Clean Energy for the Battery-to-EV Supply Chain: A Roadmap for Indonesia—Summary Brief

Indonesia has a unique opportunity to support the clean energy transition, enhance energy security, and spur economic growth with local battery manufacturing, bridging from the material supply all the way to pack designs and, ultimately, the manufacturing of electric cars.

Following the elevation of United States and Indonesia relations to a Comprehensive Strategic Partnership, leaders of both countries highlighted the importance of Net Zero World support for Indonesia's energy transition, including collaboration on low-carbon battery supply chains. In support of this agreement, Net Zero World has partnered with Indonesia's Ministry of Energy and Mineral Resources and other Indonesian partners to chart actionable steps for establishing a clean, resilient battery supply chain and circular economy. This partnership aims to position Indonesia as a regional leader in clean energy and can help attract investment in the domestic battery and electric vehicle (EV) sectors.

Net Zero World is a flagship initiative of the U.S. Department of Energy that provides world-class technical support through its national laboratories to countries transitioning to net-zero emissions energy systems.

Launched at the end of 2021, the Net Zero World Initiative brings together world-class experts and resources from 10 U.S. Department of Energy national laboratories and 9 U.S. government agencies to partner with countries to accelerate transitions to clean energy systems. Net Zero World collaborates with government leaders and technical representatives from Argentina, Chile, Egypt, Indonesia, Nigeria, Singapore, Thailand, and Ukraine to ensure they have the technical solutions, knowledge, and confidence to rapidly transition to clean, secure, and equitable energy systems.

Indonesia's Strategic Path to Clean Battery-to-EV Manufacturing Leadership

Indonesia is ideally positioned to become a clean battery manufacturing powerhouse globally and for Southeast Asia based on several factors.

- The growing importance of lithium-ion batteries for a decarbonized future emphasizes the need for critical battery materials and robust supply chains. Nickel-based lithium-ion batteries make up more than half of global demand, which is expected to grow by 20% annually (ADB 2023).
- Indonesia accounts for 48% of global nickel production, and has significant reserves of graphite, aluminum, and lithium via geothermal brines (Desai 2023).
- There is a strong shared interest across public and private sectors, as demonstrated by the creation of the Indonesian Battery Corporation and broad participation of government agencies, industry, think tanks, and civil society in development of this roadmap.
- The government of Indonesia has already provided multiple incentives to encourage development of the battery-to-EV (B2EV) market and clean energy adoption, such as those for domestic purchases of EVs and for investing in domestic production in the B2EV sector.

Indonesia can capitalize on rapidly growing demand for lithium-ion batteries and EVs domestically and globally.

- Based on the Ministry of Energy and Mineral Resource's Roadmap to Net Zero Emissions for Indonesia's Energy Sector by 2060 (MEMR 2023), Net Zero World's analysis estimates theoretical domestic battery demand to reach upwards of 30 gigawatt hours (GWh) in 2035 to support 35 million battery electric two-wheelers and 1.5 million battery EV cars.
- The International Energy Agency projects that half the cars sold globally in 2035 will be EVs (an estimated 40 million vehicles), and that global battery manufacturing capacity will reach 9 terawatt-hours (TWh) by 2030 (IEA 2024).
- A variety of Indonesian and international companies have invested in battery production in the country. Several EV manufacturers are also making investments, including BYD and VinFast.

There are many benefits to driving the development of a B2EV manufacturing market in Indonesia, including:

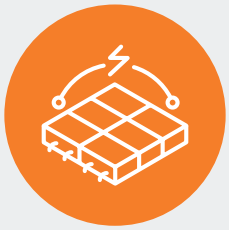
- Creating new jobs and investment and facilitating additional opportunities for public and private sector partnerships
- Developing a more robust lithium-ion battery and EV market
- Accelerating progress toward Indonesia's climate change goals
- Formulating a broader clean energy ecosystem with deepened collaboration and leadership on research and development.

Opportunities for Clean Energy in Indonesia's B2EV Manufacturing Sector

Integrating clean energy sources and adhering to environmental, social, and governance standards could give Indonesia's battery and EV manufacturing sector a significant competitive advantage in global markets. As international supply chains increasingly prioritize sustainability, decarbonizing the sector could help Indonesia attract premium partnerships and establish itself as a preferred supplier. Currently, with much of the sector reliant on coal-fired and centralized thermal power, shifting toward renewables presents Indonesia

Quick Facts

Projected EV Battery Demand



307 GWh of lithium-ion batteries for EVs in 2035

35 million battery electric two-wheelers and **1.5 million** battery EV cars by 2035

Billions of dollars of investment into B2EV manufacturing

2 GW and an estimated $5.4 billion of investment in clean energy to supply B2EV manufacturing

with a unique opportunity to enhance its market appeal, meet evolving global standards, and secure a leadership position in sustainable manufacturing.

- **Renewable capacity needs:** The analysis conducted in this collaborative effort presents opportunities for serving the electrified manufacturing annual energy load (for the whole industry, whether in a single location or multiple plants) with new GW-scale capacity for hydroelectric, solar, wind, geothermal, and biomass generation resources, including battery energy storage, with an estimated life-cycle cost of $5.4 billion. Although this may exceed the cost of coal-fired options without emission constraints, it could offer the aforementioned benefits to driving development of the B2EV sector.
- **Electrification and efficiency:** Electrification of fossil-fuel based thermal energy demand with industrial heat pumps, resistance heating, and grid improvements can offer significant emissions reductions. Facilities can also continue to improve energy efficiency to increase production yield and improve waste heat utilization.

The industry can capitalize on hydropower, solar, wind, geothermal, and biomass energy, along with energy efficiency, to create a sustainable and economically viable ecosystem. Dispatchable hydropower and biomass, paired with battery energy storage to balance variable solar and wind, can help ensure reliable power. Resource availability means that wind and solar energy can complement these reliable power sources by providing low-cost energy, particularly in windy coastal regions. Incorporating these design and construction considerations from the outset can improve technical feasibility and cost-effectiveness while remaining cheaper than emissions-constrained coal generation.

Vision and Priority Actions to Promote the Development of a Clean B2EV Sector

Net Zero World has partnered with Indonesia's government, industry, local institutions, and other development partners to outline a roadmap for possible actions for Indonesia to ramp up clean B2EV manufacturing. This draft plan draws on international best practices and stakeholder insights to identify potential strategies and initial priority near-term actions:

Photo by Bethany Speer, NREL

- **Reduce reliance on coal for battery production:** Shifting from coal power and developing strategies to reduce or eliminate the use of captive coal for battery production could open pathways to attract investment in clean energy for the B2EV sector. Approaches that might support this transition include:
  - **Priority:** Feasibility studies to assess B2EV clean energy investments.
  - **Additional measures:** Green bond issuances, energy efficiency incentives, and financial de-risking mechanisms.
- **Establish local material processing for battery supply chains:** Establishing an efficient materials processing infrastructure could help Indonesia meet both domestic and international demand for batteries and EVs, while ensuring the responsible use of critical materials and supporting a circular economy.
  - **Priority:** Supporting development of local institutions to develop, test, and validate battery and EV technologies, including for emerging chemistries.
  - **Additional measures:** Supply chain mapping, second-life battery use, and circular economy pilot projects.
- **Incentivize EV battery cell and pack manufacturing in Indonesia:** Co-location of manufacturing facilities with clean energy resources can help optimize utilization of the lowest cost renewable resources, and favorable policies can encourage investment in B2EV factories.
  - **Priority:** Adjust local content requirements to facilitate the import of high-quality equipment
  - **Additional measures:** Streamlined permitting,

reduced value-added tax (VAT) on manufacturing equipment, and development of green standards.

- **Boost domestic EV market demand:** Increased local EV demand could drive expansion of domestic manufacturing.
  - **Priority:** Reevaluate EV incentives for broader adoption
  - **Additional measures:** Expand electric bus procurement targets and develop incentives for EV charging infrastructure, disincentivize internal combustion energy vehicles and enable supply-side regulations (i.e., mandatory EV sales).
- **Build a qualified B2EV workforce:** Workforce development will be key to sustaining a domestic battery ecosystem. Stakeholders can conduct a needs assessment to address skills gaps and collaborate on education and exchange programs. Partnerships across sectors and with other countries could further enhance workforce readiness through targeted fellowships and training, building a strong foundation for Indonesia's B2EV manufacturing sector.
  - **Priority:** Develop vocational and professional training programs centered on development of the B2EV and clean energy sectors.
  - **Additional measures:** Implement health and safety standards and promote gender integration in the industry.
- **Foster a local innovation ecosystem for clean energy:** Investments in technology innovation, safety, and standards could strengthen Indonesia's role in clean energy and B2EV manufacturing. Building an enabling environment for entrepreneurship and high-quality, safe, clean energy technologies will be essential for Indonesia to sustain regional leadership in this sector. Key areas of focus could include enhancing B2EV manufacturing capabilities and advancing clean energy technology testing, safety protocols, innovation, and standardization.
  - **Priority:** B2EV demonstration projects with partners
  - **Additional measures:** Battery energy storage system testing, technology incubators, and regional EV standards.

Indonesia has already made notable progress toward clean B2EV manufacturing. Continued engagement and prioritization of these actions could further enhance Indonesia's position in sustainable battery energy storage system production.

References

ADB (Asian Development Bank). 2023. *Renewable Energy Manufacturing: Opportunities for Southeast Asia*. Manila, Philippines. https://www.adb.org/publications/renewable-energy-manufacturing-opportunities-southeast-asia.

Desai, Pratima. 2023. "Global Commodities' Indonesian nickel indices plan may be a game-changer." *Reuters*. April 11, 2023. https://www.reuters.com/article/markets/currencies/global-commodities-indonesian-nickel-indices-plan-may-be-a-game-changer-idUSKBN2W813W/.

IEA. 2024. *Global EV Outlook 2024: Towards increased affordability*. Accessed November 10, 2024 at: https://iea.blob.core.windows.net/assets/a9e3544b-0b12-4e15-b407-65f5c8ce1b5f/GlobalEVOutlook2024.pdf.

MEMR (Ministry of Energy and Mineral Resources). 2023. *Roadmap to Net Zero Emissions in Indonesia's Energy Sector by 2060*. Jakarta, Indonesia: Ministry of Energy and Mineral Resources.

Indonesia has already made notable progress toward clean B2EV manufacturing. Continued engagement and prioritization of these actions could further enhance Indonesia's position in sustainable battery production.
 Net Zero World is prepared to support this transition through analysis, pilot projects, and partnerships as Indonesia explores its potential for leadership in clean battery manufacturing.

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