Opportunities between the UK and Australia on Critical Materials and Electrification

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Critical Minerals: Australia and CSIRO

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Australia’s National Science Agency
Who we are
Australia’s national science agency

One of the world’s largest multidisciplinary science and technology organisations

5,672+ dedicated people working across 53 sites in Australia and globally

State-of-the-art national research infrastructure

We delivered $10.2 billion of benefit to the nation in FY22
CSIRO

Additional countries where CSIRO is investing significant resources and effort: India, Japan, Korea, China.

Data from the 2021-22 financial year unless otherwise indicated.

**Global top**
1% in 15/22 Research Fields and top 0.1% in 4 fields

**SCIENCE**
- Co-published 2,262 publications in 2021 with partners from 140+ countries
- 53 MOUs with global research organizations and universities
- 7 CSIRO offices outside Australia across 6 countries
- 24.9% of staff are from non-English speaking backgrounds
- Work with 345 International corporations

**PEOPLE**
- 18.2% of revenue comes from global engagement
- 4,000+ live patents and patent applications globally
- >$20 million in international engagement work delivered on behalf of the Australian Government
CSIRO’s role in the ecosystem

Universities (domestic and international)

SMEs, Governments, NGOs

Industry (domestic and international)

Basic  Applied  Tech Development  Production

Research  Prove up market + demonstrate technology  Commercial adoption

TRL 1  TRL 2  TRL 3  TRL 4  TRL 5  TRL 6  TRL 7  TRL 8  TRL 9

Basic research  Technology development  System development

Research to prove feasibility  Technology demonstration  ‘Valley of death’  System test and operations
Australia’s largest patent holder with over 650 patent families

Established more than 210 new companies with market capitalisation exceeding $5 billion
CSIRO Australia and Critical Minerals

- Australian Critical Minerals Strategy 2023-2030
  - Critical Minerals List 2023
  - Strategic Materials List 2023
  - Critical Technologies in the National Interest – Clean Energy

- Critical Minerals Office
  - Government’s central coordination point
  - Grants, finance and support for CM projects (>$4B)

- International collaborations with partner countries
  - US, Korea, Japan, France, Germany, India
  - Australia-UK Joint Working Group on Critical Minerals
  - Conference on Critical Materials and Minerals (CCMM) – annual meeting
CSIRO  Australian Government - CSIRO
Critical Mineral Initiatives

• Australian Critical Minerals Research and Development Hub
  • CSIRO, Geoscience Australia and Australian Nuclear Science and Technology Organisation (ANSTO), AUD$50.5M, 2022-2026

• India-Australia Partnerships Jan 2023 - June 2026
  • Critical Minerals Research Partnership, AUD$12.2M
  • Green Steel Partnership, AUD$10.2M
  • Rise Accelerator, AUD$9.5M
CSIRO
Australian Government Policies

- Various policies below link to the Critical Mineral initiatives

- National Battery Strategy
  - In Progress

- Powering Australia Industry Growth Centre
  - ~AU$30mill focussed on supporting clean energy (in progress)

- Future Battery Industries CRC
  - AU$25mill Commonwealth Funding, >$100mill of industry investment, 2019 – 2025

- AU-US Battery Supply Chain and Research Working Group
  - $5.4mill MYEFO funding between 2024-26

- Various State Government activities, especially WA & Qld
CSIRO’s History of Innovation

- Ultrabattery
  - Hybrid Pb-acid battery for automotive & energy storage
- Ecoult
  - Battery Management software & Grid Storage
- Access & eCommodore
  - Electric Vehicle design & demonstration
- Cap-XX
  - Supercapacitor company
- Energy Renaissance
  - Development & prototyping of storage systems
CSIRO’s battery value chain activities

Mining and refining
Discovery and Recovery
- Lithium: Rock/brines/waste
- Cobalt: CoSO4
- Manganese: MnO2, MnSO4
- Graphite: Fluoride-free
- Nickel: NiSO4
- Vanadium: V2O5 (>99%)

Recycling
- High value materials recovery
- Australian specific solutions
- Increasing economic benefits
- End of life battery safety

csiro.au/lithium
Australia's National Science Agency

Battery materials
- Electrode precursors
  - Inc. Li, CO, LiO1, LiO2, NMC, NCA
  - Graphite
- Electrolyte precursors
  - Inc. LiPF6
  - Ionic liquids
- Li metal
  - Inc. LithSonic™

Batteries
- Lithium-ion (LIB)
  - Anodes: graphite, metal foil
  - Cathodes
  - Electrolytes: PILBox, ionic liquids
  - Cell manufacture/testing
- Next generation
  - Li-I
  - Li-Air
- Packaging
  - BMS
  - Power Electronics
  - Thermal Modelling
  - Packaging

Deployment
- Grid integration
- 1st use application testing and evaluation
- 2nd life battery systems
- Maximise economic benefits of batteries
- Delay entry into waste streams

1st Use
Repurpose
2nd Use

1st Use
Repurpose
2nd Use
• High Purity NiSO$_4$ (BHP Nickel West)
• High Purity Natural Graphite (Various partners)
• Ti/V extraction using novel processes (TiVAN)
• Validation of LFP/LMFP materials (Lithium Australia NL)
• Battery Systems (Energy Renaissance)
• Recycling with ReCELL (Argonne)
• Australian Energy Minerals → advanced Energy Materials
  • AMBIC linking with the Australian cathode manufacturing facility
• UK know-how in battery cell manufacturing
  • Access to UKBIC to facilitate Australian industry pathways
• Australian knowledge & know-how in grid scale battery deployment
  • 100 MWh (now 150 MWh) Hornsdale Power Reserve
• Bilateral researcher exchange opportunities
Thank you

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