భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Australia India Critical Minerals Research Hub
Partnering for a new future

MONASH University

R E P O R T O N

TWO-DAY CRITICAL MINERALS SYMPOSIUM AND WORKSHOP

January 3-4, 2025 | IIT Hyderabad

KEY CONTACTS

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Executive Summary

The Australia-India Critical Minerals Research Hub hosted a two-day symposium and workshop on January 3-4, 2025, at IIT Hyderabad. The event was inaugurated by the Chief Guest, The Hon. Batti Vikramarka Mallu MLA, Deputy Chief Minister of Telangana, with a written message from The Hon. G Kishan Reddy MP, Minister of Mines, Government of India.

The symposium attracted significant attention from key stakeholders, including representatives from government, industry, and academia from both countries. Discussions focused on fostering collaboration between Australia and India in the areas of exploration, mining, processing, and policy frameworks for critical minerals.

Key outcomes of the symposium included:

- Actionable recommendations to strengthen bilateral ties, advance research, and enhance industry capabilities.
- Identification of priority research areas for collaboration between India and Australia and fund PhD students and Research Fellows to work on the identified research priorities.
- The signing of a Memorandum of Understanding (MoU) between IIT Hyderabad and Singareni Collieries Company Limited, demonstrating state government support for ongoing AICMRH activities.

The event underscored the importance of international cooperation in addressing the challenges and opportunities in the critical minerals sector.

CONTEXT

The forum examined the contemporary contextual factors shaping international collaboration.

Australia and India Collaboration: India has engaged in strategic partnerships and initiatives to de-risk the critical minerals supply chain. The Australia-India partnership, underscored by the India-Australia Critical and Strategic Minerals Joint Working Group, commits Australia to assist India in establishing a domestic critical minerals processing industry. Collaborations with Australia (Comprehensive Economic Cooperation Agreement), as seen in the bilateral agreement on critical minerals. India's participation in trilateral initiatives with Australia and Japan (Supply Chain Resilience Initiative), demonstrate India's commitment to promoting best practices and resilience in the Indo-Pacific supply chain. Joining the 'MSP' led by the US further underscores India and Australia's dedication to securing critical mineral resources globally.

Mineral Criticality: There are many causes of minerals criticality in many complicated, small, and dynamic markets. Nickel, Cobalt, rare-earth elements (in many different forms), and downstream lithium products (for example – lithium chemicals) are examples of products where *concentration of supply* is a significant cause of mineral criticality. However, there are many other possible causes of criticality[1] including:

- Barriers to entry (technological, capital) combined with relatively small market size (compared to copper, iron, aluminium and coal)

[1] For a more detailed discussion of minerals criticality assessment see Whittle, D., M. Yellishetty, S. D. Walsh, G. Mudd and Z. Weng (2020). Minerals Criticality Assessment from an Australian Perspective. ALTA 2020 Uranium and REE Conference. A. Taylor. Perth.

- A small number of geographically diverse customers, making it hard to achieve economies of scale on the supply side.
- Opaque markets, meaning price discovery is very difficult.
- Highly differentiated products including different forms of the same underlying mineral in different stages of the supply chain.
- Some markets are dominated by co-production (For example, much cobalt is a co-product to copper) distorting the usual market connection between price and supply.

International Workforce Development Experiences: China has 100,000 professionals involved in the REE industry, via Chinese Society of Rare Earths (CSRE) founded in 1980. Australia, US, Canada, and South Africa can count only 35,000 mining professionals – covering all minerals.

China has built scientific and industrial capability in critical minerals over several decades. Australia has world-leading METS sector capabilities and tremendous mining technical knowhow. However, to compete with China in critical minerals markets, additional capabilities will be required, particularly in downstream processes in the supply chain.

If alternative supply chains are to be developed for all critical minerals, we need to think at a scale that stretches well beyond Australia and India's shores. Australia has minerals and it has mining capability. On the other hand, India has huge demand and lacks a well-developed critical minerals industry. Australia-India capabilities thin out further along the supply chain, and we should be looking to partner with Korea, Japan, Malaysia, New Zealand, USA, UK and Indonesia (amongst others). It is for this reason that the Critical Minerals Consortium (Monash University) was involved in developing a recommendation for an Indo-Pacific Critical Minerals Consortium. Further details are included in Appendix – IPCMRC.

Recommendations for Governments, Industry, and Academia

Governments

1. **Establish research Centre of Excellence:** Develop a multi-country Indo-Pacific research centre focused on critical minerals, leveraging Australian expertise in exploration, mining, processing and technology and Indian strengths in cost-effective scaling and manufacturing.
2. **Policy alignment and support:** Introduce joint policies to incentivise critical mineral exploration and processing, including subsidies, tax breaks, and grants for start-ups and research projects.
3. **Secure raw material supply chains:** Develop government-backed initiatives to acquire or partner in overseas lithium, cobalt, and rare earth resources, ensuring long-term supply security.
4. **Promote standards and certifications:** Harmonise standards across both countries for mining, processing, and certification to enable seamless integration into global markets.
5. **International collaborations:** Facilitate and deepen cross-border cooperation between governments, research institutions and industry through committed funding mechanisms.
6. **Technology transfer:** Invest in the development of commercialisation pathways to help Australia and Indian companies access the technological sophistication required for large and complex supply chains.

To facilitate collaborations between Australian mining and Indian end-user companies, can establish bilateral agreements and joint working groups. Financial incentives and support, including funding programs, subsidies, and tax incentives, can reduce financial risks and encourage investment in joint ventures. Additionally, investing in shared infrastructure projects and facilitating technology transfer can enhance efficiency and capabilities in critical mineral processing and refining. Governments can also implement:

- price stabilization mechanisms and risk mitigation funds to protect companies from market volatility and potential bankruptcies.
- regulatory standards and promoting high environmental and social governance (ESG) standards can simplify compliance and attract investors.
- public-private partnerships (PPPs) and co-funding critical mineral projects can further reduce risks and leverage combined expertise and resources.

Academia

1. **Create academic-industry linkages:** Fund internships, co-supervision of PhD students, and collaborative research projects between universities and industries in both countries in critical minerals extraction and processing.
2. **Developing the workforce:** Invest in the vocational and tertiary sectors to be able to deliver the next generation of skills that will be required to support the rapid growth of critical mineral supply chains. The federal government should guide and support invest in industry PhDs, support university UG and PG pathways into the sector, develop specific engineering majors.
3. **Focus on sustainability:** Promote research in sustainable mining practices and recycling technologies, including bio-leaching and low-carbon processing methods.
4. **Implement cross-institutional training:** Develop joint degree programs and skill-based certifications to address workforce gaps in the critical minerals supply chain.
5. **R&D sharing through IP Libraries:** An Indo-Pacific Critical Minerals Alliance, supported by the Australian and Indian (and other) governments should set up shared IP libraries to support R&D investments, avoid duplication, optimize allocation of resources, and save time.

R&D partnerships should operate with the following three core principles, namely:

- **Complementarity:** Establish partnerships based on complementarity and build a mechanism that values and acknowledges the importance of strong relationships both within and outside the country.

- **Collaboration:** Promote exchanges and collaborations between academics and researchers in fields of minerals criticality assessments, critical minerals extraction, processing and separation and any other research priorities identified. Establish and sustain more bilateral (or multilateral) funding schemes that will enable outcome-driven research and education around critical minerals through competitive PhD and post-doctoral scholarships for researchers from partner countries. This will advance science diplomacy whilst reinforcing the ongoing trade diplomacy.
- **Value:** Set up achievable targets and make sure we deliver tangible improvements in a timely manner, not measured only by output of journal publications or reports but also through impact on policy and industrial practice, including number of patents filed.

Industry

1. **Recycling infrastructure:** Foster partnerships to establish localized recycling facilities and integrate micro-factories for battery and critical mineral waste.
2. **Accelerate innovation pipelines:** Invest in industry collaboration with universities for medium-TRL (Technology Readiness Level) developments in emerging technologies such as Na-ion, Lithium-Sulfur batteries, REE processing, Membranes Separation, Microfactories, and remove policy barriers that prevent tech-transfer and commercialisation opportunities.
3. **Strengthen local manufacturing:** Support local start-ups and SMEs to enter global supply chains by adopting international standards for materials and components.

Overview of the symposium proceedings

The symposium featured a range of sessions, including plenary talks, keynote addresses, panel discussions, and an open forum for brainstorming actionable ideas. Key sessions included:

- **Pre-workshop training:** Focused on geological exploration, beneficiation, and refining of critical minerals.
- **Plenary talks:** Delivered by eminent experts like Prof. Veena Sahajwalla and Prof. Suresh Bhargava, highlighting advanced technologies and policy challenges.
- **Panel discussions:** Addressed technology roadmaps for exploration and processing and policy frameworks for education, research, and innovation.
- **Open discussion:** Participants shared insights on collaboration models, industry challenges, and policy interventions required to strengthen the Australia-India partnership.

Key Takeaways for Stakeholders

Governments

- There is an urgent need to secure raw material supplies and reduce reliance on monopolistic markets like China, as many critical minerals are linked to national security.
- It is important to incentivise local manufacturing and recycling capabilities through the establishment of a 'national critical minerals fund'

Academia

- Emphasis on interdisciplinary research combining geology, metallurgy, and biotechnology.
- Need for accessible datasets and open platforms for collaborative research.

Industry

- Recognition of gaps in automation and advanced manufacturing in India.
- Potential for partnerships in recycling and next-generation battery technologies.

Missing links in the Australia-India Critical Minerals partnership

- **Limited access to raw materials:** Indian industries rely heavily on imported lithium and rare earth materials, necessitating secure bilateral supply chains.
- **Technology transfer gaps:** Slow adaptation of Australian advanced exploration and processing technologies in India.
- **Workforce skill deficits:** A significant shortage of skilled professionals in India's critical minerals sector compared to Australia.
- **Fragmented collaboration models:** Absence of integrated, co-funded research and development platforms akin to Australia's CRC (Cooperative Research Centres) model.

Case Study: Challenges in Synergy Development Among Complementary Industries in Telangana

Amar Raja, a battery manufacturing company in Telangana, aims to produce 16 GWh of Li-ion batteries within the next decade. However, the company faces several challenges that hinder its progress. One major issue is attracting a trained workforce, as the educated youth in Telangana prefer the IT sector over renewable energy. To address this, Amar Raja could implement experiential, paid internships and training programs to draw young talent into the industry.

Another challenge is the recycling of batteries and scraps. Currently, Amar Raja relies on external recycling providers, but establishing localized, on-site recycling through targeted micro-factories could enhance efficiency and sustainability. Additionally, Amar Raja is looking to future-proof its innovation pipeline by exploring emerging battery technologies such as Na-ion and Lithium-Sulfur chemistries. Partnering with universities for medium TRL (3-4) developments and utilizing pilot lines for manufacturing could facilitate this process.

ALTMIN, a cathode-active material manufacturer in Hyderabad, also faces significant hurdles. The company depends on imported Lithium hydroxide or Carbonate, which poses a risk to the battery supply chain in India. Government-backed firms should invest in acquiring resources and technologies to secure the Lithium supply chain. Furthermore, ALTMIN struggles to enter the indigenous battery manufacturing value chain due to the reliance on overseas technology by companies like Amar Raja. Policy-level interventions are needed to promote indigenous battery material producers.

Synergy Challenges

Despite the complementary nature of Amar Raja and ALTMIN, several factors hinder synergy development:

- Workforce preferences: The preference of educated youth for the IT sector over renewable energy creates a talent gap.
- Outsourcing vs Localisation: Reliance on external recycling providers and imported raw materials limits the potential for localized synergy.
- Technological gaps: Lagging in automation and advanced manufacturing technologies reduces competitiveness.
- Policy and market barriers: Lack of policy support and market entry barriers for indigenous producers hinder collaboration.

Enabling mechanisms to foster collaboration

- **G2G agreements:** Develop bilateral agreements focused on critical minerals exploration, trade, and research funding.
- **B2B collaborations:** Facilitate joint ventures and knowledge-sharing platforms between Indian and Australian companies to enhance technology adoption and market access.
- **Research collaborations:** Create joint research projects with clearly defined deliverables, co-supervised by experts from both countries.

Funding and grants: Establish co-funded initiatives for pilot projects, student exchange programs, and workshops.

Summary of Panel Discussion 1

Moderated by Professor Brajaesh Kr Dubey from IIT Kharagpur, the session focused on technology roadmap (Exploration, Mining, Extraction & Processing Technologies)

Collaboration and data sharing

- Establish pilot-scale projects leveraging India's skilled workforce and Australia's advanced technological labs.
- Create a Cooperative Research Centre (CRC) model in India to facilitate industry-defined research problems and collaborative solutions, a model that Australia successfully created

Exploration and mining

- Focus on identifying lithium resources in India's greenstone belts and groundwater in regions like Rajasthan.
- Investigate rare earth elements in carbonatites and beach sand deposits, addressing associated uranium and thorium issues.

Sustainable practices and innovation

- Develop bio-based extraction processes using plants, microbes, and proteins to reduce environmental impact.
- Implement novel chemical technologies for selective extraction of critical minerals from complex sources.

Policy and regulation

- Simplify regulatory processes to expedite mining projects and ensure environmental and social responsibility.
- Encourage policies that support the entire value chain, from exploration to commercialization.

Education and skill development

- Enhance educational programs and joint degrees in mining, geological engineering, and environmental science.
- Promote vocational training and upskilling to prepare the workforce for the critical minerals sector.

Supply chain and economic impact

- Address the supply chain dichotomy between resource-rich southern hemisphere and demand-heavy northern hemisphere.
- Develop a mission-critical framework that includes exploration, processing, and social aspects to ensure economic benefits for both countries.

Summary of Panel Discussion 2

Moderated by Professor M Radhakrishna from IIT Bombay, the session focused on creating a policy roadmap encompassing education, research, innovation, start-ups, regulation, and policies.

Collaboration and data sharing

- Strengthen collaboration between India and Australia at both academic and industry levels.
- Utilise India's extensive geoscience data and Australia's expertise in exploration to discover new mineral deposits.

Education and skill development

- Develop specialised educational programs and joint degrees to address gaps in mining, geological engineering, material science, and environmental science.
- Enhance vocational training and upskilling programs to prepare the workforce for the critical minerals sector.

Innovation and start-ups

- Foster a start-up culture by supporting new ventures in mining and processing technologies.
- Encourage joint research and development projects to commercialize innovative solutions quickly.

Policy and regulation

- Simplify regulatory processes to reduce the time required to start mining projects.
- Implement policies that promote sustainable mining practices and ensure environmental and social responsibility.

Sustainable practices

- Focus on responsible mining, considering environmental and social impacts.
- Engage local communities from the beginning of projects to ensure their support and address their concerns.

Supply chain and economic impact

- Create a mission-critical framework that includes exploration, processing, and social aspects.
- Develop policies that support the entire value chain, from exploration to commercialization, ensuring economic benefits for both countries.

These recommendations aim to enhance the collaboration between India and Australia, promote sustainable practices, and support the growth of the critical minerals sector through education, innovation, and streamlined policies.

Summary

The AICMRH symposium underscored the significant potential for collaboration between Australia and India in addressing global challenges within the critical minerals sector. By aligning research goals, policy frameworks, and industrial capabilities, both nations can establish a robust and sustainable supply chain for critical minerals. Implementing the symposium's recommendations will not only strengthen bilateral ties but also position Australia and India as global leaders in critical mineral innovation and sustainability.

Key outcomes of the symposium included:

- Actionable recommendations to enhance bilateral ties, advance research, and bolster industry capabilities.
- Identification of priority research areas for collaboration between India and Australia and fund PhD students and Research Fellows to work on the identified research priorities.
- Proposal to establish a joint Centre of Excellence focused on critical minerals, leveraging Australian expertise in exploration, mining, processing, and technology, alongside Indian strengths in cost-effective scaling and manufacturing. This initiative could also involve other countries in the Indo-Pacific region.

The symposium highlighted the importance of international cooperation in fostering innovation and sustainability in the critical minerals sector.

Attachments

1. Speech transcript of the Chief Guest, **The Hon. Batti Vikramarka Mallu** MLA, Dy Chief Minister, Telangana
2. Message from the Hon. **G Kishan Reddy** MP, Minister of Mines, Government of India
3. Copy of the agenda of the two-day symposium and workshop and agenda of the inauguration session
4. Panel discussion questions and panel composition
5. Indo-Pacific Critical Minerals Consortium terms of contract
6. Book of abstracts with author biographies

7. List of contributors with their affiliations
8. Clippings from Newspapers

Hon’ble Distinguished Academicians, Respected Researchers, Industry Leaders, Students, and Esteemed Guests,

It’s a privilege to stand here today at the **Australia-India Critical Minerals Research Hub Workshop**, hosted by **IIT Hyderabad**, an institution that has consistently set benchmarks in academic excellence, research innovation, and societal impact.

IIT Hyderabad has carved a niche not just in education but also in shaping **India's technological and scientific landscape**. With over **11,500 publications, 320 patents, and a thriving startup ecosystem generating over ₹1,500 crore in revenue**, IIT Hyderabad is more than an academic institution—it’s a lighthouse of innovation.

The Nexus of Research and Real-World Solutions

At the heart of this workshop lies a fundamental truth: **Research is not an academic exercise; it’s a bridge to a better world.** Whether it’s unlocking **new methodologies for critical mineral extraction**, **revolutionizing mining practices**, or **strengthening global supply chains**, the impact of this initiative will resonate far beyond the walls of laboratories and conference halls.

Critical minerals are not just resources—they are **cornerstones of our future**. From **renewable energy technologies and electric vehicles to advanced manufacturing systems**, they power the tools of tomorrow. But extracting, processing, and managing these resources responsibly demands collaboration across **academia, industry, and policy-making bodies**—exactly what this workshop aims to achieve.

Common Threads Between Science, Engineering, and Policy

There’s something beautifully symbiotic about **research and governance**—both deal with solving complex problems, managing resources wisely, and aiming for sustainable outcomes. In Telangana, this relationship has been particularly fruitful.

Take the example of our **Telangana Clean and Green Energy Policy**. As we stand on the brink of adding **20,000 MW of renewable energy and storage capacity by 2030**, we recognize that critical minerals are a **backbone for renewable technologies**—from solar panels and wind turbines to battery storage systems.

In our renewable energy roadmap, we’ve prioritized:

- **Standalone Solar and Wind Projects** to address regional energy demands.
- **Advanced Energy Storage Solutions** such as **Battery Energy Storage Systems (BESS)** and **pumped hydro storage projects** to balance intermittency.
- A strong focus on **Green Hydrogen** as the fuel of the future.

Each of these priorities relies on access to **critical minerals**, and the work being done here at IIT Hyderabad will directly support our policy ambitions.

Telangana's Commitment to Stakeholder Engagement

Let me also emphasize the importance of **collaboration and stakeholder participation**. In shaping our **Clean and Green Energy Policy**, we have engaged not only scientists and policymakers but also **industry leaders, grassroots innovators, and community stakeholders**. This model of **inclusive development and collective ownership** is something I see reflected in the very fabric of this workshop.

Workshops like this one embody a vision where **research meets governance**, where the **findings of scientists are integrated into policy frameworks**, and where **academic curiosity transforms into real-world impact.**

The IIT System: A Catalyst for Change

The **IIT system**, and particularly **IIT Hyderabad**, represents the best of India's academic and research excellence. These institutes are not ivory towers—they are **platforms for societal transformation**.

In the coming years, **critical minerals research will play a pivotal role in addressing global challenges**—whether it's mitigating the environmental impacts of mining, ensuring ethical supply chains, or driving technological innovation.

Today, as Telangana envisions becoming a leader in **renewable energy, smart infrastructure, and sustainable development**, institutions like IIT Hyderabad and collaborative initiatives like this **Australia-India Critical Minerals Research Hub** will be our key allies.

The Role of Stakeholders: A Shared Responsibility

- To the **researchers**: Your ideas, your persistence, and your curiosity will shape not just discoveries but also policies, industries, and futures.
- To the **industry leaders**: Your expertise will bridge the gap between theoretical research and market-ready solutions.
- To the **policymakers and government officials**: It's our job to create an **enabling ecosystem** where these collaborations can thrive.

In Telangana, we are committed to fostering this ecosystem—one where **researchers are empowered, industry leaders are supported, and stakeholders are heard**.

Bridging Critical Minerals and Renewable Energy Goals

As we chart our course toward **energy self-sufficiency and sustainability**, the synergy between **critical minerals research and renewable energy policy** cannot be overstated. Whether it's developing **efficient solar panels, advanced wind turbines, or cutting-edge storage solutions**, the insights emerging from hubs like this one will have a direct bearing on our **renewable energy landscape**.

Closing Thoughts: A Call to Action

As I conclude, I'd like to leave you with this thought: **Science is the engine of progress, but collaboration is the fuel.**

This workshop is not merely an event—it's a **catalyst for long-term collaboration, innovation, and progress**. The roadmap developed over these two days will not just impact academic journals; it will shape **policies, industries, and societies.**

In Telangana, we believe in **practical governance backed by sound science**. Whether it's critical minerals or renewable energy, our commitment is clear: **to build a future that is cleaner, smarter, and more sustainable.**

I look forward to the outcomes of this workshop and assure you of the **Telangana Government's wholehearted support** in advancing these goals.

Thank you all for your dedication, your expertise, and your commitment to building a better world.

Jai Hind! Jai Telangana!

जी. किशन रेड्डी
జి. కిషన్ రెడ్డి
G. Kishan Reddy

सत्यमेव जयते

कोयला एवं खान मंत्री
भारत सरकार
नई दिल्ली
MINISTER OF COAL AND MINES
GOVERNMENT OF INDIA
NEW DELHI

MESSAGE

I extend my heartfelt wishes on the launch of the Two-Day Critical Minerals Symposium and Workshop at IIT Hyderabad. Critical minerals are essential for the green energy transition, digital innovation, and advanced manufacturing. As the world moves toward achieving sustainable development goals and the demand for these minerals soar, collaboration and innovation in responsible exploration, processing, and recycling are becoming increasingly vital.

The Australia India Critical Minerals Research Hub highlights the strength of international cooperation. Through shared resources, research, and initiatives like PhD scholarships, we are nurturing expertise and advancing global sustainability. I express my gratitude to all the researchers, academics, and industry leaders who are part of this collaborative effort. Your work is paving the way for a new era in critical minerals exploration, processing, and recycling.

I wish the Symposium and Workshop a great success!

(G. KISHAN REDDY)

Date: 03.01.2025

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Two-Day Critical Minerals Symposium and Workshop

January 3-4, 2025 | IIT Hyderabad
https://che.iith.ac.in/aicmrh-2025/index.html

Day 1: 3rd January 2025 (Inaugural)

09:30-10:15	**Inaugural session Conducted by Prof Narsimha, IIT Hyderabad**
09:30-09:32	Lighting of the Lamp
09:32-09:35	Welcome by **Prof B S Murty**, Director, IIT Hyderabad
09:35-09:39	Opening Remarks by Guest of Honour, **Ms Hilary McGeachy,** Consul General, Australian Consulate-General Bengaluru
09:39-09:42	Message from **H E Mr Gopal Baglay**, High Commissioner of India, Australia (online)
09:42-09:45	Opening Remarks by Guest of Honour, **Sh Sridhar Babu**, Minister for IT & Industries, Govt. of Telangana (online)
09:45-09:55	Address by Guest of Honour, **Mr Dinesh Mahur**, Joint Secretary, Ministry of Mines
09.55-10.05	Address by **Chief Guest**, **Mr Batti Vikramarka Mallu**, Honourable Dy Chief Minister, Telangana
10:05-10:08	Message from **Mr. Kishan Reddy**, Honourable Minister of Mines, Govt. of India (online)
10:08-10:10	MoU Signing between IIT Hyderabad and Singareni Collieries Company Limited
10:10-10:13	Vote of thanks **Prof Mohan Yellishetty**, Monash University
10:13-10:15	**National anthem**
Group Photograph (10-15-10:17)	
10:15-10:45	**High Tea**

AUSTRALIA-INDIA CRITICAL MINERALS RESEARCH HUB

Two-Day Critical Minerals Symposium and Workshop

January 3-4, 2025 | IIT Hyderabad

https://che.iith.ac.in/aicmrh-2025/index.html

Venue: Convention Centre, IIT Hyderabad

Day 1: 3rd January 2025

Time	Activity (Auditorium 1)	Coordinator	
09:30-10:15	**Inaugural session**	**Conducted by Prof Narsimha**	
Group Photograph (10--10:15)			
10:15-11:00	**High Tea**		
Time	**Activity (Auditorium 1)**	**Speaker**	**Session Chair**
11:00-11:30	Plenary Talk 1	Prof Veena Sahajwalla, Univ New South Wales	**Dr D Pandey**, Director Atomic Minerals Directorate
11:30-12:00	Plenary Talk 2	Prof Suresh Bhargava, RMIT University	
12.00-12:20	Keynote Talk 1	Mr Roopwant Singh, Gujarat Mineral Development Corporation	**Dr K Bala Subramanian** Director, NonFerrous Materials Technology Development Centre
12:20-12:40	Keynote Talk 2	Mr Rajat Verma, Lohum Cleantec	
12:40-13:00	Invited Talk 1	Dr Ashok Kamaraj, IIT Hyderabad	
13:00-14:00	**Lunch Break (IGH)**		
14:00-14:20	Keynote Talk 4	Prof Sankar Bhattacharya, Monash University	**Dr R Ratheesh** Director, Centre For Materials for Electronics Technology, Hyderabad
14:20-14:40	Keynote Talk 5	Prof Edward Buckingham, Monash University	
14:40-15:00	Keynote Talk 6	Dr Vilas Tathavadkar, Hindalco Industries	**Amb. Rajasekhar Chinthapally,** IFS, Ministry of External Affairs, India
15:00-15:15	Invited Talk 2	Dr. Vamsi Gande, IIT Hyderabad	
15:15-15:45	**Tea Break & Poster Session**		
Time	**Activity (Auditorium 2)**	**Speaker**	**Session Chair**
15:45-16:05	Keynote Talk 7	Prof Mainak Majumdar, Monash University	**Dr R Vijay** Director, Advanced Research Centre for Powder Metallurgy and New Materials
16:05-16:25	Keynote Talk 8	Prof Mohsen Yahyaei, University of Queensland	
16:25-16:45	Keynote Talk 9	Prof Muhammad Akbar Rhamdhani, Swinburne University	**Dr Mohan B Verma,** formerly with Atomic Minerals Directorate
16:45-17:05	Keynote Talk 10	Dr Ramanuj Narayan, CSIR-Institute of Minerals and Materials Technology (IMMT)	
17:05-17:25	Keynote Talk 11	Dr K Bala Subramanian Director, NFTDC	
Cultural Programme (Auditorium 1) & Dinner (18:30-21:30)			

Day 2: 4th January 2025

Time	Activity **(Auditorium 2)**	Name of the Speaker	Session Chair
09:00-09:20	Keynote Talk 12	Prof Mohan Yellishetty, Monash University	**Dr Sandip Ghosh Chowdhury** Director, CSIR-National Metallurgical Laboratory (NML), Jamshedpur
09:20-09:40	Keynote Talk 13	Sh D Singh, formerly with IREL Limited	
09:40-10.00	Keynote Talk 14	Dr Sakthi Saravanan Chinnasamy, IIT Bombay	
10:00-10:20	Keynote Talk 15	Dr Pradip, formerly with Tata Research Development and Design Centre	**Dr S Ravi,** Dy DG & Head GSI Training Institute
10:20-10:40	Keynote Talk 16	Dr Balamuralikrishnan, Defence Metallurgical Research Laboratory	
10:40-10:55	Invited Talk 3	Dr Abhilash, NML	
10:55-11:20	**Tea break & Poster Session**		
11:20-12:20	Panel Discussion 1: **Technology Road Map** (Exploration, Mining, Extraction & Processing Technologies)	Dr C S Singh, Coal India Ltd Dr Kali Sanjay, IMMT Mr Anupam Jalote, Gujarat Mineral Development Corporation Dr Bhuvana Kamath Shanbhag, AMITY University Prof Raman Singh, Monash University Prof Prashant Sonar, Queensland University of Technology Dr Sandeep Hamilton, Formerly AMD Dr K Bala Subramanian, NFTDC	**Prof Brajesh K Dubey** IIT Kharagpur
12:20-13:20	Panel Discussion 2: **Policy Road Map** (Education, Research, Innovation, Start-ups, Regulations & Policies)	Mr Anshuman Tripathi, National Security Council Dr Lalan Prasad Singh, Dy DG, GSI Telangana region Dr P K Banerjee, Central Institute of Mining and Fuel Research Dr Sapna A Narula, NIAM Ministry of Agriculture Prof Kannan Govindan, University of Adelaide Assoc Prof Vinod Mishra, Monash University Dr. Pradip, Formerly with Tata Research Development and Design Centre Dr. Venkata Ravibabu Mandla, NIRDPR	**Prof Radhakrishna Munukutla** Head of Department, Earth Sciences, IIT Bombay
13:20-14:20	**Lunch Break (IGH)**		
14:20-15:40	Open Discussion: **Way Forward**		Prof M Yellishetty
15:40-16:00	Valedictory Ceremony		Prof M Yesllishetty & Prof M Narasimha
16:00-16:30	**High Tea**		

Pre-Workshop Training on Critical Minerals on 2nd January 2025

Time	Activity (Seminar hall 1)	Speaker
08:15-08:45	Registration	Student team
08:45-09:00	Inaugural Session	Prof. B.S Murty welcome address Dr T Srinivas & Prof Mohan- Opening Remarks
09:00-10:00	Geological Exploration of Critical Minerals	Dr K L Mundra, Additional Director AMD
10:00-11:00	Characterisation	Dr Srinivas Rao, formerly with IMMT
11:00-11:15	**Tea Break & Poster Session**	
11:15-12:15	Beneficiation of Critical Minerals	Dr T Sreenivas, formerly with BARC
12:15-13:15	Refining & Extraction of Critical Minerals from E-Waste	Dr Nikhil Dhawan, IIT Roorkee
13:15-14:20	**Lunch Break (IGH)**	
14:20-15:20	Rare Earth Elements Extraction & Recycling	Dr Borra Chennarao, IIT Kharagpur
15:20-16:20	Critical Metals & Alloys	Dr Alok Awasthi, BARC
16:20-16:50	**Tea Break**	
16:50-17:50	Critical Minerals Mining	Dr Ram Chandar, NIT Surathkal
17:50-18:40	Digital Technologies in Critical Minerals & Metals	Dr Venkat Runkana, TCS TRDDC

AUSTRALIA-INDIA CRITICAL MINERALS RESEARCH HUB

Two-Day Critical Minerals Symposium and Workshop

January 3-4, 2025 | IIT Hyderabad

https://che.iith.ac.in/aicmrh-2025/index.html

Venue: Convention Centre, IIT Hyderabad

Day 1: 3rd January 2025

11:20-12:20	Panel Discussion 1: **Technology Road Map** (Exploration, Mining, Extraction & Processing Technologies)	Dr C S Singh, Coal India Ltd Dr Kali Sanjay, IMMT Mr Anupam Jalote, Gujarat Mineral Development Corporation Dr Bhuvana Kamath Shanbhag, AMITY University Prof Raman Singh, Monash University Prof Prashant Sonar, Queensland University of Technology Dr T Sreenivas, Formerly BARC	**Prof Brajesh K Dubey** IIT Kharagpur
12:20-13:20	Panel Discussion 2: **Policy Road Map** (Education, Research, Innovation, Start-ups, Regulations & Policies)	Mr Anshuman Tripathi, National Security Council Dr Lalan Prasad Singh, Dy DG, GSI Telangana region Dr P K Banerjee, Central Institute of Mining and Fuel Research Dr Sapna A Narula, NIAM Ministry of Agriculture Prof Kannan Govindan, University of Adelaide Assoc Prof Vinod Mishra, Monash University Dr Pradip, Formerly with Tata Research Development and Design Centre	**Prof Radhakrishna Munukutla** Head of Department, Earth Sciences, IIT Bombay

Panel Discussion 1: **Technology Road Map** Exploration, Mining, Extraction & Processing Technologies	**Opening Question (5 minutes)** **Chair to All Panelists:** Critical minerals are crucial for the clean energy transition and economic resilience. From your sector's perspective, what are the key opportunities and challenges in fostering Australia-India collaboration across exploration, mining, extraction, and processing technologies? **Exploration Technologies (10 minutes)** **To the Industry Panellist (Australia):** Australia is known for its advanced exploration technologies. How can these capabilities be leveraged to support India's growing demand for critical minerals? **To the R&D Labs Panelist (India):**

	What role do emerging technologies like remote sensing, AI, and machine learning play in improving critical mineral exploration in India? How can Australia and India collaborate on these fronts? **To the Government Panelist (India):** What bilateral policies or incentives could strengthen technology transfer and joint exploration projects between Australia and India? **Mining Technologies (10 minutes)** **To the Academia Panelist (Australia):** What lessons can Indian academia and industry learn from Australia's practices in sustainable and automated mining? **To the Industry Panelist (India):** What are the primary gaps in India's mining technology infrastructure, and how can collaboration with Australian industries address these gaps? **To the Government Panelist (Australia):** What role does the Australian government see in enabling partnerships for mining technology development and deployment with India? **Extraction and Processing Technologies (15 minutes)** **To the R&D Labs Panelist (Australia):** Australia has expertise in advanced extraction technologies for rare earths and critical minerals. How can joint research programs with India accelerate the development of cost-effective and sustainable extraction techniques? **To the Academia Panelist (India):** What are the critical research areas for India in processing technologies, and how can Australian institutions contribute to capacity building and technology development? **To the Industry Panelist (Australia):** What strategies can be employed to scale up and commercialize innovative extraction and processing technologies across Australia-India supply chains? **To the Government Panelist (India):** How can policy frameworks ensure the adoption of advanced processing technologies that meet global sustainability standards while fostering Australia-India partnerships?

	Collaboration and Bilateral Roadmap (15 minutes) **To All Panelists:** Collaboration between Australia and India is key to securing critical mineral supply chains. What specific actions can strengthen technology co-development, knowledge-sharing, and innovation partnerships? **To the Government Panelist (Australia):** How can Australia's Critical Minerals Strategy align with India's initiatives like Atmanirbhar Bharat to create a joint technology roadmap? **To the Industry Panelists (Both):** What role can industry-led consortia or public-private partnerships play in driving Australia-India collaboration in critical minerals? **To the R&D Labs Panelists (Both):** What are the priority areas for collaborative R&D, and how can funding and resource-sharing mechanisms be structured between Australia and India? **Closing Question (5 minutes)** **Chair to All Panelists:** If you were to suggest one transformative idea for the Australia-India technology roadmap in critical minerals, what would it be, and why?
Panel Discussion 2: **Policy Road Map** Education, Research, Innovation, Start-ups, Regulations & Policies	**Opening Question (5 minutes)** **Strategic Importance**: How can the Australia-India Critical Minerals Partnership be leveraged to address the global demand for critical minerals while ensuring mutual economic and strategic benefits? **Core Discussion Questions (45 minutes)** **Education and Talent Development (10 minutes)** **Building a Skilled Workforce**: What educational and vocational programs are needed in both countries to develop a highly skilled workforce capable of addressing challenges across the critical minerals value chain? **Bilateral Education Opportunities**: How can joint academic initiatives, such as exchange programs or dual-degree courses, enhance knowledge sharing and capacity building in critical minerals-related fields?

	Research and Innovation (15 minutes) **Collaborative Research Priorities**: What should be the top research priorities for Australia and India to ensure sustainable extraction, processing, and recycling of critical minerals? **Technology Innovation**: How can partnerships between R&D labs, universities, and industries drive innovation in areas such as mineral beneficiation, clean processing technologies, and waste reuse? **Funding Research and Innovation**: What mechanisms can be established to co-fund and scale bilateral research projects focused on critical minerals, ensuring long-term impact? **Start-ups and Industry Collaboration (10 minutes)** **Empowering Start-ups**: What role can start-ups play in the critical minerals value chain, and how can Australia and India's ecosystems support their growth and scaling efforts? **Industry-Academia Synergy**: How can industry and academia in both nations collaborate to address real-world challenges in critical minerals exploration, processing, and supply chain resilience? **Regulations and Policies (10 minutes)** **Regulatory Harmonization**: What steps can be taken to align regulatory frameworks between Australia and India to facilitate smoother trade, investment, and technology transfer in the critical minerals sector? **Environmental and Social Governance (ESG)**: How can both nations ensure that critical minerals extraction and processing align with stringent ESG standards while maintaining competitiveness? **Closing Question (5 minutes)** **Vision for Partnership**: What is your vision for the Australia-India Critical Minerals Partnership in the next decade, and what policy or initiative would you prioritize to make this vision a reality?

Terms of Reference

Indo-Pacific Critical Minerals Research Consortium (IPCMRC)

a Community of Practice

The Indo-Pacific Critical Minerals Research Consortium (IPCMRC) is established to unite academics, industry professionals, and government officials from the Indo-Pacific region dedicated to the critical minerals sector. By bringing together diverse expertise and resources, IPCMRC aims to harness intellectual, financial, and human resources for the effective utilization for critical minerals.

The initiative will support the mission of Australian Government's Critical Minerals Office and the US-led Minerals Security Partnership in improving and securing critical mineral supply chains. The consortium's scope aligns with the Indo-Pacific Economic Framework's mission to enhance cooperation and economic integration, focusing on supply chains, clean energy, decarbonization, and infrastructure.

Vision

Empowering mineral security to accelerate a low-carbon economy through the research-industry nexus.

Mission

- Forge research partnerships with leading entities within our Indo-Pacific network to address mineral security.
- Develop a future talent program in the Indo-Pacific focused on critical minerals to support the renewable energy transition.
- Advance advocacy and thought leadership initiatives to enhance our partnerships and research recognition.

Motivations for the Indo-Pacific R&D Partnership

- China has a strong industrial and scientific capability in Rare Earth Elements (REEs), with 100,000 professionals and 11,000 patents filed between 2015 and 2019.
- Successful networks like the International Network for Acid Prevention and the International Council for Mining and Metals demonstrate the benefits of international collaboration in addressing common industry challenges.
- Partner countries in the critical minerals supply chain face similar startup questions and are developing policies and funding mechanisms that promote cross-border development and mutual growth.

Role and Purpose of the Indo-Pacific R&D Partnership

This consortium will facilitate the sharing of knowledge, capacity building, foster innovation, and promote sustainable practices to address the growing demand for critical minerals essential for the global transition to a low-carbon economy. Through collaborative efforts, IPCMRC will drive advancements in mineral security, enhance technological capabilities, and support the development of policies that benefit all member nations.

Framing and Implementing Consistent ESG Standards

- Develop international standards for responsible extraction and use of critical minerals.
- Create a framework for monitoring and evaluating ESG standards in clean energy supply chains.
- Train and upskill the workforce to promote large-scale operations with high ESG standards.

Technology Transfer: Support technology transfer among partner countries to achieve sophistication in large and complex supply chains.

R&D Sharing through IP Libraries

- Establish shared IP libraries to support R&D investments, avoid duplication, optimize resource allocation, and save time.
- Facilitate academic mobility and enduring international collaborations, benefiting higher education ecosystems.

Attracting International Talent: Attract international talent with expertise in critical minerals to enhance research and development capabilities in participating countries.

Utilizing Existing Infrastructure: Ease the burden of immediate capital investment by utilizing existing facilities in participating countries on a complimentary basis.

Promoting Capacity Budling through Education and Training: Support and promote education and training initiatives to ensure a skilled workforce in mining, geosciences and critical minerals processing and recycling.

Facilitating Cross-Border Cooperation: Facilitate cross-border cooperation between governments, research institutions, and industry to achieve outcome-driven research and translational advancements from lab to land.

Enhancing Institutional Rankings: Encourage joint publications and patents to improve world institutional rankings, such as QS and Times Higher Education rankings.

Membership of the Indo-Pacific R&D Partnership

While the Critical Minerals Office is working with key countries (the US, India, Japan, Korea, the UK, and European Union members) to strengthening engagement, these partnerships are either bilateral or trilateral at most. A more meaningful and enduring partnership should be multilateral in nature and must include governments, industry, trade associations and academia and research.

Membership is open to researchers, educators, postgraduate and undergraduate students, and professionals from industry and government organizations in Australia, India, Japan, Korea, Singapore, New Zealand, Vietnam, Sri Lanka, Bangladesh, UK, USA, Indonesia, and Malaysia (other countries and continents with large mining activities). Expertise includes: Criticality assessments; Economic geology; Critical minerals extraction, processing, and separation; Mining sustainability and ESG standards; Mineral processing and metallurgy; Supply chain analyses; and Recycling and circular economy.

Core Principles for Indo-Pacific R&D Partnerships

R&D partnerships should operate with the following three core principles, namely:

- **Complementarity:** Form partnerships based on complementary strengths and create a system that values and acknowledges strong relationships both within and outside the country.
- **Collaboration:** Encourage exchanges and collaborations between academics and researchers in critical minerals. Establish and sustain bilateral or multilateral funding schemes to support outcome-driven research and education, including competitive PhD and post-doctoral scholarships for researchers from partner countries. This will advance science and trade diplomacy.
- **Value:** Set achievable targets and ensure timely delivery of tangible improvements. Measure success not only by journal publications or reports but also by impact on policy and industrial practice, including the number of patents filed.

Roles and Responsibilities

By working together, the members of the Indo-Pacific Critical Minerals Consortium will advance research, innovation, and sustainable practices in the critical minerals sector, contributing to global economic growth and environmental sustainability.

Academic and Research Organisations:

- Conduct and disseminate research on critical minerals extraction, processing, and sustainability.
- Mentor and train students to develop expertise in critical minerals.
- Collaborate with industry and government partners to translate research into practical applications.
- Facilitate international academic exchanges to foster innovation and global expertise.

Industry:

- Share industry insights and technological advancements to support academic research.
- Invest in and collaborate on R&D projects to advance critical mineral technologies.
- Implement sustainable mining practices and contribute data for supply chain analysis.
- Partner with academia and government to pilot and scale new technologies.

Governments:

- Develop policies and provide funding to support responsible critical minerals extraction and use.
- Implement and enforce standards for environmental and social governance (ESG).
- Support education and training programs to build a skilled workforce in the critical minerals sector.
- Promote education and training initiatives to build a skilled workforce in critical minerals

భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

MONASH University

Australia India Critical Minerals Research Hub
Partnering for a new future

BOOK OF ABSTRACTS

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About the Australia-India Critical Minerals Research Hub (AICMRH):

The Australia-India Critical Minerals Research Hub (AICMRH) was established through an MoU between IIT Hyderabad and Monash University, witnessed by Hon Shri Dharmendra Pradhan, Minister of Education, India, and Hon. Jason Clare MP, Minister for Education, Australia. The Hub is dedicated to addressing global challenges in critical minerals research and promoting sustainable mining innovations. The Ministry of Education has approved $1.1 million as the first instalment in a $5 million funding plan under the SPARC Scheme to support AICMRH's activities, including HDR scholarships, research fellowships, and collaborative visits for Australian scholars to India. The AICMRH is an alignment with India's National Education Policy (NEP-2020) and the Australian Researcher Cooperation Hub (ARCH-India) of the Australian Government Department of Education on promoting research collaborations. The AICMRH aims to develop pioneering technologies for a competitive and environmentally sustainable future, playing a vital role in supporting the objectives outlined in India's NEP-2020 and the G20 New Delhi Leaders' Declaration. There are plans to expand into the Indo-Pacific region by including researchers from other countries in the region. AICMRH aims to unite leading academicians, researchers, and industry leaders from Australia and India to collaborate on joint projects focused on the exploration, extraction, processing, and recycling of critical minerals. By harnessing the collective expertise of professionals from academia, research, and industry, the Hub will drive transformative advancements in the critical minerals sector, fostering international collaboration, innovation, and knowledge exchange.

Message from Co-Convenor

The Workshop has received an exceptional response across both countries' critical minerals ecosystems, with proposed participation from government agencies, industries and academia. The AICMRH provides an exciting opportunity for India and Australia to work together to expand its increasingly important mineral resources partnership. This strategic partnership as a synergy embodies a concerted effort to drive impactful advancements in the critical minerals domain, fostering innovation and knowledge exchange on an international scale.

Prof. BS Murty, Director, IITH

Message from Co-Convenor

The AICMRH is built on the principles of collaboration, value, and complementarity, this Symposium and Workshop will assemble leading experts from industry, academia and governments in critical minerals assessment, economic geology, extraction, processing and separation, mining sustainability, and supply chain analyses.

Prof . Mohan Yellishetty, Monash University

Prof. Veena Sahajwalla

Centre for Sustainable Materials
Research & Technology,
SMaRT@UNSW,
UNSW SYDNEY,
Australia

AUTHOR'S BIOGRAPHY

- Professor Veena Sahajwalla is an internationally recognised materials scientist, engineer, and inventor revolutionising recycling science. She is renowned for pioneering the high temperature transformation of waste in the production of a new generation of 'green materials' at the UNSW Sustainable Materials Research and Technology (SMaRT) Centre, where she is Founding Director. Professor Veena is the inventor of polymer injection technology, known as green steel, an eco-friendly process for using recycled tyres in steel production. In 2018, Veena launched the world's first e-waste MICROfactorie™ and in 2019 she launched her plastics and Green Ceramics MICROfactories™, a recycling technology breakthrough. Professor Veena is the director of the ARC Industrial Transformation Research Hub for 'microrecycling', a leading national research centre that works in collaboration with industry to ensure new recycling science is translated into real world environmental and economic benefits. Professor Veena has also been appointed hub leader of the national NESP Sustainable Communities and Waste Hub. In 2021, Professor Veena featured in the ABC's Australian Story and she was named the 2022 NSW Australian of the Year in recognition of her work. Professor Veena was named the 2022 Australian Museum Eureka Prizes winner for the Celestino Eureka Prize for Promoting Understanding of Science and was also awarded the Australian Academy of Technology and Engineering (ATSE) Clunies Ross Innovation Award. In 2023, Professor Veena was awarded the **Engineering Australia Chemical College Chemical Engineer Achievement Award and the Good Design 2023 Women in Design Award.**

- **E-mail : veena@unsw.edu.au**

ABSTRACT

Prof. Veena Sahajwalla

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The rapid growth of complex waste streams, including e-waste, end-of-life vehicles (EVs), plastics, and batteries, poses significant environmental challenges and is expected to exacerbate manufacturing difficulties. To address these pressing issues, the SMaRT Centre has developed innovative technologies and MICROfactories™ that convert complex waste into valuable materials and products, fostering resource circularity. By leveraging and optimising microrecycling science, diverse waste streams are transformed into new products, such as Green Steel™ and Green Ceramics™. Additionally, valuable metals and nonmetals are extracted for advanced applications, including energy storage systems.

A major advancement involves the use of waste-derived feedstock to produce in-situ hydrogen and carbon for green metal manufacturing processes, significantly reducing dependency on traditional carbon-intensive inputs like coke and coal. The Green Steel™ Polymer Injection Technology (PIT) proposed by SMaRT exemplifies these breakthroughs by enhancing efficiency, curbing emissions, and amplifying yields in electric arc furnace steelmaking.

The SMaRT Centre has also demonstrated that e-waste can be reformed via selective thermal transformation using microrecycling technologies to produce a range of high-value metal alloys. For example, printed circuit boards can undergo selective thermal transformation to recover copper- and tin-based alloys at various temperatures through a process called "thermal micronising". Nickel-based alloys and valuable rare earth elements have also been produced from spent nickel-metal hydride batteries via thermal routes. Additionally, cobalt and lithium have been simultaneously recovered from spent lithium-ion batteries using microrecycling techniques [8]. Carbon, hydrogen, and other reducing gases derived from bio-waste, i.e., waste coffee powder can be utilised to produce green metals and regenerate cathode active materials from waste lithium-ion batteries at significantly lower temperatures, thanks to the synergistic effect of reducing gases and carbon.

These cutting-edge solutions not only address global waste and recycling challenges but also contribute to responsible consumption and production, industrial innovation and infrastructure, job creation, and environmental stewardship. By bridging recycling with manufacturing, SMaRT technologies are pioneering the development of a sustainable, resource-efficient circular economy, exemplifying the transformation of waste into green materials.

Prof. Suresh Kumar Bhargava

STEM college,
RMIT University,
Mlebourne-3000, Australia.

AUTHOR'S BIOGRAPHY

- Distinguished Professor Suresh Bhargava is a globally recognised leader in the resource sector, whose ground breaking contributions have advanced sustainable technologies and critical mineral processing. With a strong focus on translating research into industrial impact, he has forged collaborations with global giants such as Alcoa, Hindalco, BHP Billiton, QPM, and Rio Tinto. He currently holds the QPM Industrial Chair of Critical Minerals for EV Batteries, highlighting his pivotal role in enabling green energy solutions. Professor Bhargava has authored over 800 highly cited publications, 12 patents, and delivered more than 350 keynote and plenary lectures worldwide.
- As a non-executive board member of the Aditya Birla Group (ABML) for over eight years, he has influenced strategic developments in materials and mining between Australia and India. His 20 years executive leadership, currently as Dean (R&I) at RMIT University has strengthened global partnerships, particularly with CSIR laboratories in India. Professor Bhargava's innovations include pioneering additive manufacturing in chemical engineering and leading a $6 million AISRF Grand Challenge on CO_2 conversion to mini-DME. Recognized with prestigious awards, including the CHEMECA Medal, the P.C. Ray Chair of INSA, and two Honoris Causa doctorates, Professor Bhargava was also honoured with the Member of Order of Australia by Queen Elizabeth II in 2022 for his outstanding contribution in Higher Education and straightening Australia-India relationship through science and technology. Today, Professor Bhargava remains a driving force in sustainable resource technologies, advancing critical mineral solutions and addressing the pressing challenges of the 21st century

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ABSTRACT

Prof. Suresh Kumar Bhargava

The strategic partnership between Australia and India is poised to become a global benchmark for addressing critical challenges in sustainable resource development and critical minerals. This plenary talk will delve into the transformative potential of bilateral collaborations in advancing cutting-edge technologies, fortifying supply chain resilience, and accelerating clean energy transitions.

Distinguished Professor Suresh Bhargava, a globally renowned scientist in the resource sector and an industrial thought leader, will present ground breaking approaches to resource processing, value addition, and sustainable development.

Leveraging successful partnerships over 30 years with industry giants such as Alcoa, Hindalco, BHP Billiton, QPM, and Rio Tinto, as well as collaborative ventures between RMIT University and CSIR laboratories in India, this session will highlight the critical role of science-driven strategies and skill development programs in driving sustainable growth. Key case studies, including the application of additive manufacturing in chemical sciences and engineering, and innovations in Critical Minerals (AM for CM), will illustrate scalable and impactful solutions.

This talk aims to inspire policymakers, industry leaders, and researchers to harness collaborative frameworks between Australia and India to unlock the vast potential of critical minerals. By integrating advanced technologies, nurturing research excellence, and building robust, trust-based partnerships through cutting-edge intellectual infrastructure, this collaboration is set to redefine energy security and environmental sustainability in the 21st century.

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Mr. Roopwant Singh

IAS Managing Director,
Gujarat Mineral Development Corporation Ltd

AUTHOR'S BIOGRAPHY

- Roopwant Singh, IAS is a career civil servant & has been serving as the Managing Director of Gujarat Mineral Development Corporation (GMDC) since June 2021. GMDC is an organisation listed on BSE & NSE and has a current net worth more than Rs. 6,154 Cr. & a market capitalization of Rs. 10,938 Cr. He completed his master's in political science from Panjab University, Chandigarh. Prior to joining IAS in Gujarat, he was selected in the Indian Railways. He has served as the Collector (in-charge of general administration) for the districts of Bharuch, Valsad & Ahmedabad and has extensive experience of working in field of public finance through his two stints in the Finance Department, as Additional Secretary (Budget) and as Secretary (Expenditure). Besides public finance, he also has extensive experience in the mineral resources side, wherein he has served two stints as the Commissioner of Geology & Mining. Therein, he was instrumental in setting up a new regime for the auction of mineral resources in the State and making significant strides in increasing non-tax revenues i.e. mineral royalties. During his tenure as MD-GMDC he was able to build on his previous experiences and turn around the organisation which in FY 20-21 stood at loss of Rs. 348 Cr. to steering the company towards three best years for GMDC. With FY 22-23 standing as the best year for GMDC with revenues touching Rs. 3,895 Cr. and profitability at Rs.1,657 Cr. He has been central towards evolving a path for quick corrections and developing a strategic vision for the company. Under his leadership, GMDC has embarked on a path of strategic transformation and growth, for which it has enlisted the services of the best advisory firms and experts. GMDC has embarked on a 4X growth path with work commencing on three pillars, the first being strengthening the core lignite business in Gujarat, the second pillar involves expanding to Odisha state and building a strong solid fuel vertical of coal and the third and most important pillar focusing on developing critical minerals i.e. Rare Earth Elements and Copper in Gujarat.

ABSTRACT

Role of GMDC in helping build global Critical Mineral Supply Chain Resilience

Critical Minerals are key enablers to the Green Energy transition.

Globally, geo-politics is causing a seismic shift in Critical Mineral supply chains.

India has a critical role to play in helping create these new supply chains.

GMDC Ltd. is playing a big part in these early changes by establishing a complete ‘Mines to Magnets’ facility for Rare Earth Elements that help in the Green Energy transition.

It is also establishing a complete ecosystem in the shape of a Hub where it invites partners to come on board to use the REO’s that GMDC will be making and use them for downstream products.

GMDC also invite tech partners to participate in the mineral concentration and separation.

Mr. Rajat Varma

Management Department,
LOHUM Cleantech Pvt Ltd,
Uttar Pradesh, India.

AUTHOR'S BIOGRAPHY

- Rajat Verma is the Founder and CEO of Lohum. Over the last 6.5 years, Rajat has grown Lohum into India's largest sustainable critical minerals company, producing a wide range of materials including Lithium, Nickel, Cobalt, Platinum Group Metals, and Rare Earth Elements. In addition to its expanding portfolio of metals, Lohum also manufactures specialized high-value materials such as cathode active materials, catalysts, and alloys. The company has customers on all continents, 8 existing facilities across Delhi-NCR and Gujarat, and upcoming facilities in Tamil Nadu, Telangana, UAE, and US.
  Rajat has over 20 years of global experience across tech, finance, e-waste, and critical minerals in geographies as far apart as India, US, and Middle East.
  Rajat is passionate about deep tech. At Lohum, almost 10% of the company is involved in R&D. He holds and Undergraduate degree from IIT-Kanpur, Master's from Stanford University, and an MBA from Harvard Business School. He was on the Dean's merit list across all the aforementioned academic institutes.

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ABSTRACT

Critical Minerals & Metals & Their Applications

Critical minerals are crucial to India's economic growth and technological advancement, especially as the country experiences a surge in demand for electric vehicles (EVs). In the first half of 2024 alone, EV sales in India reached 927,097 units, marking a 21% increase from the previous year. Electric two-wheelers (E2Ws) and three-wheelers (E3Ws) accounted for over 89% of total sales, and projections indicate total sales could reach around 2 million units by the end of 2024. This growth is propelled by government initiatives and a rising consumer preference for sustainable mobility.

India's drive for EV expansion underscores the country's increasing reliance on critical minerals like lithium, cobalt, and nickel. However, these minerals are not only essential for battery production and the EV sector but also play a key role in other green technologies, such as solar and wind. As the global push for clean energy accelerates, India has a significant opportunity to position itself as a global hub for refining critical minerals, driven by its competitive cost structures and expanding industrial capabilities.

Research into achieving ultra-high purity in minerals, including trace elements, is crucial to India's strategic focus on critical minerals. Innovations in refining technologies will enable the country to produce high-purity base metals and valuable trace elements for industries like electronics, aerospace, and advanced manufacturing. With cost advantages and a growing focus on primary extraction and recycling, India has the potential to become a global leader in mineral refining, supporting the clean energy transition worldwide.

Prof. Sankar Bhattacharya

Professor,
Department of Chemical and Biological Engineering,
Monash University

AUTHOR'S BIOGRAPHY

- Professor Bhattacharya joined academia in 2009 having worked in industry for over twenty years in three different countries – in India on power plant design and commissioning, in France managing the Cleaner Fossil Fuels program at the International Energy Agency, in Australia as a Principal Process Engineer with Anglo Coal Australia and as a Principal Research Engineer with the Lignite CRC in Australia operating large pilot plants in Australia and the USA. At Monash University, Professor Bhattacharya's research areas include a) thermo-catalytic processing of wastes to liquid fuels, chemicals and hydrogen, gasification, b) rare earth metal recovery from wastes, c) conversion of biomass to high-value platform chemicals. He leads a group of 16 PhD students and a research fellow, having supervised 36 PhD students to completion. Professor Bhattacharya advises several governments, domestic and international, on energy issues. He is the holder of three patents, edited three books, authored six book chapters and over 200 journal papers on energy, fuels and biochemicals. He is a Fellow of the Australian Institute of Energy and currently Head of the Department of Chemical & Biological Engineering

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ABSTRACT

Rare Earth Metals Extraction and Separation from Low-value Wastes

Prof. Sankar Bhattacharya

Rare earth elements (REEs), a group of 15 lanthanides, have garnered widespread interest due to their application in batteries, electric vehicles, lightweight alloys and medical equipment, amongst several other applications. Despite their growing demands, there are restricted sustainable engineering practices that could build a steady supply of these metals, with mineral and metal mining being the major pathway for REE production.

This predicament, in turn, provides a window of opportunity for REEs to be mined from secondary sources such as coal fly ash, e-wastes & mine tailings. Mining from secondary sources, also called urban mining, offers alternative REE production pathways and reduces supply monopolization from limited mining locations around the world. Coal fly ash, a residual by-product of the coal combustion process, promises to be an important source of different REEs associated with minerals in the parent coal. The utilization of such waste stream(s) from legacy coal-fired power plants, embodies the underlying principles of waste utilization. Understanding fly ash properties through characterization techniques such as SEM-EDX, XRD, synchrotron-based µ-XRF and µ-XANES sheds light onto various minerals, with which the REEs, are often associated in coal fly ash, and subsequently play a crucial role in developing sustainable leaching and separation methodology. This presentation focuses on the latest and most significant results published, including our work, in REE extraction from wastes - solvo-metallurgical pathways utilizing deep eutectic solvents and ionic liquids, and the subsequent metal recovery processes via solvent separation process, electrochemical separation, and membrane separation technique.

The presentation will also discuss opportunities for collaboration between Australia and India.

Prof. Edward Buckingham

Professor,
Monash Business School
MBI Director, Monash University Indonesia

AUTHOR'S BIOGRAPHY

- Professor Edward Buckingham is Professor of Management at Monash Business School in Melbourne and Program Director of the Master in Business Innovation, Monash Indonesia.
  Professor Buckingham's areas of expertise are strategy, business model design, international business and operations management. He has extensive experience as an educator in leadership and board level roles. His industry interests include agribusiness, manufacturing, education and natural resources.
  He began his career with the Boston Consulting Group in Shanghai where he advised multinational corporations and state owned enterprises. After completing his MBA at INSEAD he ran the French manufacturing subsidiaries of Sud Chemie (now Clariant) which specialised in pharmaceutical and medical device packaging.
  As a Manager at Schlumberger Business Consulting he advised national and international oil companies on their exploration and production strategies in Russia, Gabon, Pakistan, France and the UK.
  Just prior to the Global Financial Crisis Professor Buckingham returned to INSEAD where he directed the Executive MBA programs through a period of rapid expansion in Europe, the Middle-east, Southeast Asia. In China he co-directed the newly founded Tsinghua INSEAD Executive MBA program which was ranked number one in the Financial Times.

ABSTRACT

Key principles in the quest for value creation and capture in critical minerals

Have you ever wondered why it is so easy to lose money while investing in critical minerals? I have.

Take lithium for example. It looks set to play an outsized role, as a store of energy, in the transition away from fossil fuels. The fundamentals look very good. Lithium is abundant. Lithium battery technology is shaping the future. And most importantly it is commercially proven in the market for electric vehicles, which appear to be here to stay. Nevertheless, recent investments in lithium mining and processing, like many other critical minerals, struggle to make good returns.

In this presentation I will explore Lithium's pathway to technological and commercial dominance, drawing on principles derived from other commercially successful minerals.

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- **Dr Vilas Tathavadkar** is Chief Technology Officer (CTO) of Hindalco Industries Ltd and President, Metals & Mining Technology Function at ABSTC.
- He received his B. Eng (Metallurgy) from College of Engineering, Pune, M Tech (Materials Sciences) from IIT, Mumbai and Ph. D. (Metallurgy) from University of Leeds, UK. He was also Post Doctoral Research Fellow at University of Leeds, UK and Technical University of Delft, The Netherlands.
- He has 33 years of research experience in national, academic & industrial research laboratories, including C-MET, Hyderabad, University of Leeds, UK and Tata Steel R&D, Jamshedpur before joining ABG in 2012.
- He has filed 44 patents and published over 75 papers He is recipient of Pune University Gold Medal, Tata Innovista Promising Innovations award and Hindustan Zinc Gold Medal of IIM. He is member of Research Council of CSIR-AMPRI, National Executive Council of IIM and MTD Committee of BIS.

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ABSTRACT

Critical Minerals & Metals in Primary Aluminum & Copper Industry

Dr. Vilas Tathavadkar

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Rapid technological innovations, from Electric Vehicles, Renewable energy to telecommunications, aerospace & defence, have increased the demand of advanced materials, minerals, and metals. The sustainable supply of these minerals, metals & materials is critical to economic stability, national security, and technological leadership. The primary resources of these critical minerals are localized in certain geographies and fast depleting due to over-usage to meet global demand.

In order to address this issue, critical minerals have been identified by Ministry of Mines, Govt. of India based on economic importance and supply chain risks. Primary resources for the critical materials are not available in the country, recycling is the only option for the self-reliance. There is also need to identify secondary resources for the critical minerals.

Many critical minerals & metals are present in various waste & buy-products streams of Primary Aluminium & Copper industries. For example, vanadium, gallium, scandium & REE in redmud in aluminium industry and selenium, tellurium, nickel, arsenic, bismuth in copper effluents & slimes. Details of critical minerals present in copper & aluminium industries and technologies adopted to recovery these critical minerals are discussed with case studies.

Dr. Ashok Kamaraj
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- Dr. Ashok Kamaraj is an assistant professor in the Department of Materials Science and Metallurgical Engineering at IIT Hyderabad. Before joining IITH, he was a Senior Scientist at CSIR-National Metallurgical Laboratory (NML), Jamshedpur. He obtained a B.E. in Metallurgical Engineering from the Government College of Engineering, Salem, in March 2011. From Sep 2012 - Aug 2015, he held the Trainee Scientist fellowship to pursue an M.Tech., in Materials and Metallurgical Engineering. He continued his doctoral research in process metallurgy (steelmaking) at CSIR-NML and obtained a doctoral degree from AcSIR in February 2020.

  The overarching theme of his research work is the physical simulation of steelmaking practices, the development of alloy steels, metal recycling, and the life cycle and sustainability analysis of metallurgical processes. Recent highlights of his research work are demystifying the shape effect of BOF & EAF on the liquid steel transfer process, designing and developing a hot model to simulate continuous casting in-mold phenomena, indigenizing technologies for cannon liner steel, and hydrogen standard (CRM) in steel.

  To his credit, he has published 31 research articles in a peer-reviewed journal, 14 articles in conference proceedings, 1 software copyright, and 1 design patent. He was conferred the Young Metallurgist (metal science) award by the Steel Ministry (GOI) in April 2022, the IEI Young Engineers Award (Metallurgical and Materials Engineering) by the Institution of Engineers (India), the Prof. Shilowbadra Banerjee Award (for the best In-house project on technology for H2 standard in steel and Mg production) by CSIR National Metallurgical Laboratory in Nov 2022/2024, and the M. S. Khan Memorial Award by the IIM Jamshedpur chapter in Feb 2020. He is one of the editors of Transaction of Indian Institute of Metals (IIM) and IIM Metals News. His hobbies are listening to music and gardening.
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ABSTRACT

Sustainability-Driven Process Design for Waste PCB Recycling

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Keywords: Cu smelting, E-waste recycling, slag, FactSage, Sustainable metallurgy, Exergy

This study presents a comprehensive thermodynamic optimization and exergy analysis of the secondary copper smelting process for waste Printed Circuit Board (PCB) recycling. The study investigates various scenarios with different proportions of waste PCB in the input stream, ranging from 0% to 100%. Through thermodynamic modeling using FactSage version 8.1, the optimization process is conducted in three stages. The results of the thermodynamic modeling indicate that the best-case scenario for waste PCB recycling is achieved with a 40-50% proportion of waste PCB in the input stream. This case exhibits a maximum copper recovery of 99.93% while minimizing the formation of metal dust (94.26 Kg/t) and exhaust gas (156.69 Kg/t). Moreover, the analysis revealed that 40% of waste PCB recycling cases yield the highest concentration of precious metals in black copper compared to other cases. Furthermore, exergy analysis is performed to assess the overall energy efficiency of the process. The results demonstrate that the 40% waste PCB recycling case achieves a total exergy efficiency of 90.02%, indicating its superior energy utilization and performance. In addition to the thermodynamic and exergy analyses, environmental factors such as the sustainability index, carbon emission index, and resource utilization efficiency are studied. The 40% waste PCB recycling case exhibits a sustainability index of 10.20%, resource utilization efficiency of 93.055 %, and a carbon emission rate of 0.133. The present investigation highlights the significant benefits of a 40% waste PCB recycling scenario through a secondary copper smelting process in terms of metal recovery and energy efficiency, thus emphasizing its potential for sustainable PCB waste management and resource utilization.

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- 38 years of experience (MECL & HGML) in identifying viable gold (Primary & Secondary) and base metals mineral properties for exploration, mining (Underground & Open –pit), Processing i.e. Planning, execution, Documentation, Feasibility, related R&D activities and Project Management.
- Travelled national and international extensively for exploration and Mining.
- He established himself as an eminent exploration & mining geologist, an accomplished manager, a proficient technocrat and a Board of Director. He is author of numerous reports & research papers published in national & international journals. He developed the deep underground gold mine brick by brick with his team. His scientific knowledge & administrative capabilities have enhanced the economics and the image of HGML.
- Served & Serving as Member, Convener and Chairman of several Committees on exploration, mining, environment, management and related R&D.
- In recognition of his significant work in exploration, mining and research he has received many awards, honours, laurels conferred including **"National Geoscience Award"** from Govt. of India, as well as membership and fellowships of important professional, academic bodies and Council Member of Geological Society of India.

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ABSTRACT

Exploration Techniques for Critical Minerals

Dr. Prabhakar Sangurmath

The role of exploration geologists is very important & critical for the identification and development of critical minerals deposits, which are essential for economic growth and national security. The stages of exploration ie., reconnaissance survey, preliminary exploration, and detailed exploration, emphasizing that as the target are an arrows, the intensity of exploration increases. Key techniques include meticulous geological studies, geochemical, geophysical surveys, and rock sampling. Modern analytical instrumentation has significantly improved geochemical analysis, enhancing detection limits and accuracy. The challenges in sampling critical minerals, particularly the impact of erratic high values, which can distort average grade calculations. various exploration techniques in geological studies, emphasizing the importance of mapping geological features and analyzing geochemical values to identify mineral deposits. Geochemical surveys involve the quantitative assessment of element distribution in surface soils and sub-surface materials, comparing them to background values. Key sampling methods include soil, stream sediment, and rock sampling, each targeting specific geological indicators. Modern analytical instrumentations enhance the accuracy and detection limits of these surveys, marking a significant advancement in geochemical analysis and exploration methodologies. Geo statistical studies are crucial f or understanding the frequency distribution of sample values and determining the best estimates of deposit grades at various confidence levels. Vario graphic studies further aid in understanding the structural characteristics of ore bodies, which is vital for effective reserve estimation. The document notes that in India, the classification of mineral reserves follows the UNFC system, which prioritizes geological exploration over techno-economic viability, potentially leading to subjective interpretations of resource worth. The design of exploration programs must balance cost and accuracy, emphasising systematic sampling and detailed geological mapping. Skilled exploration geologists are vital, combining geological knowledge with innovative techniques to address the complexities of critical minerals exploration. The significance of critical minerals in supporting India's economic growth and environmental goals, framing exploration as a crucial endeavour for ensuring a stable supply chain and fostering sustainable development in the context of a rapidly evolving global market. The theme of this paper is to trace the exploration techniques for critical minerals.

Prof. Mainak Majumder

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- Mainak Majumder is a professor in the Department of Mechanical and Aerospace Engineering of Monash University. He joined Monash as a lecturer in 2010 after his postdoctoral stint at Rice University, USA (2008-2010). He is the Director of the Australian Research Council's Research Hub on Advanced Manufacturing with 2D Materials (AM2D), and an Associate Director of the Monash Energy Institute. He and his team have taken fundamental scientific breakthroughs in Graphene materials from the laboratory to market, including products such as direct graphene nanofiltration membranes, energy dense supercapacitors, and Lithium Sulfur batteries.
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ABSTRACT

Graphite and Graphene: Story of Tradition vs. Innovation

Prof. Mainak Majumder

Carbon, asides from being the fourth most abundant material available on the universe and being in use from circa 400 BC, remains a material which is a hotbed of research and development. Major discoveries with the various allotropes have been awarded the Nobel Prizes in 1996 (Smalley, Kroto, and Curl), and in 2010 (Geim and Novoselov) for discovery of Fullerene and Graphene, respectively. The use of Carbon materials such as in Carbon fiber composites have revolutionized light-weight, high strength materials, while graphite as the stable anode material for Li-ion batteries have dramatically changed how we use electronics in our daily life. Graphite and Graphene, two types of Carbon allotropes, remain at the forefront of our discussions as crucial materials required for our sustainable development and clean energy transition. In this talk, I will highlight some examples of our qresearch on Graphene materials and the deeper implications of these either on fundamental science, value-added new products or a potential like-for-like replacement in existing technologies. I will also showcase examples of commercialized Graphene products from around the world, including Australia, such as thermal dissipations films and coatings (6th Element, China, and GMG, Australia), large-area smart fabrics (Ionic Industries, Australia), Lithium Sulfur batteries (Lyten, USA), and water filtration membranes (NematiQ, Australia). I will then segue to an emerging topic of research on Graphite, driven primarily by the demands of the Li-ion battery industry and geopolitics of import and export policies, noting that the significant number of Graphene products are derived from Graphite. Graphite with low ESG and quality suitable for anode materials is a growing research endeavor with significant efforts directed towards conversion of bioresources and carbon di-oxide to battery grade materials thereby decreasing the demand on geographically constrained mining resources. Conversion of natural graphite to high grade battery materials are also being pursued as means to overcome the high ESG and cost concerns of synthetic graphite. Recycling and recovery of graphite from end-of-life Li-ion batteries remain a challenge in terms of retaining the properties of the original material. Overall, the re-emergence of Graphite as a critical material in our energy transition requires strategic investments towards diversifying sources, reducing ESG concerns associated with production, marrying innovation with tradition and comprehensive planning towards meeting the aforementioned challenges.

Prof. Mohsen Yahyaei
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- Professor Mohsen Yahyaei is a leading expert in mineral processing modelling and automation. He is the Director of the Julius Kruttschnitt Mineral Research Centre (JKMRC) at the University of Queensland. His research focuses on optimising mineral processing techniques to enhance efficiency and sustainability, with a strong emphasis on practical applications.
  Professor Yahyaei's expertise includes novel mineral processing solutions for base metals and critical minerals. He has also developed applied research in advanced process control, developing soft sensors, and model-predictive control solutions. His work aims to improve the precision and reliability of industrial processes, significantly contributing to the field of mineral processing..

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ABSTRACT

Rethinking the mineral processing for eco-efficient beneficiation of critical minerals

Prof. Mohsen Yahyaei

The growing demand for critical minerals, including Rare Earth Elements (REE), Nickel, Cobalt, Lithium, Vanadium, and a wide range of other minerals, necessitates innovative approaches to mineral processing to ensure a secure supply for sustainable societal development. This requires rethinking mineral processing beyond traditional methods such as comminution, classification, flotation, and leaching. Instead, the entire process should be treated as an interconnected separation process, with mineral liberation as the key factor to be measured and assessed as a measure of process performance.

This proposed approach enables eco-efficient beneficiation, particularly for complex minerals. Developing and implementing novel separation solutions requires advanced modelling capabilities to evaluate not only the technical viability but also the sustainability of these solutions from environmental and social perspectives. Incorporating mineral liberation allows for precision extraction and separation, supported by novel processing units and advanced process automation, which aid in complex decision-making.

The talk will provide insights into cutting-edge technologies and future directions for sustainable mineral processing.

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- Professor M. Akbar RHAMDHANI is a Professor in Extractive Metallurgy and Metals Recycling. He obtained his PhD from McMaster University Canada in Materials Science and Engineering. He has been an Academic at Institute of Technology Bandung (ITB) and the University of Queensland, before joining Swinburne University of Technology. Akbar was a Visiting Professor at KU Leuven Belgium and Visiting Scientist at CSIRO.

- He is currently the Director of Fluid and Process Dynamics (FPD) Group; and is the leader of Energy Transition Metals Research Flagship at Swinburne. He is currently the Editor-in-Chief of Journal of Sustainable Metallurgy, TMS Springer Nature, USA. His research expertise is on advanced pyrometallurgical metal/material refining and impurities removal; development of low-C new processes for metal production. His research directions include: (1) Pyrometallurgical recycling and recovery of metals from urban resources; (2) Decarbonisation and Hydrogenation of metallurgical processes; (4) Solar metallurgy; and (5) Astro metallurgy.

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ABSTRACT

Electrically-Enhanced Refining of Silicon for Solar Panel Recycling

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Silicon is important for energy transition and listed as one of critical metals in many countries. Hence, a secured supply of silicon from primary resource and recycling from secondary resource (such as end-of-life solar panel) will be vital. This paper describes the progress of a method developed at Swinburne on electrically-enhanced refining of silicon using slag in support of recycling of end-of-life solar panel. During the recycling of solar panel, metal impurities can go to the silicon phase which needs to be removed before it can be used as precursor for solar grade silicon. The electrically-enhanced refining takes advantage the electrochemical nature of liquid metal (silicon) and liquid slag and carried out by manipulating the reactions (enhancement or retardation) by applying external electromotive. In this work, the enhanced removal of both boron and phosphorus from silicon by $CaO-SiO_2-Al_2O_3$ and $CaO-SiO_2-MgO$ slags was investigated. Improved cell configurations at small and medium scales were developed and utilized. New experimental data were generated by carrying out high temperature reactions between Si-B-P alloys and slag in and inert (Ar) atmosphere at 1500°C to 1600°C and applying different current (0.5 - 1 A) and voltage (0 – 5 V) across the molten slag and silicon. The dynamic and final elements concentrations were tracked and measured. The composition change results were compiled and fitted to a newly developed kinetic model to predict the corresponding parameters and the final concentrations. The new developed kinetic model explicitly correlates applied voltage with concentration change and mass transfer coefficient. The results show that kinetics and partitioning ratio of boron were significantly affected by the applied current, while the effect on phosphorus was quite small.

Dr. Ramanuj Narayan

Director
CSIR-IMMT

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- Dr. Ramanuj Narayan has joined as the Director of CSIR-IMMT on 01st May, 2023. Prior to joining he was Chief Scientist & Chair, Department of Polymers & Functional Materials at CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad. Currently, he is also the Outstanding Professor of Academy of Scientific & Innovative Research (AcSIR) and earlier served as Dean and Associate Dean of Chemical Sciences, AcSIR. Prior to joining CSIR he has served Asian Cosmos R&D Co. Ltd., Tata Steel Ltd., and Tata Autocomp Systems Ltd. at various positions during 2002-08. He is the alumni of Magadh University, Bodhgaya, University of Delhi, NIT, Jamshedpur and IIT (ISM), Dhanbad & CSIR-IICT wherein he has pursued graduation, post-graduation, post-graduation in technology and Ph.D. His research interest includes Coating/Paints, Hyperbranched Polymers, Polyurethane, Nano, functional & hybrid Materials and third generation solar cell.

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ABSTRACT

The CSIR-Institute of Minerals and Materials Technology (CSIR-IMMT) Bhubaneswar has been at the forefront of addressing the strategic need for critical minerals through innovative research and technological advancements. Recognizing the surging global demand for critical minerals essential for advanced technologies and sustainable energy solutions, CSIR-IMMT has undertaken extensive efforts to develop efficient beneficiation and metallurgical technologies for their extraction and recovery. Key research initiatives include processing deep-sea polymetallic nodules to extract valuable metals and recovering rare earth elements (REEs) from industrial by-products such as fly ash and red mud. Additionally, the institute has made significant progress in extracting tellurium (Te) and selenium (Se) from anode slimes, recovering platinum group metals (PGMs) from chromite ore, and extracting nickel and cobalt from chromite overburden. Notably, lithium carbonate has been successfully produced from primary resources of the Amareshwar deposits, and high-purity tungsten was recovered from Hutti gold mine tailings.

Several of these technologies have achieved higher Technology Readiness Levels (TRLs). To ensure long-term sustainability and resource security, CSIR has launched two mission-driven projects:"Mapping and Tapping," which focuses on resource mapping and the development of advanced processing technologies, and "Battery to Battery," aimed at recycling spent batteries to recover critical minerals vital for energy storage technologies. In alignment with its strategic objectives, CSIR-IMMT has signed MoUs with key organizations, including KABIL (Khanij Bidesh India Limited), GSI (Geological Survey of India), GMDC (Gujarat Mineral Development Corporation) etc. These collaborations focus on resource sharing and joint exploration initiatives, ensuring a synergistic approach to critical mineral exploration and processing.

To build a complete value chain for processing critical minerals, CSIR-IMMT is establishing state-of-the-art mineral beneficiation facilities to augment existing ones. These include a pilot plant for PGMs, advanced pyro-hydrometallurgical facilities, and a 200-stage solvent extraction pilot plant for REE separation. These facilities aim to bridge the gap between laboratory-scale research and industrial- scale implementation, accelerating the commercialization of innovative technologies. Through these focused efforts, CSIR-IMMT continues to play a pivotal role in advancing India & #39;s capabilities in critical mineral processing.

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- Dr. Gande Vamsi Vikram is Assistant Professor in the Department of Chemical Engineering, IIT Hyderabad from November 2024. Prior to joining IITH, he was working as postdoctoral researcher and instructor at University of Illinois Chicago, USA. Vamsi did his B.Tech. from Osmania University and obtained his M.Tech. and Ph.D. degrees from IIT Madras. Vamsi's PhD research focused on e-waste recycling, and his work led to the establishment of a pilot plant at BHEL Trichy. He was honored with the Lovaraj Kumar Memorial Trust Best PhD Thesis Award in 2022 for his research contributions. His research interests are hydrometallurgy, mineral recovery, flow chemistry and sustainable process development.

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ABSTRACT

Sequential recovery of metals as value added products from waste printed circuit boards

G Vamsi Vikram, S Pushpavanam

The recovery of valuable metals from printed circuit boards (PCBs) in waste electronic equipment remains a critical challenge, with numerous hydrometallurgical methods proposed in the literature. These methods typically involve a variety of chemical reagents for metal recovery and separation, but managing the reuse and recycling of multiple reagents—such as unreacted acids, neutralizing agents, and metal salts—often requires complex downstream processes, which can hinder economic viability.

This talk focuses on presenting a novel, scalable hydrometallurgical process for the selective recovery of metals from PCBs using nitric acid. The focus is on tin, lead, and copper—key metals present in significant quantities in PCBs. By exploiting the distinct physio-chemical interactions between nitric acid and these metals, the process enables their sequential extraction with high selectivity.

At low acid concentrations, tin and lead, found primarily in the solder, are selectively dissolved. Tin is extracted as colloidal metastannic acid, while lead nitrate is separated through evaporation of unreacted nitric acid, allowing lead nitrate crystals to precipitate. This process also facilitates the recycling of concentrated nitric acid for further dissolution. Additionally, nitrogen oxide gases produced during the dissolution steps are absorbed in water and recycled, contributing to the sustainability of the process.

In a subsequent stage, copper, found in the PCB tracks, is recovered by reacting with higher concentrations of nitric acid. The copper nitrate formed is then separated from the acid using liquid-liquid extraction with Tri-Butyl Phosphate (TBP), ensuring both copper recovery and acid recycling.

This innovative hydrometallurgical process offers a safe, eco-friendly, and economically feasible solution for recovering tin, lead, and copper from PCBs, with minimal waste generation and efficient reagent recycling—paving the way for more sustainable electronic waste management practices.

Prof. Yellishetty Mohan
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Co-founder, Critical Minerals Consortium,
Monash University, Australia,
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Honorary Academic Fellow, Australia India Institute, Co-convenor of the National Industry Working Group (Critical Minerals), Australia India Chamber of Commerce (2019-2023)

AUTHOR'S BIOGRAPHY

- Mohan Yellishetty boasts extensive research and academic expertise spanning nearly three decades across esteemed institutions such as Monash University, CSIRO, Yale University, and IIT Bombay.
- Recognized as a leading authority in Sustainable Mineral Resources and Global Thought Leader, A/Prof Yellishetty's research interests encompass diverse areas including Critical Minerals, Mine Rehabilitation and Closure, and Mine Tailings and Waste within the framework of the Resources Trinity.
- A/Prof Yellishetty's efforts have contributed significantly to fostering robust relationships and knowledge exchange through the facilitation of numerous bilateral and multilateral workshops and symposiums within the Indo-Pacific region (*i.e.* Australia-India; Australia-Japan; Australia-Korea; and Australia-India-Japan-Korea-UK).

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ABSTRACT

"Securing Energy Future: India-Australia Role in the Global Renewable Transition"

Prof. Yellishetty Mohan.

The risk to energy security is a constant concern, as demonstrated by the sharp rise in global oil and coal prices following Russia's invasion of Ukraine. Transitioning to renewable energy can mitigate these risks by reducing dependence on global energy markets, as renewable energy is typically produced and consumed domestically. However, building renewable energy capacity requires a variety of raw materials, including both common and critical minerals like lithium, cobalt, and rare earth elements, which are essential for manufacturing solar panels, wind turbines, and batteries.

Critical minerals are those at risk of significant supply disruptions, often due to supply concentration. Diversifying supply is crucial, and Australia is well-positioned to contribute significantly. Australia not only has abundant mineral resources but also possesses extensive mining expertise. Many critical minerals can be co-produced with existing minerals, and some can be recovered from mine tailings.

Transitioning to large-scale renewable energy operations requires a significant amount of raw materials, with foundational elements like copper, steel, and concrete forming the base. Specialized materials such as lithium, cobalt, cadmium, indium, selenium, rare earth elements (REEs), and vanadium play a crucial role in this journey. For instance, an electric car, on average, demands six times the mineral inputs of a traditional internal combustion engine car, with a 60-kWh battery containing approximately 185 kg of minerals. This breakdown includes lithium, manganese, copper, and nickel. Similarly, a wind turbine relies on 120 kg of neodymium and 12 kg of praseodymium per megawatt, while an electric vehicle motor requires 0.45 kg of neodymium and 0.075 kg of dysprosium. These material considerations underscore the intricate dependencies and resource needs associated with advancing renewable energy technologies.

Transition to renewable energy reduces exposure to global energy markets because the vast majority of renewable energy will be produced and consumed in-country, and another country can’t stop the sun shining and the wind blowing.

This presentation will explore the geopolitical challenges accelerating the global energy transition and highlight Australia's role in the critical minerals sector. It will discuss Australia's mineral endowment, capabilities, and potential to create economic opportunities, develop sovereign capabilities, and build reliable, competitive, and diverse supply chains in the Indo-Pacific region. Additionally, the presentation will cover the efforts of the Critical Minerals Consortium in addressing these issues.

Dr. Deependra Singh

Former CMD,
IREL (India) Limited

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Dr. Deependra Singh is the Former Chairman and Managing Director of IREL (India) Limited, a Central Public Sector Undertaking under the aegis of Department of Atomic Energy, Govt. of India

- Having rich and varied experience spanning over more than three and half decades in the diverse areas including mining, mineral processing and rare earth fields.
- Having credential of association in various projects under World Bank, OPEC and Asian Development Bank including prestigious projects of Central Govt.
- UNIDO fellowship in Germany.
- Credited with over 85 presentations in international Mineral Rare Earth
- Won numerous awards and holding position of Chairman/President of reputed industrial associations in rare earths, processed minerals and export field

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ABSTRACT

Critical Minerals and Rare Earth Element Recovery Potentials

Dr. Deependra Singh

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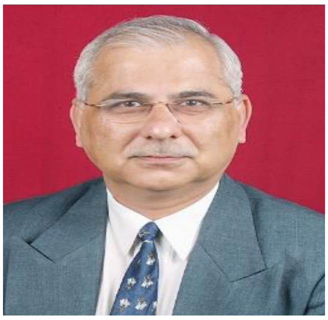
The technological revolution in recent decades has led to increased demand for critical minerals and rare earth elements (REEs) across various industries with wide-ranging industrial applications, the clean energy sector is one among them. The unique intrinsic properties of these minerals are useful to build our own technology-powered society and are often difficult to replace or duplicate by using conventional methods. The occurrence such minerals may not be in abundance as like bulk minerals, but they have potential to impact the technological development of a society. The most important aspect is to mine economically and sustainably without causing damage to environment including technical feasibility of processing and refining of the minerals for ready use in the industry. The current challenge in India is to develop the supply chain for the critical minerals & rare earths. Other than Rare Earth (RE), exploration of resources for critical minerals is the requirement of today with qualitative aspects of mine. The increased domestic demand for Critical minerals and REE in India is principally driven by the demand for products used in defence and environmental technology. IREL(India) Limited, a unit of India's Department of Atomic Energy was established in 1950 to process monazite that hold rare earths and thorium used in the nuclear industry. It operates eight mines across the Indian states of Odisha, Tamil Nadu and Kerala and it is the only entity having capability to process rare earths**.** The present manuscript deals with resources, capabilities, exploitation, recovery processes and extraction where a sustainable eco-system for mining, processing, and manufacturing has been taken care.

Key words: Critical minerals, rare earths, clean energy, defense.



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An alumnus of the Indian Institute of Technology, Kanpur (B. Tech,1970-75) and the University of California at Berkeley (M.S., 1977 and Ph. D, 1981), Pradip, formerly the Vice President (Technology) at Tata Consultancy Services (TCS) Ltd., served as the Chief Scientist and the Head of Process Engineering Innovation Lab at Tata Research Development & Design Centre (TRDDC), Pune - a Division of Tata Consultancy Services (TCS) from 2007 to 2016. He had joined Tata Research Development and Design Centre in 1984 after serving BARC for four years after his return from US in early 1981. He superannuated from active service from TCS in 2016.

His main areas of research include rare earth minerals flotation, particle science & technology, mineral processing and extractive metallurgy, nanotechnology, design and development of performance chemicals based on molecular modeling, applied surface and colloid chemistry, mathematical modeling & simulation of particulate processing systems, integrated computational materials engineering, colloidal processing of advanced ceramics, waste recycling, cement chemistry and manufacturing of eco-cements.

With more than 200 publications and twenty one patents to his credit, Pradip is the recipient of several honors including KONA's Distinguished Service Award, SME's Taggart Award, VASVIK Award for outstanding contributions to industrial research, Kuczynski Prize of International Institute of Science of Sintering, National Metallurgist Award and Hindustan Zinc Gold Medal of Indian Institute of Metals (IIM), Materials Research Society of India (MRSI) Medal and the Mineral Beneficiation Award of Indian Institute of Mineral Engineers (IIME). He is also the past President of IIME and has served on the National Executive of IIM for three decades. Pradip has delivered more than 200 invited, keynote and plenary lectures in several national and international forums.

Pradip is the elected fellow of several academies and professional societies - Foreign Member of National Academy of Engineering, USA and Fellow, Indian National Science Academy, Fellow, Indian National Academy of Engineering, Honorary Member and Fellow, Indian Institute of Metals (FIIM) and Fellow, Institute of Materials, Minerals and Mining (FIMMM), UK.

During 2018 to 2020, Pradip served as the Vice President of Indian National Academy of Engineering (INAE). Pradip has also served as a member of the editorial board of several international journals including Minerals Engineering, International Journal of Mineral Processing, J Physicochemical Problems in Mineral Processing, Advanced Powder Technology, Transactions, Indian Institute of Metals, Steel Technology and KONA, Japan. He has edited and/or co-edited several special issues of international journals on topics of contemporary research interest and organized several international conferences including the prestigious International Mineral Processing Congress (2012) and Asian Particle Technology Symposium (APT 2009).

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ABSTRACT

Challenges and the Way Forward
A Critical Minerals Strategy for INDIA

Dr Pradip

We are witnessing two major revolutions unfolding before us – first, the digital revolution encompassing recent advances in both the design and the development of the most advanced AI chips as well as the development of software tools needed to digitalize various operations including the design, development and manufacturing of various products needed for a dignified human living - it has matured to a level that digital transformation in various domains, has become a reality of our lives. The second revolution is the availability of clean electricity from renewable energy sources at affordable prices for electrification in general and transportation in particular, in the face of urgent need to reduce emissions of all kinds but most importantly in the generation of electricity itself – a basic necessity of human life today. Both these revolutions have triggered a multi-fold increase in the global demand for several critical elements – establishing the full value chain of each of those critical elements from exploration, mining, mineral processing, extraction, manufacturing of various industrial products and recycling of all kinds of waste produced (cradle to cradle cycle) within the constraints of energy, resources including land and water and its inevitable environmental impact – has become an urgent necessity of our times. The challenges and opportunities in the domain of establishing resilient supply chains for certain critical minerals for a country like India (minerals containing 30 elements have been identified as critical by the Ministry of Mines) are illustrated in this presentation with the help of a few selected minerals - those containing rare-earths, lithium and tungsten. A few important challenges facing us in India namely (a) exploration and discovery of new deposits including new sources of critical elements including mine waste, overburden, abandoned mines, slags, tailings, sewage etc. utilizing recent advances in this domain (b) design for recycle strategies including material substitution options (c) innovative processing of low grade ores including tailings management strategies (d) business model innovations to enhance the economic viability of the critical minerals value chains (e) leveraging recent advances in digital technologies including AI-ML tools, airborne geophysical surveys including hyperspectral remote sensing using drones and satellites, digital twins, robotics, automation and autonomous equipment for accelerated exploration, mining and processing operations, are discussed.

Dr. Sakthi Saravanan Chinnasamy

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- Dr. Sakthi Saravanan Chinnasamy is a renowned figure in the field of Economic Geology. He has cultivated an illustrious academic and professional career, earning a Ph.D. from IIT Kharagpur. Currently serving as an Associate Professor at IIT Bombay, Dr. Chinnasamy brings over two decades of expertise to pioneering research in Economic Geology, with a particular focus on the genesis of orogenic gold deposits and magmatic ore systems. His contributions to the global understanding of mineralization processes span diverse regions, including Sweden and South Africa, where he has made significant advances in deciphering complex geological processes. His groundbreaking work on ore fluid dynamics and mineralogical-geochemical analyses has played a crucial role in expanding knowledge of mineral deposits, both within India and internationally. Presently, Dr. Chinnasamy is spearheading research on critical mineral exploration and genesis in India, with a focus on Rare Earth Elements, Cobalt, Moly and Lithium. His efforts not only deepen scientific understanding but also contribute to the development of sustainable mining practices, affirming his position as a visionary leader in the field.

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ABSTRACT

The Indian Shield: A Geological Treasure for the Future of Renewable Energy

Dr. Sakthi Saravanan Chinnasamy

The Indian Shield holds vast potential for critical minerals (CM), essential for advancing the global green energy transition. Critical minerals, including rare earth elements (REEs), cobalt, lithium, and molybdenum, are fundamental to renewable energy technologies such as solar panels, wind turbines, and electric vehicles. These minerals are indispensable for producing components like magnets, batteries, and advanced electronics, which play a pivotal role in achieving a low-carbon future. Despite its promising geological diversity and significant reserves, India's critical mineral sector remains underutilized due to technical, economic, and policy challenges.

India is home to the world's fifth-largest reserves of REEs, primarily hosted in monazite found along coastal sands, as well as in hard-rock sources such as bastnäsite and xenotime. However, the country largely relies on imports for processing and refining, with China dominating the global supply chain. Cobalt, a crucial component in battery technology, is available (though in trace amount) in Sukinda's lateritic nickel-cobalt deposits, and also as co- or by-product of many polymetallic mineralization across India, but economic constraints and technological limitations hinder its extraction. Lithium, often termed "white petroleum" for its role in powering electric vehicles, shows potential in pegmatites within the Indian Shield. Similarly, molybdenum, vital for high-strength alloys and other industrial applications, is found in association with copper, though its extraction remains nascent. These minerals represent a critical opportunity for India to enhance its green energy capabilities and reduce import dependency. The challenges to tapping into India’s critical mineral potential are multifaceted. Key barriers include low-grade deposits, inadequate exploration and extraction technologies, insufficient downstream processing capacity, and fragmented policy support. The technical complexity of refining rare earths and separating individual elements further exacerbates these challenges. Additionally, the environmental impact of mining and refining these minerals necessitates the development of sustainable practices. The Indian Shield’s rich geological diversity positions the country as a potential leader in the critical mineral domain. Systematic efforts to address technical and infrastructural challenges could unlock its untapped potential, ensuring a secure and sustainable supply chain. By leveraging its critical minerals effectively, India can play a significant role in the global green energy transition while fostering domestic economic growth and energy security. This comprehensive analysis highlights the strategic importance of coordinated action in realizing the Indian Shield’s critical mineral potential, ensuring a sustainable and inclusive pathway to a low-carbon future.

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- Dr. Abhilash is Senior Principal Scientist and Group Leader- Secondaries and Resource Utilisation Group in the Metal Extraction and Recycling Division of CSIR-National Metallurgical Laboratory (CSIR-NML), Jamshedpur, INDIA. He hold the position of Associate Professor in ACSIR.
- He obtained Ph.D. for his work entitled "Biohydrometallurgy of Indian uranium ores", which was awarded Prof. H.J.Arnikar Best Thesis award by IANCAS-DAE.
- He is the recipient of Shanti Swarup Bhatnagar Prize by Govt of India in 2024 for his contributions to critical metal extraction and waste recycling. He is also the recipient of 12 "Young Scientist/Engineer Award" by various governmental organizations and societies. He is a recipient of Young Metallurgist Award in the category of Nonferrous Extractive Metallurgy by Ministry of Steel and Mines, GOI, CSIR Raman Research Fellowship, etc.
- He is also awarded the Membership by National Academy of Sciences, India, apart from other 27 societies as Life Member.
- Dr. Abhilash has published over 107 papers in SCI Journals and Nat./Int. Conference Proceedings, edited 5 books and published 13 chapters in edited books. He has presented over 50 oral papers in various National and International Symposia/Colloquiums in India and Abroad. He holds 6 granted and 7 filed patents to his credit, mostly as joint IPs with industries like NALCO, TATA STEEL and Nissan Motors Limited.
- He is on the Editorial Board of International Journals like Mineral Processing and Extractive Metallurgy Review, Russian Journal of Nonferrous Metals, Frontiers in Chemical Engineering, Journal of Chemistry, etc.
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ABSTRACT

CSIR-NML In Sustainable Extraction of Critical Metals

Dr. Abhilash

India is on the brink of becoming a global player in augmenting the supply chain of critical metals from some of its primary and majority of secondary resources. Due to declining primary resources vis-a-vis leaner grades and less sustainable exploitation, it is even a global trend to opt for recycling of various metal based wastes (appropriately termed as resources) to extract critical metals. Metals with an average crustal abundance of <0.01 ppm, which are high in supply shortage due to soaring demand, can, under the excessive environmental risk and <1% recycling rate of their production, be termed as ‘critical’ in a limited geo-boundary. Critical metals have applications in renewable energy, and other green energy-cum-low carbon technologies. This strategic and critical group of metals/minerals considered “critical” changes constantly over time, for which recycling and recovery from spent secondary resources will be the only viable options for sustainable growth. India like other global leaders have also enlisted the critical metals which plays or ideally will play a pivotal role in the low carbon and clear energy economy. Among the existing methods, aqueous extraction of metals (if not hybrid) can be a sustainable mode for extracting and concentrating these metals. It is envisaged to emphasize the prospective recuperation of critical metals (including rare earth elements, precious metals, lithium, etc.) from tested primary ores and plethora of secondary resources like process wastes, WEEE, mine wastes, chemical wastes, etc, in addition, to the problems and prospects in achieving sustainability.

భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
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ADITYA BIRLA
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Clippings from Newspapers

Experts from Australia-India to establish roadmap for critical minerals research

The Hindu Bureau
HYDERABAD

Advancing research and innovation in critical minerals with a focus on sustainable methods for mineral exploration, extraction and recycling as the theme, Indian Institute of Technology, Hyderabad, on Saturday concluded its two-day workshop.

The Australia-India Critical Minerals Research Hub (AICMRH) symposium co-organised by Monash University saw attendance of researchers, academicians, and industry leaders from across India and Australia.

The first day featured keynote and expert talks and the concluding day, with workshops and deliberations, marked a roadmap for research priorities between Australia and India.

Deputy Chief Minister Bhatti Vikramarka, B.S. Murthy, Director IITH, at Australia - India Critical Minerals Research Hub workshop, in Sangareddy, on Friday. MOHD ARIF

Key goals

According to Deputy Chief Minister Mallu Bhatti Vikramarka, who was present to share the Telangana government's commitment, "critical minerals are the building blocks of green energy and sustainable development, and they play a key role in achieving the goals of renewable energy, battery storage, and green Hydrogen."

He said the government was committed to fostering sustainable mining, green energy and innovation. By advancing green hydrogen technology, the target is to produce 20,000 MW green energy by 2030, he said.

For Consul General Hilary McGeachy (Australia Consulate-General), critical minerals is a key area of Australia-India collaboration. "These initiatives drive commercial links, sustainable practices and supply chain diversification in support of the transition to clean energy," she said.

The AICMRH is a dedicated centre for research promoting sustainable mining innovations and was established through a MoU between IITH and Monash University.

IIT-H hosts workshop on critical minerals

EXPRESS NEWS SERVICE
@ Hyderabad

IIT Hyderabad, in collaboration with Monash University, Australia, is hosting a two-day workshop under the Australia-India Critical Minerals Research Hub (AICMRH) on January 3-4. The event focuses on advancing research and innovation in critical minerals, emphasising sustainable methodologies for exploration, extraction, and recycling.

The workshop brings together researchers, academicians, and industry leaders from India and Australia. An MoU was also signed between IIT Hyderabad and The Singareni Collieries Company Limited to promote sustainable mining research and innovation.

Deputy Chief Minister Mallu Bhatti Vikramarka, the chief guest on the first day, highlighted the significance of critical minerals in sustainable development. He stated, "Critical minerals are the building blocks of green energy and sustainable development, playing a key role in achieving ambitious goals for renewable energy, battery storage, and green hydrogen. The Telangana government is committed to sustainable mining, green energy, and innovation, aiming to produce 20,000 MW of green energy by 2030 while advancing green hydrogen technology."

Hilary McGeachy, Consul General of the Australian Consulate-General in Bengaluru, remarked, "Critical minerals are a key area of collaboration between Australia and India. Today's symposium at IIT Hyderabad with Monash University involves some of the brightest minds and cutting-edge research from both countries. These initiatives foster commercial links, sustainable practices, and supply chain diversification, supporting the transition to clean energy."

Deputy Chief Minister Mallu Bhatti Vikramarka inaugurates the Australia-India critical minerals workshop at IIT-Hyderabad on Friday

Minerals crucial for TG's green energy push: Bhatti

DC CORRESPONDENT
HYDERABAD, JAN. 3

"Critical minerals are not just industrial raw materials; they are the foundation of a green economy," said Deputy Chief Minister Bhatti Vikramarka Mallu during the inaugural session of the Australia-India Critical Minerals Research Hub (AICMRH) workshop at IIT Hyderabad on Friday. This two-day event, organised in collaboration with Monash University, Melbourne, Australia, brings together researchers, academics and industry leaders to foster advancements in sustainable mining practices and renewable energy solutions with a special focus on critical minerals.

At the event, IIT Hyderabad and Singareni Collieries Company Limited signed a memorandum of understanding for joint research on sustainable mining methods, resource efficiency and innovations in critical mineral exploration and recycling. SCCL chairman and managing director Balaram Naik stated, 'Partnering with IIT Hyderabad opens new avenues for innovation and development in mining practices. Together, we aim to set new benchmarks in sustainability and resource efficiency.' The workshop focused on the pivotal role of critical minerals in developing renewable energy technologies such as solar panels, wind turbines and electric vehicle batteries. Telangana, through its clean and green energy policy, aims to generate 20,000 MW of renewable energy by 2030 and develop green hydrogen. Present at the event were Hilary McGeachy, Australian consul general in Bengaluru, Gopal Baglay, high commissioner of India to Australia and Dinesh Mahur, joint secretary, Union mines ministry. Plenary and keynote talks by global experts set the stage for discussions that will culminate in a roadmap for collaborative research between Australia and India. The workshop is also supported by funding under the SPARC scheme, aimed at promoting research collaborations in critical minerals. The AICMRH initiative aligns with India's National Education Policy (NEP-2020) and Australia's ARCH-India framework, focusing on sustainable mineral exploration, processing and recycling.

Mallu Bhatti Vikramarka

ఐఐటీలు దేశ నిర్మాణ కేంద్రాలు

అద్భుతమైన ఆవిష్కరణకు వేదిక **ఐఐటీలకు ఆద్యులు నెహ్రూనే..**

క్రిటికల్ మినరల్స్ వర్క్‌షాప్‌ను ప్రారంభించిన డిప్యూటీ సీఎం భట్టి విక్రమార్క

నవతెలంగాణ-మెదక్ ప్రాంతీయ ప్రతినిధి

ఐఐటీలు విద్యా సంస్థలు మాత్రమే కావని, దేశ నిర్మాణానికి దోహదపడే వేదికలని డిప్యూటీ సీఎం భట్టి విక్రమార్క అన్నారు. శుక్రవారం సంగారెడ్డి జిల్లాలోని ఐఐటీ హైదరాబాద్ (కంది)లో ఆస్ట్రేలియా ఇండియా క్రిటికల్ మినరల్స్ రిసెర్చ్ హబ్ వర్క్‌షాప్‌ను ఆయన ప్రారంభించి మాట్లాడారు. ఐఐటీ హైదరాబాద్ అద్భుతమైన ఆవిష్కరణలకు చిరునామాగా మారిందన్నారు. ఐఐటీ హైదరాబాద్ విద్యార్థులు దేశ భవిష్యత్‌కు కలల కర్మాగారం అని తెలిపారు. ఇక్కడి నుంచి ఇప్పటి వరకు 11,500 పరిశోధనా ప్రచురణలు, 320కి పైగా పేటెంట్లు, స్టార్టప్‌ల ద్వారా రూ.1500 కోట్ల ఆదాయాన్ని అర్జించడం గొప్ప విషయమని అన్నారు. ఆస్ట్రేలియా-ఇండియా క్రిటికల్ మినరల్స్ రిసెర్చ్ హబ్ కింద మోనాష్ యూనివర్సిటీ సహకారంతో చేపట్టిన కార్యక్రమాలు కేవలం తెలంగాణకు, భారత దేశానికే కాకుండా ప్రపంచానికే కీలకంగా మారనున్నట్టు తెలిపారు. తెలంగాణలో క్లీన్ అండ్ గ్రీన్ ఎనర్జీ పాలసీని రూపొందించడంలో ఈ వర్క్‌షాప్ సహకార స్ఫూర్తికి అద్దం పడుతుందన్నారు. భారత్‌లో ఐఐటీలకు తొలి ప్రధాని నెహ్రూయే ఆద్యులని గుర్తు చేశారు. ఐఐటీలను ఆధునిక భారతదేశ దేవాలయాలుగా నెహ్రూ అభివర్ధించినట్టు గుర్తుచేశారు. దేశంలో సైన్స్ అండ్ టెక్నాలజీ.. పేదరికం, అసమానతలపై పోరాడడానికి అవసరమైన సాధనాలుగా నెహ్రూ పేర్కొన్నారని తెలిపారు. ఐఐటీ హైదరాబాద్ ఏర్పాటులో అప్పటి ఏపీ ముఖ్యమంత్రి, దివంగత కాంగ్రెస్ నేత వైఎస్ రాజశేఖర్‌రెడ్డి కీలక పాత్ర పోషించారన్నారు. వైఎస్సార్ నాయకత్వంలోనే ఐఐటీకి పునాదులు పడ్డాయని చెప్పారు. వైఎస్సార్ గొప్ప రాజకీయ నాయకుడే కాకుండా గొప్ప సంఘసంస్కర్త అని అన్నారు. రాష్ట్రంలో విద్య, వైద్య సౌకర్యాల మెరుగుదల కోసం ఎన్నో సంక్షేమ పథకాలు ప్రవేశపెట్టి, నిరుపేదల జీవితాల్లో వెలుగులు నింపడం కోసం వైఎస్ఆర్ ప్రయత్నించినట్టు తెలిపారు. ఐఐటీ ఏర్పాటు సమయంలో తాను ఎమ్మెల్సీగా భాగస్వామిని కావడం అదృష్టంగా భావిస్తున్నానని అన్నారు. రాష్ట్రంలో క్లిష్టమైన ఖనిజాలను వెలికితీసేందుకు సమర్థవంతమైన మార్గాలు కనుగొనడం, స్థిరమైన మైనింగ్ పద్ధతులు అవసరమని రాష్ట్ర ప్రభుత్వం గుర్తించిందన్నారు. అందుకోసమే రాష్ట్ర ప్రభుత్వం క్లీన్ అండ్ గ్రీన్ ఎనర్జీ పాలసీ ద్వారా పరిశోధన, వాటి సంబంధిత సైన్స్ ఆధారిత కార్యక్రమాలకు ప్రాధాన్యత ఇస్తున్నట్టు తెలిపారు. క్లిష్టమైన ఖనిజాలు పారిశ్రామిక పదార్థాలు మాత్రమే కాదని, అవి హరిత ఆర్థిక వ్యవస్థ నిర్మాణానికి ఉపయోగపడతాయన్నారు. సోలార్ పవర్ ప్యానెల్స్, విండ్ టర్బైన్లు, ఎలక్ట్రిక్ వాహనాలు, విద్యుత్ నిల్వ బ్యాటరీల వంటివి క్లిష్టమైన ఖనిజాల ద్వారానే తయారవుతాయని తెలిపారు. 2030 నాటికి 20 వేల మెగావాట్ల గ్రీన్ ఎనర్జీని రాష్ట్రంలో ఉత్పత్తి చేయడానికి ప్రణాళికలు సిద్ధం చేసినట్టు చెప్పారు. గ్రీన్ హైడ్రోజన్ టెక్నాలజీని భవిష్యత్ ఇంధనంగా ప్రభుత్వాలు భావిస్తున్నట్టు తెలిపారు. ఆవిష్కరణల ప్రోత్సాహానికి, సుస్థిరతకు రాష్ట్ర ప్రభుత్వం నిబద్ధతతో పని చేస్తుందన్నారు. ఐఐటీల ఆలోచనలు పరిశ్రమలను పునర్ నిర్వచించి, ఆర్థిక వ్యవస్థను పునర్నిర్మిస్తాయన్నారు. గ్రీన్ ఎనర్జీ, స్థిరమైన టెక్నాలజీ, శాస్త్రీయ ఆవిష్కరణల్లో దేశంలో మొదటి స్థానంలో నిలిచేందుకు రాష్ట్ర ప్రభుత్వం నిబద్ధతతో పనిచేస్తుందని తెలిపారు. ఈ కార్యక్రమంలో డైరెక్టర్ ప్రొఫెసర్ బీఎస్ మూర్తి, గౌరవ అతిథి కాన్సుల్ జనరల్ ఎంఎస్ హిల్లరీ మెక్‌గేచీ, ఆస్ట్రేలియన్ కాన్సులేట్-జనరల్ బెంగుళూరు, భారత హైకమిషనర్ గోపాల్ బాగ్లే, మైనింగ్ జాయింట్ సెక్రటరీ దినేష్ మహూర్, సింగరేణి కాలరీస్ సీఎండీ మోహన్ యెల్లిశెట్టి, ప్రొఫెసర్ నరసింహారెడ్డి తదితరులు పాల్గొన్నారు.