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J1Or2B-01: [Invited] Decarbonizing ultra-class haul trucks and the mining ecosystem through utilization of liquid hydrogen

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A vast majority of the items made in the modern world are dependent on materials sourced through mining operations. The world uses mining to obtain the materials needed for shelter, transportation, and more, including steel, solar panels, and electronics. Not only does mining contribute to the global consumer market, but the industry also provides employment to millions of people, with over 13.6 million people employed worldwide in 2016 [1]. A large portion of the mines lie within the Pacific Rim, which contains many rich mineral deposits.

Unfortunately, while the economic contributions of the mining industry are large, so are its contributions to global warming. Mining contributes 4–7% of annual global greenhouse-gas emissions [2]. Diesel fuel alone accounts for about 50% of mining-related CO₂ emissions. Governments around the world are pushing to lower CO₂ emissions and advocating for a transition across industries to clean energy. To meet these goals, the global transition to clean energy will require unprecedented extraction of raw materials, most of which will be obtained through mining. Therefore, mining cannot be discarded, and it must transition to clean energy as well. Heavy industry is often ignored and underfunded when it comes to identifying innovative and reliable pathways to decarbonization. However, a transition is occurring, and mining companies are beginning to make pledges to reduce emissions, with hydrogen fuels, particularly liquid hydrogen, emerging as a key method of addressing the emissions problem. By decarbonizing mining haul fleets and transitioning trucks away from diesel, there is an opportunity to reduce carbon emissions by 50% or more at any given mine site.

Founded in Seattle, Washington, USA, First Mode is a global decarbonization company committed to seizing this opportunity by working to help heavy industry, starting with mining, transition to a diesel-free future. On May 6, 2022, First Mode debuted the world's largest hybrid hydrogen and battery powerplant, replacing the diesel engine in a Komatsu 930E-4 ultra-class haul truck at Anglo American's Platinum Group Metals mine site at Mogalakwena, South Africa. First Mode is now refining the design of the powerplant and developing support infrastructure. The resulting system will be produced and adopted at scale, starting with a retrofit of approximately 400 ultra-class haul trucks for Anglo American. To support this development effort, First Mode has established a proving ground at Centralia, Washington. The site is a retired coal mine (now in reclamation) and moving forward it will be used to test the next generation of hydrogen-fueled ultra-class haul trucks, as well as the associated hydrogen refueling infrastructure, within a true mining environment.

Growing the hydrogen fuel economy has the potential to revolutionize heavy industry, lowering emissions while creating new economic opportunities. However, simply changing the fuel source will not eliminate emissions. To fully transition fleets away from diesel, additional changes must be made in parallel, including addressing change management, establishing a fuel supply chain, and providing education to enable safe operation. Fully embracing this transition within heavy industry will benefit areas affected by mining, not only in the Pacific Rim, but across the globe as well.

[1] World mining employment for selected countries 1/ world mining ... [Internet]. National Mining Association; [cited 2023Feb9]. Available from: https://nma.org/wp-content/uploads/2016/12/m_world_employ.pdf

[2] Delevingne L, Glazener W, Grégoir L, Henderson K. Climate risk and decarbonization: What every mining CEO needs to know [Internet]. McKinsey & Company. McKinsey & Company; 2021 [cited 2023Feb8]. Available from: <https://www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-decarbonization-what-every-mining-ceo-needs-to-know>

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