESIA 

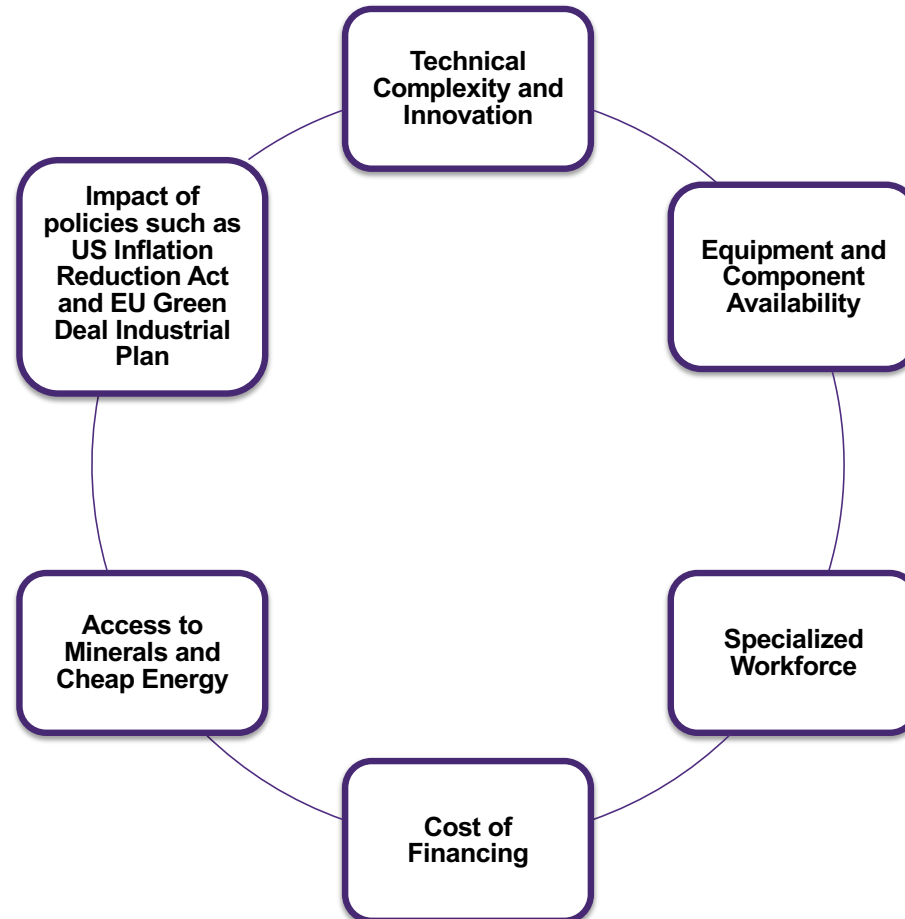
The Government **plans to ban copper ore exports in 2023** once **construction of two smelters are completed**, adding 722,000 tonnes per year (tpy) to existing 325,000 tpy

INDONESIA 

Indonesia's goal is to **achieve a 140 GW capacity by 2030**, enticing foreign investments in **end-to-end EV battery production with tax incentives up to 100% for 5-20 years**



# Challenges to Boosting Investments in Emerging Markets and Developing Economies



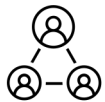
## Way Forward

### One-ADB Initiative on Diversifying Clean Energy Supply Chains

#### 6 Pillars



**Knowledge Sharing:** Promote knowledge sharing and collaboration among member countries to bridge information gaps in manufacturing and supply chain processes



**Capacity Building:** Facilitate capacity building programs to equip nations with the skills and knowledge needed for clean energy manufacturing



**Investment Promotion:** Encourage investments in infrastructure, technology, and workforce development for clean energy manufacturing



**Standards Development:** Develop and implement standards and quality assurance frameworks for clean energy equipment



**Market Expansion:** Explore new markets and trade opportunities for clean energy technologies and minerals



**Regional Partnerships:** Explore development of regional platforms to exchange best practices in operational excellence, policies, ESG compliance, R&D, and governance

A person wearing a blue long-sleeved shirt is working on a large, rectangular solar panel in a factory. The panel is mounted on a metal frame and has a grid of thin lines on its surface. The background shows industrial machinery and a perforated metal wall.

**ADB**

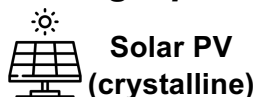
**Thank you..**

**Pradeep Tharakan**  
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**Annexure**

# Needs Assessment & Development Roadmap for Diversifying the Clean Energy Supply Chain in the Asia Pacific

*Preliminary findings: prioritizing midstream manufacturing areas for APAC economies with India-Indonesia focus*



Solar PV  
(crystalline)

**Component / equipment:** Silver paste manufacturing  
**Strategic value:** High value share in solar cell, concentrated manufacturing  
**Capability required:** sintering technology, access to raw material (silver)

**Component / equipment :** Wafer sawing equipment

**Strategic value:** Few manufacturers, growing market share, exported machinery is trailing edge

**Capability required:** wire electroplating technology, future sawing technologies



Wind

**Component / equipment:** Electrically excited generator  
**Strategic Value:** growing market share, non-dependence on rare-earths  
**Capability required:** R&D into alternative magnet materials, skills in precision engineering, economies of scale

**Component / equipment:** Sub-components (eg. Bearings)

**Strategic value:** growing market share, highly concentrated market, low capex required, improves service life and efficiency of wind turbines  
**Capability required:** keeping pace with technological advancements, economies of scale

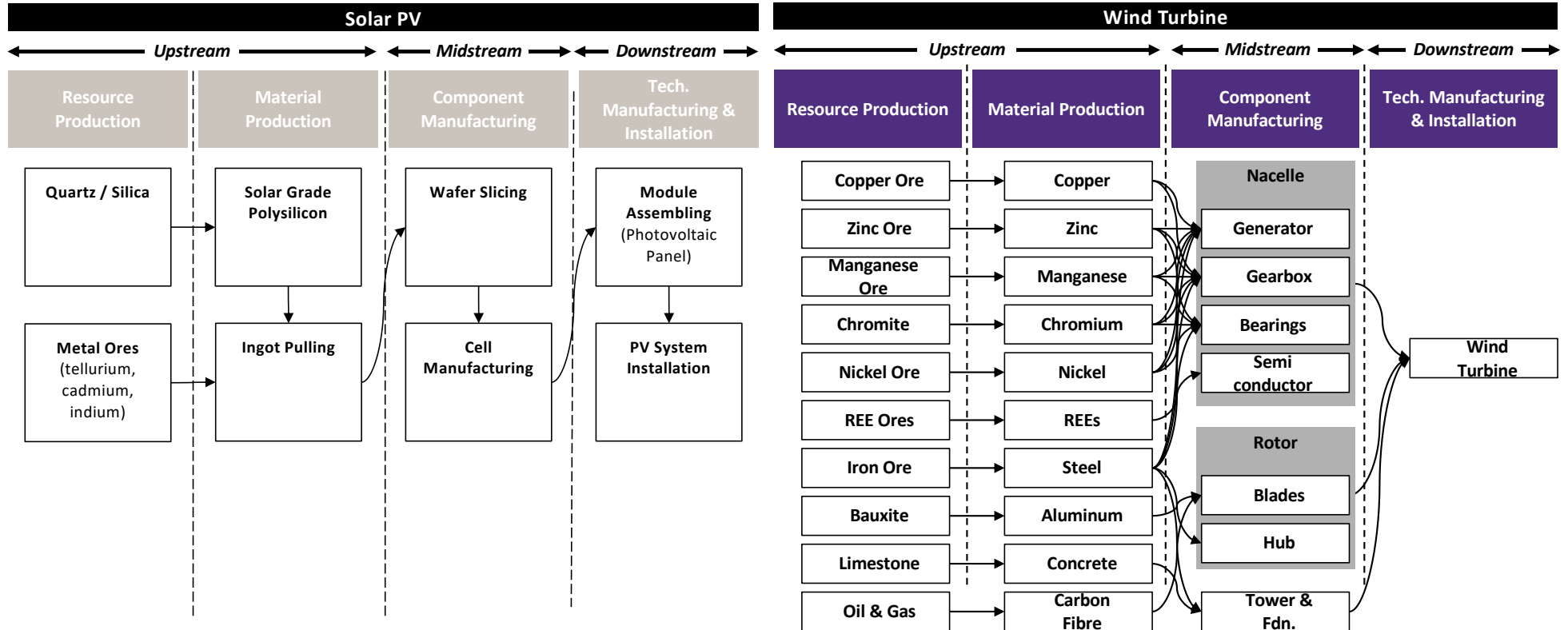


Lithium-ion  
battery

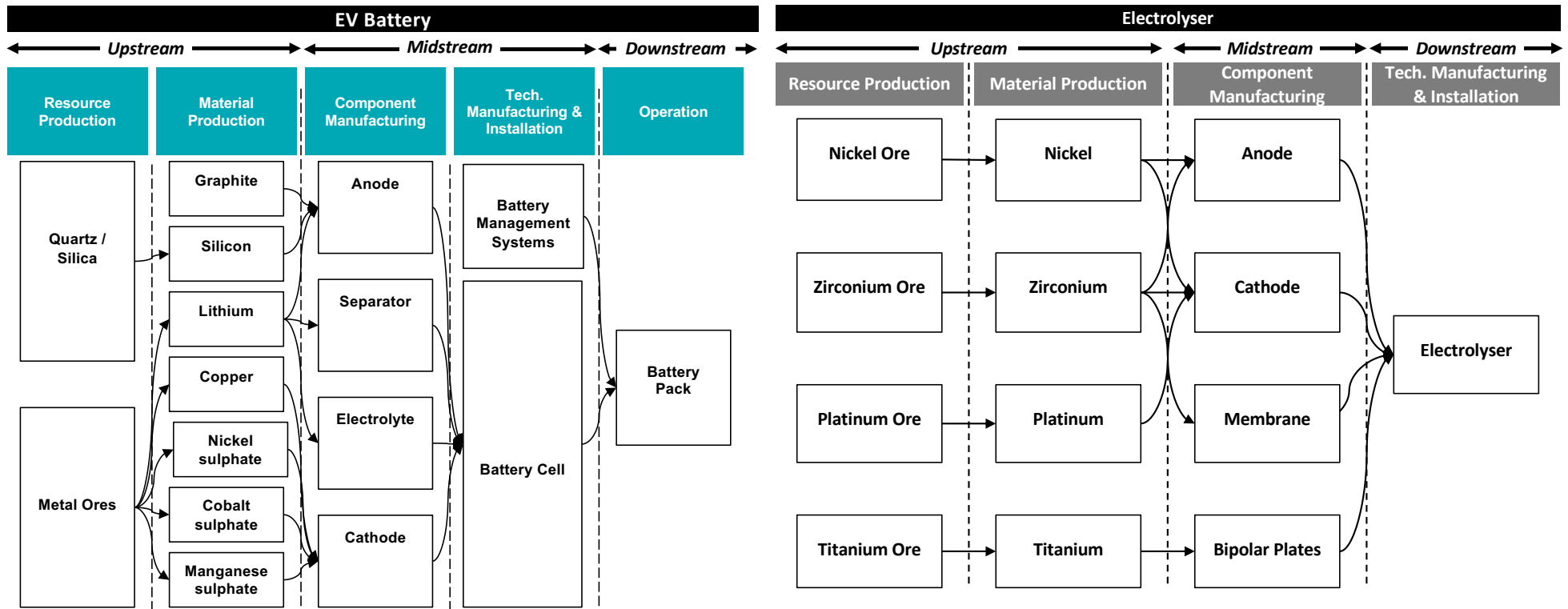
**Component / equipment:** Lithium metal phosphate cathode material  
**Strategic value:** Growing market share, potential use in emerging economies, high value capture, easier mineral access than alternatives, highly concentrated  
**Capability required:** Chemistry technology, raw material (lithium) and testing labs

**Component / equipment:** synthetic graphite anode  
**Strategic value:** Largest market share by mid-decade, resource constraints and manufacturing concentration of natural graphite anodes  
**Capability required:** Raw material (low-sulphur coke), graphitisation and coating technology, high CAPEX spending

## Securing supplies will be difficult, as clean energy supply chains are long and complex (1/2)



## Securing supplies will be difficult, as clean energy supply chains are long and complex (2/2)



# Needs Assessment & Development Roadmap for Diversifying the Clean Energy Supply Chain in the Asia Pacific

*Preliminary findings: prioritizing midstream manufacturing areas for APAC economies with India-Indonesia focus*



Lithium-ion  
battery

**Component / equipment: Lithium metal phosphate - cathode active material**

## **Strategic value:**

- **Growing market share**, particularly in emerging economies due to low cost
- **High value capture** – cathode share of final cell cost is currently 40 per cent, and will continue to grow
- **Easier mineral access** than alternatives (uses lithium and phosphoric acid, but no need for nickel and cobalt inputs)
- **Lower capital intensity** than other battery component production

## **Strategic vulnerabilities:**

- Highly concentrated production, 90 % cathode material production in a single country
- Technology change – emergence of new chemistries

**Capability required:** Chemistry + calcination technology, raw material (lithium, phosphoric acid), testing and validation labs

## **Other priority areas:**

### **Solar photovoltaic (crystalline)**

1. Silver paste mfg.
2. Wafer sawing equipment mfg.

### **Wind turbine**

1. Electrically excited generator mfg.
2. Sub-component (eg. bearings) mfg.

### **Lithium-ion battery**

Synthetic graphite anode active material mfg.



# Demand for critical minerals from clean energy technologies is forecast to grow multifold by 2050



APS=Announced Policy Scenario; NZE=Net-Zero Emissions by 2050 Scenario; STEPS=Stated Policies Scenario

Source: ADB calculations based on data from the IEA Critical Minerals Data Explorer, data downloaded on 11 October 2023