Introduction

Rare Earth Minerals Symposium

The Sustainable Minerals Institute (SMI) at the University of Queensland is a world leading research institute dedicated to finding knowledge-based solutions to the sustainability challenges of the global minerals industry. SMI has organised a one-day Rare Earth Minerals Symposium to bring together leading international academics, industry practitioners, and policy makers to discuss the full product cycle of rare earth minerals.

The event will have presentations by leading researchers followed by a workshop on charting research trajectories with full audience participation. It will consider a panoramic perspective of the sector, moving beyond a solely industrial performance focus to address four critical research themes:

- International governance and security concerns around rare earths supply
- Industrial ecological approaches to minimising environmental footprint of rare earths
- Perceived and real nuclear risks and social conflicts
- Economic determinants and future contributions of the sector to a green economy.

NextMine™

The symposium has been managed through an internal grant from Sustainable Minerals Institute’s NextMine™ initiative which aims to identify and pursue cutting edge research areas in the mineral sector. NextMine™ is a collaborative effort between engineers, scientists and social scientists to identify and address factors that have the potential to limit future growth of the mining industry and its capacity to contribute to sustainable development.
About the Consortium

The University of Queensland’s new research initiative – The UQ Rare Earth Consortium – seeks to bring together leading international academics, industry practitioners, and policy makers to discuss the full product cycle of rare earth minerals. Research undertaken as part of the Consortium will have direct application for companies working with rare earth minerals, addressing issues from the mine to the market.

“To undertake leading research to investigate the complex matrix of economic, social, political and environmental issues relating to the sustainable extraction and application of rare earth minerals.”

The Opportunity

We are establishing a research fund with contributions from international organisations, industry and other institutions interested in research in this area. The fund will be administered by the consortium steering committee who will decide on what areas of research are most needed.

Such research will include:

- Development of economic and ecological sustainability metrics to provide companies with advice on the optimal mix of mined and reused material flows to meet the demand for using rare earths
- Policy recommendations for using a hybrid approach to materials sourcing to mitigate international conflicts and improve resilience in the supply chain model.

Keynote Speakers

Roderick G Eggert
Professor and Director of the Division of Economics and Business at the Colorado School of Mines, and also Deputy Director of the Critical Materials Institute (CMI), USA.

He has lectured extensively on the economics of rare earths and other critical elements, and has testified on this topic before committees of the European Parliament, the U.S. House of Representatives, and the U.S. Senate.

Professor Eggert has B.A. in earth sciences, Dartmouth College, M.S. in geochemistry and mineralogy, and Ph.D. in mineral economics, Penn State University.

Yoshihiko Wada
Professor at Doshisha University in the Faculty of Economics (Kyoto, Japan).

He graduated from School of Community and Regional Planning at the University of British Columbia, Vancouver, BC, Canada and obtained his PhD in 1999. He has taught ecological economics and research skills at Sapporo University, and Doshisha University.
Keynote Speakers

Ahmad Zaidee Laidin

Council Member of the Academy of Sciences Malaysia, and Vice President of the Academy in 2008-2012. Visiting Professor in Electrical Engineering to Universiti Malaysia Pahang, and a Board Member of several universities in Malaysia. He was also appointed director of several public-listed as well as private companies.

He is an Electrical Engineering graduate, Brighton (1966), holds M.S. in Technological Economics, Stirling (1974), awarded honorary doctorates, and is an Honorary Professor of Napier University, UK (1999).

Keisuke Nansai

Senior Researcher at the Centre for Material Cycles and Waste Management Research, National Institute for Environmental Studies, Japan. Dr Nansai has been working on environmental emission accounting, life cycle assessment, material flow analysis and input-output analysis.

He received the Leontief Memorial Prize (2007), and the Sir Richard Stone Prize (2011) from the International Input-Output Association (IIOA). He is also a contributing author of Chapter 5 for Intergovernmental Panel on Climate Change (IPCC).

Agenda

8.15am Registrations, Tea and Coffee
8.45am Open of event by Pro-Vice-Chancellor (research and international) – Professor Alan Lawson
9.00am Introductions and welcome – Professor Saleem Ali
9.30am Scarcity and security of rare earths – Professor Roderick Eggert
10.15am Economic development determinants of the rare earth sector – Dr Haji Ahmad Zaidee bin Laidin
11.00am Morning Tea
11.30am Social perceptions of radiation in processing – Professor Yoshihiko Wada
12.15pm Characterisation of global flow of rare metals in order to promote the sustainability of global resources – Dr Keisuke Nansai
1.00pm Lunch
1.45pm Four breakout sessions (Attendees nominate which group they go to)
1. International governance and security
2. Industrial ecology approaches
3. Perceived and real nuclear risks and social conflicts
4. Economic determinants
3.15pm Afternoon Tea
3.45pm Share findings from breakout sessions – Facilitators
4.15pm Wrap up and identification of a research agenda – Professor Saleem Ali
5.00pm Event closes
Breakout Sessions

**GROUP 1. International governance and security concerns around rare earths supply**

**Facilitator:** Sebastien Peyrouse (George Washington University)

**SMI Liaison:** Saleem Ali (SMI CSRM)

**Key questions for discussion**

Q1. National and International Governance: What should be the respective roles of government initiatives and supplier-consumer actions and alliances? How do the approaches of ‘resource-rich’ nations (e.g., USA) compare with those of ‘resource-poor’ nations (e.g., Japan, EU, South Korea)?

Q2. Should there be movement towards an international treaty or other multilateral agreement related to strategic minerals, with perhaps a protocol focused on rare earths? Could the Energy Charter Treaty or the International Renewable Energy Agency (IRENA) play a role in this context?

Q3. Primary Production versus Recycling: How significant a role might we expect recycling to play in reducing supply risks? What are the key technical, economic, and geopolitical differences between these two sources of supply?

Q4. Investing in REE National Stockpiles: What role should stockpiles play relative to other means of stabilizing and securing supplies? Should government manage stockpiles, or are stockpiles more appropriately left to the private sector?

“Placing the REE supply chain in the global context is unavoidable. The current goal is to promote an adequate, stable, and reliable supply of materials for national security, economic well-being, and industrial production.”

*CRS Report for U.S. Congress, 2012*

**GROUP 2. Industrial ecology: a comprehensive loop from mining to recycling**

**Facilitator:** Anna Littleboy (CSIRO)

**SMI Liaison:** Glen Corder (SMI CSRM/SUSOP)

**Key questions for discussion**

Q1. New REEs projects: are there any missed synergy (by-product and waste reuse) opportunities to minimize environmental impacts and improve economics?

Q2. Could we achieve better results investing in recycling projects? What are the key areas for REEs recycling?

Q3. Are current products containing REEs designed for easy recycling? What are the challenges, e.g. small quantities, collection and sorting, associated hazardous materials?

Q4. Economic/technological/legislative barriers: what are they and how can they be overcome? Who should cover the costs associated with the collection and recycling?

Q5. How should we compare environmental impacts of REEs production versus recycling, and assess the benefits arising from final applications? Is there a lack of data for comprehensive life-cycle analysis (LCA) for regulative purposes?

“...up to 2011 less than 1% of the REEs were actually recycled. This is mainly due to inefficient collection, technological problems and, especially, a lack of incentives...”

*Binnemans et al., 2012*
GROUP 3. Nuclear (radiation and thorium) risks and social conflicts: perception and reality

Facilitator: Jim Joy (SMI MISHC)
SMI Liaison: Peter Erskine (SMI CMLR)

Key questions for discussion

Q1. Communicating with the local community: What have been past mistakes, and what is the best strategy to overcome these?

Q2. An isolated desert versus a populated area in a sensitive environment: where is the best location for a new REEs processing and refining facility? Also, how should transportation risks be assessed?

Q3. Processing of the previously accumulated tailings for REEs extraction (e.g. from iron ore, uranium, alumina, nickel, phosphates production): what are the risks and are they reduced compared with mining and processing ore?

Q4. Are there any other overlooked significant associated health risks for REEs mining and processing?

"Radioactive waste arises in most cases, as the majority of the rare earths deposits also contain thorium and/or uranium. The radionuclides are partly separated in the flotation and partly remain in the tailings... A safe disposal is required in all cases.”
Öko-Institut, 2011

GROUP 4. Economic aspect: determinants and future contributions (downstream industries and green economy)

Facilitator: Malanie Banney (Queensland Department of State Development, Infrastructure and Planning)
SMI Liaison: Margaretha Scott (SMI BRC)

Key questions for discussion

Q1. How important is the green economy to long term viability of rare earths production? Does uncertainty of supply restrict R&D in new, green technology equating to unrealised demand? Is oversupply on the horizon? Discussion on whether in fact there is an underlying long term issue/s. Do regulators need to step in, and if so in what way?

Q2. REEs and substitutes: costs versus efficiency? What price are consumers willing to pay, and what are the risks to national economies? Are there other issues with substitutes?

Q3. Key future consumption sectors – magnets, battery alloys, polishing powders, phosphors, auto catalysts – could they be designed for easy recycling?

Q4. GHG and REEs: how significant is the mitigation effect? How should we inform and convince the regulators?

"Possible scarcities of fossil fuels and related increases in fuel prices together with emissions of GHG are reasons for transforming the current energy system towards a more sustainable and renewable one. The technologies needed have in common that they require the rare earth metals...”
Sander Hoenderdaal et al., 2012
Affiliates

UQ Rare Earth Minerals Consortium is pleased to be working with researchers from the following key centres in developing this program:

- Critical Materials Institute, an Energy Innovation Hub of the U.S. Department of Energy
- National Institute of Advanced Industrial Science and Technology, Japan
- Commonwealth Scientific and Industrial Research Organization (CSIRO)
- UK Natural Environment Research Council (NERC)
- Centro de Tecnologia Mineral, Brazil
- Chinese Academy of Sciences
- Malaysian Academy of Sciences
- Institute for Sustainable Futures, University of Technology Sydney
- Materials Systems Laboratory, Massachusetts Institute of Technology
- Graduate School of Energy Science, Kyoto University, Japan.

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