Hydrogen and Mines

The opportunities and applications for mining
June 18, Westin Perth
Organized by **Energy and Mines**
Co-located with Energy and Mines Australia Summit, June 19-20

Commercialization of hydrogen technologies and hydrogen infrastructure development initiatives are rapidly gaining momentum in Australia. Hydrogen offers the mining sector a range of solutions to address energy and carbon goals including as a zero-emissions fuel for heavy haulage equipment and machinery; as a means of firming renewable electricity and providing back-up power generation, and as a source of high-grade heat for mineral processing.

Beyond direct energy applications, hydrogen derivatives, such as ammonia can be used to localize supply chains for explosives and chemicals used in mining operations and mineral processing, further strengthening the value chain for mineral extraction and processing. Adoption of these technologies for the mining sector requires a co-ordinated approach to address challenges such as infrastructure, costs, safety standards, and pilot projects.

Hydrogen and Mines will provide a timely opportunity for senior mining leaders to meet, explore and understand the opportunities and challenges for the introduction of hydrogen across mining's value chain. Organized by Energy and Mines, the global leader in content and events on renewables for mines, the event will address key questions for the mining sector around the timescale, commercialization, economics and real-world applications of hydrogen for mines, and runs as part of the 3rd annual **Energy and Mines Australia Summit**, June 19-20. Key topics include:

- Mining applications including fuel substitution, renewables integration and power supply
- Technology updates, pilot projects and commercialization outlook
- The economics and business fundamentals of hydrogen for mines
- Insight on codes, standards, safety, training and capacity-building
- Exploring the value-added benefits: hydrogen for processing applications
- Plus the official launch of a new International Energy Agency program - "Hydrogen Applications in the Mining and Resources Sector"

8:20 **Welcome**
Adrienne Baker, Director, **Energy and Mines**

8:25 **Chair's Opening Remarks**

8:30 **Opening Keynote:**
Hon. Alannah MacTiernan MLC, Minister for Regional Development; Agriculture and Food; **Government of Western Australia**

8:50 **Unlocking Australia's Hydrogen Potential**

- Fortescue Metals Group (FMG) is investing $19.1 million to partner with CSIRO to unlock hydrogen's potential as a fuel-source and export industry in Australia

Bethwyn Cowcher, Legal Manager for Energy and Power, **Fortescue Metals Group**

9:10 **Why Hydrogen for Mines - Why Now?**

- Why is hydrogen for resource companies gaining so much traction today - and how does it fit with other mining energy and carbon initiatives including renewables and mine electrification?
- What particular opportunities are there for Australian mining companies to benefit from current support and enthusiasm around hydrogen?
- Economics and timescales for hydrogen transport, power and processing applications for mines

9:30 Panel: **Australia's Hydrogen Economy and Mining Sector Opportunities**
Strong government support combined with a number of industry-led initiatives to develop hydrogen's potential as a fuel replacement and export product has positioned Australia as a global centre for the technology's advancement. How can the domestic resource sector capitalize on this momentum and lead on real-world applications of hydrogen for mines? This keynote panel will bring together leading hydrogen, mining and energy experts to discuss the opportunities and challenges for the mining sector.

- Understanding key hydrogen market developments and the likely impacts for the resource sector
- How can mining position itself to benefit from the enthusiasm and support for hydrogen?
- What types of collaboration opportunities exist for mines to partner on hydrogen projects?
- What are the best near-term opportunities for mines to integrate this technology?
- What are the advantages and disadvantages for mines of being first-to-market with hydrogen?
- What are the main barriers that need to be overcome for hydrogen to be used in mining?
- Which test sites and initiatives provide the most insight for mines on the technology's potential?
- What are the next steps for implementing hydrogen applications for Australia's resource sector?

Chair: **Attilio Pigneri**, Chief Executive, **Hydrogen Utility™ (H2U)** and President,
Australian Association for Hydrogen Energy
Alison Reeve, Taskforce Leader, National Hydrogen Strategy, **Australian Government**
Kathryn Horlin, Principal Low Emissions Technology, **BHP**
Bethwyn Cowcher, Legal Manager for Energy and Power, **Fortescue Metals Group**
Russell James, General Manager Business Development & Customer Experience, **ATCO Gas Australia**

10:10 **Audience Q&A**

10:20 **Networking Break**

Session 1: **Decarbonizing Mine Transport: Key Developments in Hydrogen for Heavy-Duty Fleets**
With transport accounting for a high proportion of mining's energy costs and carbon footprint, hydrogen fuel cells represent a significant opportunity to drive down power costs and the associated emissions. In fact, heavy-duty mobility is expected to be the first application of hydrogen in mining as the fuel is becoming cost-competitive with diesel and gas and offers a viable, carbon-free alternative. This session will provide the very latest updates on developments, challenges, and next steps for hydrogen-fueled mining vehicles and cargo trains.

10:50 Case Study: **Testing Hydrogen Transportation Solutions**
South African platinum-producer Impala is testing hydrogen transport solutions for its mining operations.

- Details on pilot projects and initial results from hydrogen mobile applications
- Key benefits for hydrogen-powered vehicles and remaining barriers to commercialization
- Next steps in collaborating on economies of scale and building demand

Fahmida Smith, Market Development Manager, **Impala Platinum**

11:10: Panel: **Decarbonizing Mine Transport: Key Developments in Hydrogen for Heavy-Duty Fleets**

- What are the main barriers for hydrogen for heavy-duty fleet applications - infrastructure, economics, safety standards, vehicle conversion?
- How are mines currently testing or assessing hydrogen to power transport and equipment?
- How are fuel and equipment suppliers approaching hydrogen for mining vehicles and trains?
- How does hydrogen fit (or not) with current OEM business and contract models?
- What lessons have been learned in testing hydrogen to power heavy haulage trucks and trains?
- What solutions are being considered to ensure safe and economical delivery of hydrogen for underground vehicles?
- What factors need to be present to support the business case for hydrogen-fueled mobile fleets?
- Experts views on the timescale for commercializing hydrogen-powered mine vehicles and trains?

Gerard de Fleurieu, Vice-President Zero-Emission Mobility, **Michelin**
Mikio Kizaki, Chief Professional Engineer, **Toyota Motor Corporation**
Victor López, Innovation Manager, **Codelco**
Daniel Chen Wang, Vice Director of Business Development, **Weichai Power Co**

11:50 **Audience Q&A**

12:00 **Networking Lunch**

Session 2: **Integrating Hydrogen into Mining Power Systems**
Affordable hydrogen could address the primary barrier to sustainable energy for mining by delivering an emissions-free alternative to diesel or gas back-up. With this in mind, mines and other heavy industrial sectors are exploring hydrogen integration with wind and solar energy. This session will offer critical insight on the latest developments, test sites, business models, hurdles and milestones for hydrogen integration into remote mining power systems.

1:00 Case Study: **Hydrogen for a Mining Microgrid in Canada's North**
Glencore's Raglan mine is the world's first mining microgrid to incorporate hydrogen storage

- Performance results from hydrogen alongside wind and lithium ion and flywheel storage
- Lessons learned from implementing and operating hydrogen in an extreme climate
- Benefits and drawbacks from hydrogen versus other storage options in a mining microgrid

Jean-Francois Veret, Director, Capital Projects and Exploration, **Glencore**

1:20 Case Study: **Opportunities and Challenges of Integrating Hydrogen into a Mining Hybrid**

- Key attributes including energy costs and mine life that support hydrogen's business case
- Insight on the financial modelling: what is the expected value of converting excess renewable energy into hydrogen fuel?
- What are the main challenges - economic, technical, cultural - that need to be overcome?

1:40 Panel Discussion: **Integrating Hydrogen into Mining Power Systems**

- What are the main considerations for mines when assessing on-site hydrogen production?
- How much energy spillage from renewables is needed to make hydrogen production economic?
- How can hydrogen work with other storage technologies to meet mining's energy demands?
- What are the main barriers to integrating this technology for mining power systems?

- How is this market developing - which suppliers and miners are taking the lead on testing and introducing hydrogen into remote power systems?
- Is hydrogen for power systems expected to follow a similar trajectory as renewables for mines with small, isolated pilot projects eventually leading to broader, and larger-scale uptake?
- When is hydrogen storage for mining power systems expected to be viable for large-scale deployment?
- What key technological advancements and market developments will accelerate the uptake of hydrogen for remote mines?
- What options are there for repurposing hydrogen production after mine closure?

Luca Maria Rossi, Chief Technology Officer Turbomachinery, **Baker-Hughes GE (BHGE)**
Ryan Sookhoo, Director of New Initiatives, **Hydrogenics**
Andrew Dickson, Project Manager, **Asian Renewable Energy Hub**
Jean-Francois Veret, Director, Capital Projects and Exploration, **Glencore**

2:20 **Audience Q&A**

2:30 Session 3: **The Economics and Business Fundamentals of Hydrogen for Mines**
At this stage of hydrogen's commercialization, the technology is very costly, requiring significant capital investment. As renewables have demonstrated in the past, this is particularly challenging for mines that are accustomed to high-opex, low-capex energy and transport costs. This session will explore the economics of hydrogen for mines and outline key considerations for mines when analyzing the potential business case for hydrogen integration and investment.

- Experts' views on the current economics of hydrogen for mining applications - how does hydrogen stack up against traditional mine energy and transport costs and finance models?
- What type of finance models could support the higher capex required for hydrogen investments - can the economics work today?
- What fundamentals are required to support the business case for a mine to consider hydrogen - mine life, energy as a portion of operating costs, transport costs, carbon targets, etc.?
- What type of financial incentives and grants are available for mines that want to be first-to-market?
- What are the most viable routes to financing these projects today - how are suppliers and industrial users collaborating on projects to demonstrate the technology's feasibility?
- As the costs come down, what type of contract models and partnerships are expected to work best for hydrogen for mines?
- When is hydrogen expected to be available to mines as a viable, economic, low-carbon fuel option?

Chair: **Claire Johnson,** CEO, **Hydrogen Mobility Australia**
Christopher Jackson, Hydrogen and Fuel Cells Consultant, **The World Bank Group**
Tom Campey, General Manager Strategy, **Australian Renewable Energy Agency**
Rob Wilson, Head of Western Australia, **Clean Energy Finance Corporation**
A Representative, Energy and Resources Division, **Macquarie Capital**

3:10 **Audience Q&A**

3:20 **Networking Break**

3:50 Session 4: **Hydrogen Processing Applications in Mining**

Hydrogen derivatives, such as ammonia can be used to localize supply chains for explosives and chemicals used in mining operations and mineral processing, further strengthening the value chain for mineral extraction and processing. This discussion will examine the value-added benefits of hydrogen derivatives in mining operations and mineral processing.

- How can hydrogen address processing challenges for mines?
- What are the key benefits of introducing hydrogen, ammonia, and derivatives for processing application (heat processing, leaching, etc.)?
- What are the current challenges of integrating these hydrogen derivatives into minerals processing applications?
- What examples are there of pilot projects in operation and under development for mining companies?
- What lessons can be learned from this application for other industrial sectors?
- What are the next steps for integrating hydrogen into mining and mineral processing?

Chair: **Miranda Taylor**, CEO, **National Energy and Resources Australia (NERA)**
Gus Nathan, Director, Centre for Energy Technology, **University of Adelaide**
Kevin Eggers, Partner, **AP Ventures**

4:30 **Audience Q&A**

4:40 Session 4: Interactive Discussion: **Industry Response and Next Steps for Hydrogen and Mines**
Following a full-day of expert insights, this interactive discussion will ask audience members for their perspectives and observations on hydrogen applications for the local resource sector and next steps.

- How can the domestic resource sector maximize this opportunity for integrating hydrogen into energy, transport and processing applications?
- What is preventing mines from testing hydrogen applications today?
- What are the deployment timelines for operational projects and business models for mines to draw from?
- What needs to happen to drive uptake for mining applications in Australia?
- Hydrogen and decarbonizing mining: what are the advantages and disadvantages of hydrogen as a means of decarbonizing mine transport and power systems?
- What will mines be watching for in terms of key milestones for mining applications?
- How can mines position themselves to benefit from the current enthusiasm for building Australia's hydrogen economy?
- What are the key takeaways for mining and energy leaders on the next steps for integrating hydrogen for mines?

5:10 **Networking Drinks and Welcome Drinks for Energy and Mines Australia Summit**