

International Energy Analysis News from Berkeley Lab

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Roadmap for Decarbonizing Indonesia's Key Industries: Achieving Near-Zero Emissions by 2060

As the largest country in Southeast Asia and the fourth most populous nation globally, Indonesia is facing great opportunities to grow its economy, driven by a young and growing labor force, rich and abundant natural resources, and technology advancements. The industrial sector is one of the largest carbon dioxide (CO₂) emitting sectors in Indonesia, contributing to one-third of the country's energy-related CO₂ emissions, when only accounting for direct emissions from onsite fossil fuel use. Industrial sector CO₂ emissions are even higher when indirect emissions from electricity consumption are included. Identifying technological pathways and policy options to decarbonize the key industries in Indonesia is critical for the country's energy transition, and supporting Indonesia's climate goals.

Our report conducted the first-ever deep-dive into five important industrial sectors in Indonesia, including iron and steel, cement, ammonia, pulp and paper, and textiles, building on the extensive process-level modeling work of each sector, in-country focused-group discussions, stakeholder meetings and discussions, and close collaboration between Berkeley Lab and the Institute for Essential Services Reform of Indonesia.

Our research showed that it is technically feasible to achieve near-zero CO₂ emissions in Indonesia's industrial sector by 2060, the target year for carbon neutrality in Indonesia's updated Nationally Determined Contributions (NDCs), as shown in Figure 1. Achieving net-zero CO₂ emissions in Indonesia's industrial sector by 2050, as aspired in the government goals, will require extraordinary efforts and a much more accelerated pace of adoption of low-carbon technologies. A portfolio of technologies and measures is available for Indonesia to consider for industry decarbonization. Different strategies can play different roles in specific industries (Figure 2).

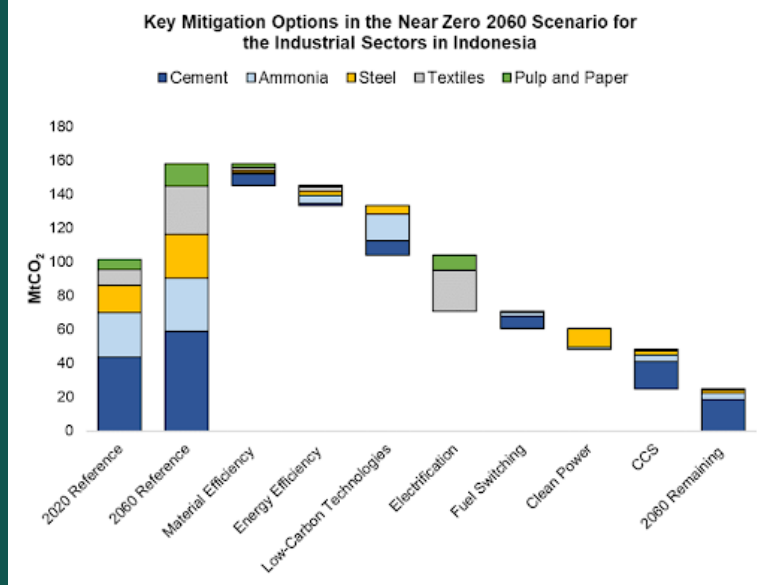


Figure 1. Key Mitigation Options in the Near-Zero 2060 Scenario for the Industrial Sectors in Indonesia

Notes: 1) Low-carbon technologies include a) clinker substitution technologies for the cement industry; b) scrap-based electric arc furnaces and green H₂-based direct reduction of iron technologies for the iron and steel industry; c) electrolytic ammonia and other green ammonia technologies for the ammonia industry. 2) Emissions include direct (fuel and process-related) and indirect (electricity-related) CO₂ emissions for all sectors, except for the pulp and paper industry, where we focused on CO₂ emissions from direct emissions only.






Sector	Near-term	Mid-term	Long-term
 Iron and Steel	Transition to scrap-based EAF	Green H ₂ -DRI	
	Improving material efficiency and energy efficiency		
 Cement	Increase the use of SCM	Zero-carbon fuels	CCS
	Improving material efficiency and energy efficiency		
 Ammonia	Improve energy efficiency	Green H ₂ and other low-carbon feedstocks	CCS
	Improving material efficiency		
 Pulp and Paper	Improve energy efficiency	Electrification	
	Improving material efficiency		
 Textiles	Electrification	Renewable heating	
	Improving material efficiency and energy efficiency		

Figure 2. Technologies and measures to decarbonize industrial sectors in Indonesia by timeline.

Notes: EAF refers to electric arc furnaces; DRI refers to direct reduction of iron; SCM refers to supplemental cementitious materials; CCS refers to carbon capture and storage.

Achieving Indonesia's announced national economic development targets will require significant growth in the industrial sector, which provides the foundational materials and infrastructure for urbanization, improved living standards, and other industry development (renewables, batteries, electric vehicles) that is necessary for the country's energy transition. Industrial capacity expansion is expected in several key industries in Indonesia, such as iron and steel, driven by domestic construction demand, as well as investment in and transfer of industrial production capacity from other Asian countries. As a result, the current industry development is not on track to achieve the Near-Zero 2060 Scenario developed for this report.

National strategies on carbon-intensive materials (e.g., steel and cement), green energy carriers (e.g., hydrogen and ammonia), and cross-cutting technologies (e.g., industrial heat pumps and CCS) need to be developed. A coordinated approach on infrastructure development (pipelines, storage sites, power transmission, and distribution systems) and utilization is necessary. Industry decarbonization also requires a rapidly decarbonizing power sector. Near-zero CO₂ emissions in industry requires access to clean, low-cost electricity. Policies that support industry in connecting to renewable power or developing its own renewable electricity are very important.

Finally, a multifaceted policy approach is needed to encourage investment in industry decarbonization in Indonesia, including clear and credible emission targets at the sectoral level, a policy framework that encourages fuel switching and energy efficiency investment, a new market for material efficiency, and investment in research, development, innovation and demonstration projects. At the same time, it is necessary to prepare the workforce with the skills, knowledge, and capabilities necessary to enable the transition to low-carbon solutions and enable local communities to benefit from the transition.

Indonesia's Green Industry Center (PIH) of the Ministry of Industry is currently developing decarbonization roadmaps for eight priority industries, building on our roadmap report (released in February 2024). The impact of our research has been recognized at the highest level of the Indonesian Government.

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Berkeley Lab's groundbreaking research on industry decarbonization comes at a critical time for Indonesia. For developing countries like ours, balancing economic growth with climate commitments is crucial. These insights are very important for Indonesia and other countries. We also know that we still have plenty of problems left to resolve. We hope Berkeley Lab can continue conducting research to solve the decarbonization problem, and that more people in developing countries can benefit from this."

- Rachmat Kaimuddin, Deputy Coordinating Minister of Maritime Affairs and Investments

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