### THE 9<sup>TH</sup> ANNUAL ENERGY AND MINES AUSTRALIA SUMMIT MAY 6-7, 2025 PERTH CONVENTION AND EXHIBITION CENTRE

Effective community engagement and ESG strategies Partnerships and innovation for low-carbon energy solutions

Impact of technical standards on renewable energy projects

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Technological hurdles in shifting to electrified mining fleets Challenges in decarbonizing process steam generation daptation energy strategies in arid and wind-abundant regions

Hybrid renewable systems for remote mine operations



#### **THINK TANK** | 2025



# EXPLORING PATHWAYS TO ZERO EMISSIONS: INSIGHTS FROM THE DECARBONISED MINE THINK TANK

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#### THE DECARBONISED MINE THE 9<sup>TH</sup> ANNUAL ENERGYANDMINES AUSTRALIA SUMMIT MAY 6-7, 2025



At the 2025 edition of The *Decarbonised Mine* in Perth, a standout session led by Greg Koppens of Entura brought together mining leaders, energy specialists, and sustainability professionals to tackle one of the industry's most pressing challenges: how to meaningfully decarbonise mine sites under complex, real-world conditions.

Framed as an interactive Think Tank, the session invited attendees to roll up their sleeves and co-design a decarbonisation pathway for a fictional mine. The setting—a hypothetical Mithral mine located in the arid plains of Moria—was inspired by Tolkien lore but grounded in very real challenges. The mine featured a hybrid of gas-fired steam turbines, diesel gensets, a significant process steam requirement, and a service obligation to a nearby town. The goal: figure out how to operate it with zero emissions.

Koppens, a specialist in hybrid renewable systems at Entura (part of the Hydro Tasmania group), drew on his organisation's century-long experience managing intermittent power sources to set the stage. He highlighted several recurring technical hurdles facing mine decarbonisation efforts: balancing power quality in off-grid systems, managing voltage sags, defining consistent technical standards, and understanding the long-term impacts of battery microcycling and inverter limitations. His overarching message was clear—there's no one-size-fits-all solution, and every site presents unique challenges that require nuanced, collaborative problem-solving.

The Think Tank format offered exactly that opportunity. At their tables, attendees addressed technical, ESG, and zero-emissions challenges. Their ideas were informed by hands-on experience, sector expertise, and a shared ambition to help the mining sector lead in energy transition innovation.

#### TECHNICAL PATHWAYS: RENEWABLES, STORAGE, AND SMARTER SYSTEMS

Multiple tables focused on technology integration strategies. Across these groups, consensus emerged

that a high-penetration hybrid renewable system solar, wind, and battery storage—would serve as a practical starting point. Given the fictional mine's location with strong evening winds and a large thermal load, participants proposed a wind farm of 20–30 MW, complemented by solar PV in a similar range, and a battery storage system designed to enable minimal reliance on thermal generators.

However, the mine's process steam needs posed a more intractable challenge. While initial stages could achieve significant emissions reductions, full decarbonisation would depend on emerging technologies—potentially electric boilers, hydrogen injection into gas pipelines, or even concentrated solar thermal (CSP) if the site had sufficient direct normal irradiance. As one group noted, transitioning away from gas-fired steam production is "the hurdle to watch."

On the load side, participants urged a rethink of mine planning. For underground operations, electric rock drills and battery-electric vehicles could reduce diesel use. In open-pit scenarios, trolley-assist systems were flagged as promising but site-dependent. Digitisation and data-driven planning also featured strongly, particularly in optimizing energy usage and forecasting demand to align with renewable availability.

Short- and long-duration storage emerged as critical enablers for system reliability and deeper decarbonisation. Participants stressed that while batteries can flatten the duck curve and address daily intermittency, seasonal storage and dispatchable clean alternatives would be key for resilience.

#### **FINANCIAL HURDLES AND PPA REALITIES**

Several teams acknowledged that the biggest barrier to implementation wasn't necessarily technical—it was financial. High upfront capital costs and uncertainty around gas prices and long-term return on investment make it difficult for miners to commit to large-scale renewable transitions.

In this context, an Independent Power Producer (IPP) model was frequently suggested. With companies like Zenith and EDL represented at the table, IPP solutions involving long-term Power Purchase Agreements (PPAs) were seen as viable ways to derisk the transition. However, the typical 9-year gas contract timeframe wouldn't suffice for renewables participants argued for PPA terms of 20 years or more to make these projects stack up.

#### ESG AND COMMUNITY-CENTERED DESIGN

ESG-focused tables explored how the mine's energy transition could also be a platform for broader social benefit. Drawing inspiration from Papua New Guinea's community-owned power models, proposals included giving nearby towns more control over electricity supply through demand management tools, preferential tariffs, and employment pathways.

Participants emphasized that trust and transparency are non-negotiable. From environmental impact assessments to the sharing of operational data and progress updates, stakeholders need to be consistently engaged and respected. One speaker also warned against simply replicating existing mining technical standards without reassessment what's appropriate for a processing mill may not be necessary for a solar farm.

### CREATIVE THINKING AND CANDID CONVERSATIONS

While the topic was serious, the session maintained a creative and collaborative spirit. Light-hearted references to Mordor, elves, and using the Balrog as a heat source gave the discussion an edge of levity, but the solutions proposed were grounded, detailed, and forward-thinking.

As Koppens noted in closing, the exercise confirmed the sector's growing readiness to think differently. "Once again, I'm amazed by the depth of insight and ideas that emerge when we bring the right mix of people together," he said. "These kinds of collaborative sessions show that we can find creative, practical solutions when we share knowledge across the silos."

#### **LOOKING AHEAD**

The Think Tank session at The *Decarbonised Mine* didn't yield a single answer—but it did deliver what was perhaps more important: a platform for open dialogue, interdisciplinary learning, and candid discussion of the challenges that still lie ahead.

Whether it's redefining technical standards, creating space for community ownership, or investing in more resilient hybrid systems, the road to decarbonisation will require this kind of holistic, inclusive thinking. And as this session showed, the industry is more than ready to meet that challenge.

# **KEY TAKEAWAYS** FROM ENTURA'S THINK TANK:



#### PHASED APPROACH TO ZERO EMISSIONS

Achieving zero emissions in mining operations requires a phased approach, starting with high renewable penetration and gradually addressing challenges like process steam and mobile equipment electrification.



#### **COMMUNITY ENGAGEMENT STRATEGIES**

Meaningful community engagement is crucial for successful renewable energy projects in mining, potentially including equity stakes, power-sharing agreements, or infrastructure sharing for local industry development.



#### **POWER QUALITY CHALLENGES IN HYBRID SYSTEMS**

Power quality in hybrid renewable systems is becoming a point of tension, with the need to balance performance and cost. Developing off-grid power quality standards is crucial for system design and operation.



#### FINANCIAL CHALLENGES OF RENEWABLE INVESTMENTS

The significant upfront capital costs of renewable energy systems pose a major challenge for mine decarbonisation, requiring careful consideration of long-term investment returns.



#### HIGH RENEWABLE PENETRATION IN OFF-GRID MINING

Off-grid mining operations can achieve 50-80% renewable energy penetration relatively easily, with solar providing up to 50% and wind enabling up to 80% renewable energy share.



#### **TECHNICAL RISKS AND CONSTRAINTS**

Key technical risks in deploying renewable solutions include environmental impact assessments, community engagement, infrastructure aging, and the need for specialized training and education.

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#### **ENERGY STORAGE INTEGRATION**

Effective integration of both short-duration and long-duration energy storage is crucial for ensuring reliability and continuity of supply in renewable-powered mining operations.



#### **BATTERY MICROCYCLING CONCERNS**

The impact of battery microcycling on service life is a significant concern in hybrid systems, with uncertainty around long-term performance and lifespan predictions.



#### MINING EQUIPMENT ELECTRIFICATION

Electrification of mining equipment, such as electric rock drills in underground mines, is a key strategy for reducing emissions in mining operations.