

# Opportunities between the UK and Australia on Critical Materials and Electrification

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# CSIRO

## Critical Minerals: Australia and CSIRO



Dr Joanne Loh Group Leader Critical Minerals

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Australia's National Science Agency

Who we are  
**Australia's national science agency**



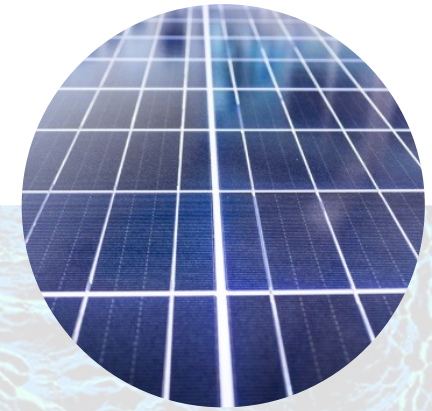
One of the world's largest multidisciplinary science and technology organisations



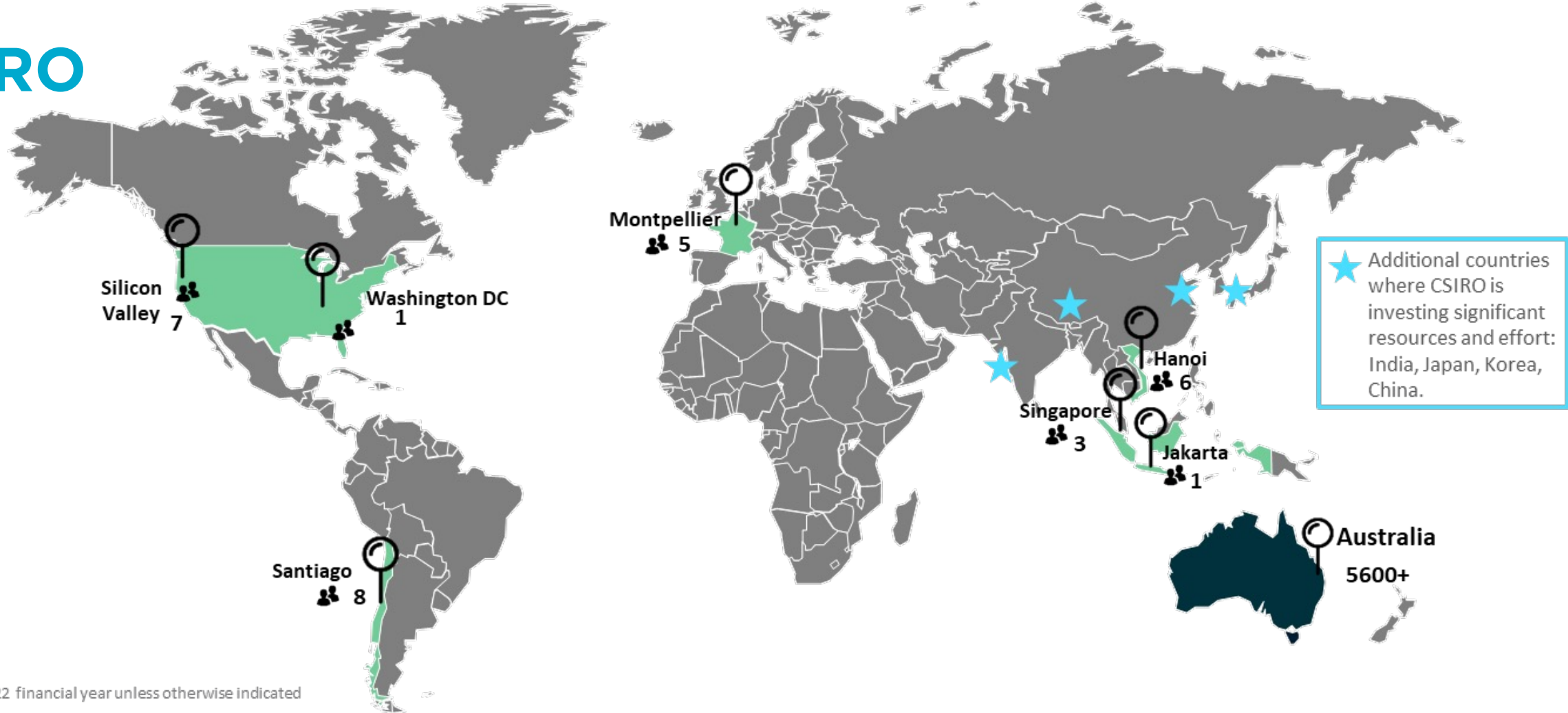
5,672+ dedicated people working across 53 sites in Australia and globally



State-of-the-art national research infrastructure



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



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

Co-published **2,262** publications in 2021 with partners from **140+** countries

**53 MOUs** with global research organisations 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

**18.2%** of revenue comes from global engagement

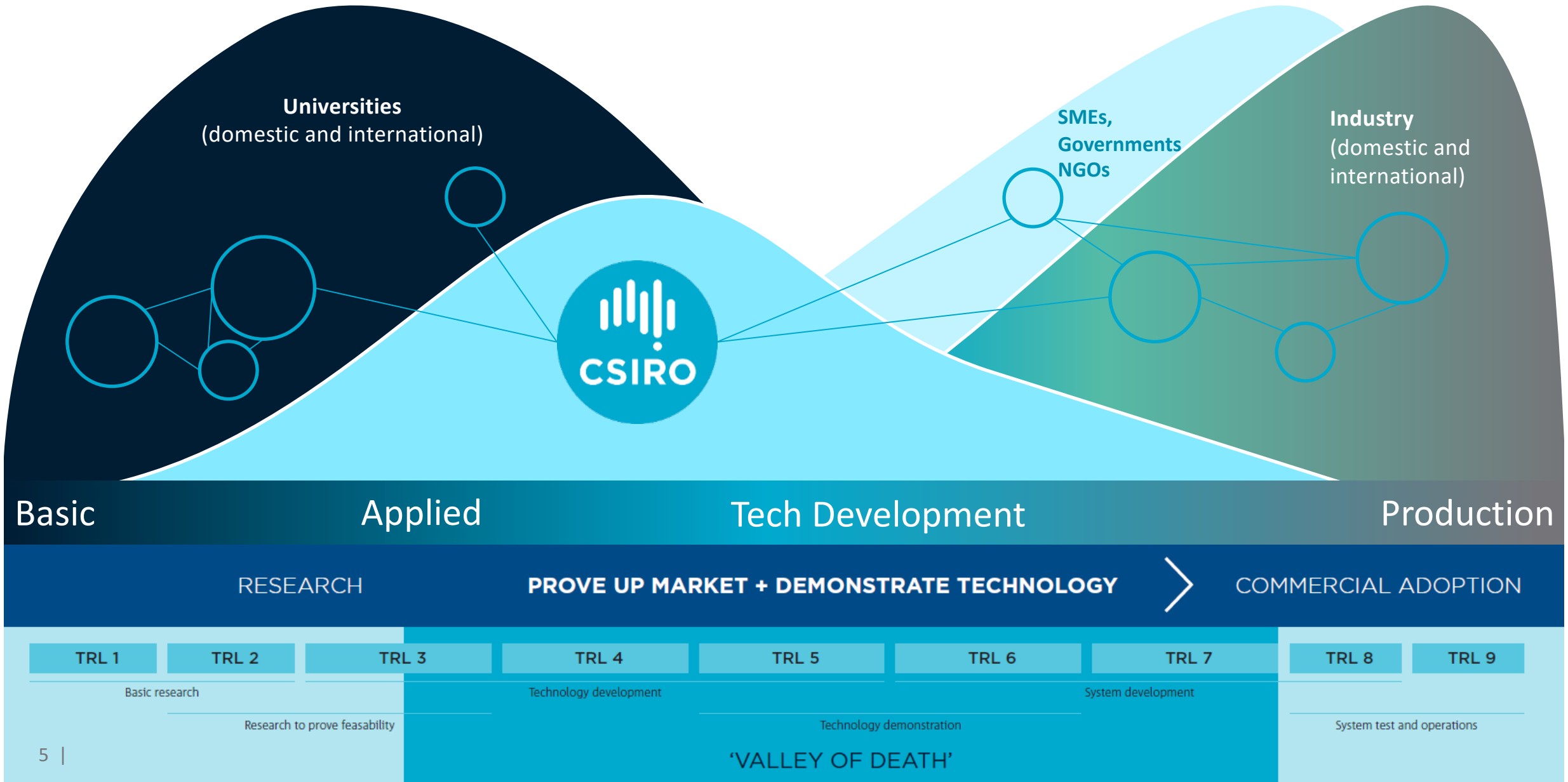
**4,000+** live patents and patent applications globally

**>\$20 million** in international engagement work delivered on behalf of the Australian Government

4 | **SCIENCE**

**PEOPLE**

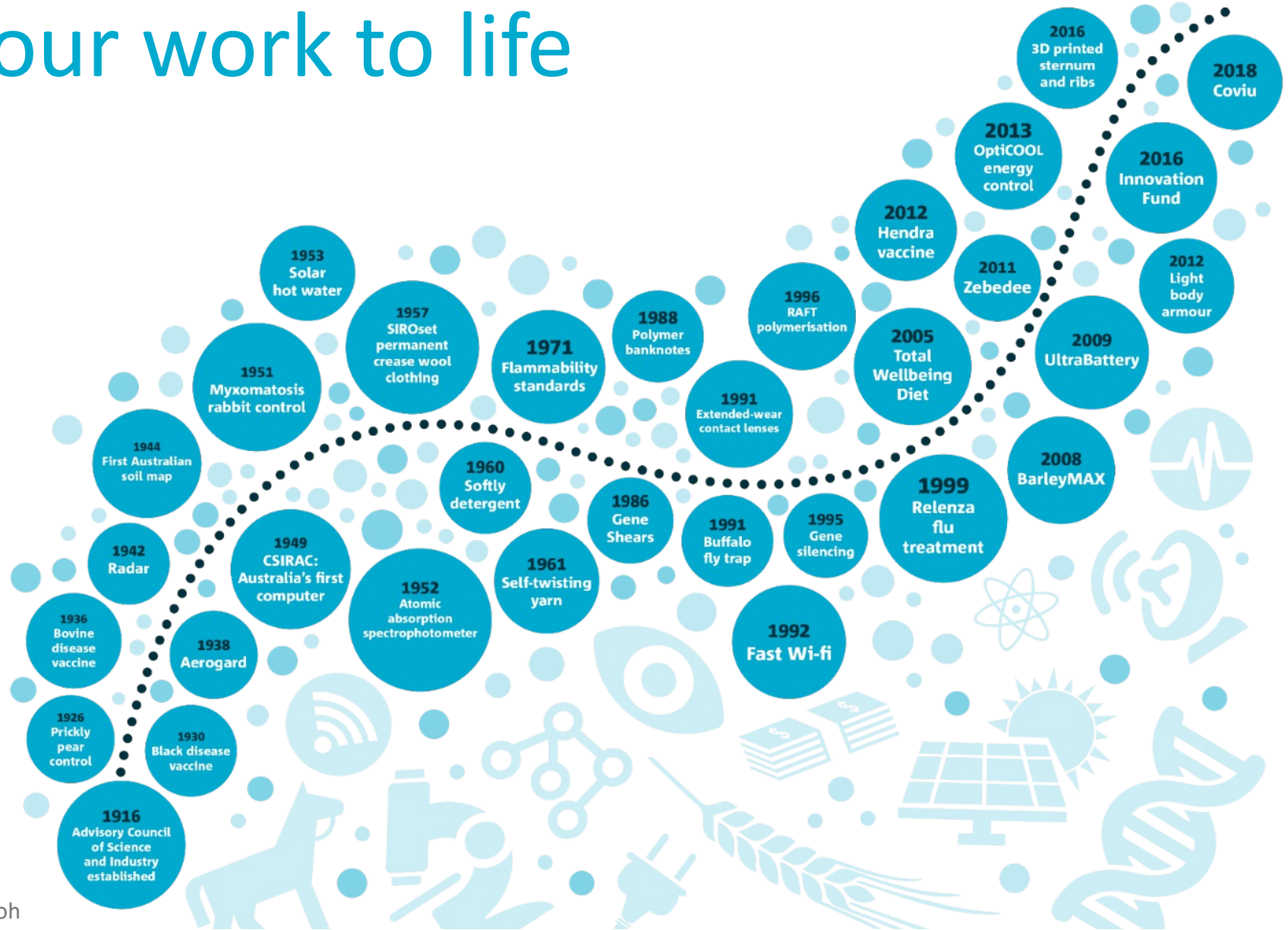
**VALUE**



# The invention-innovation lifecycle brings our work to life

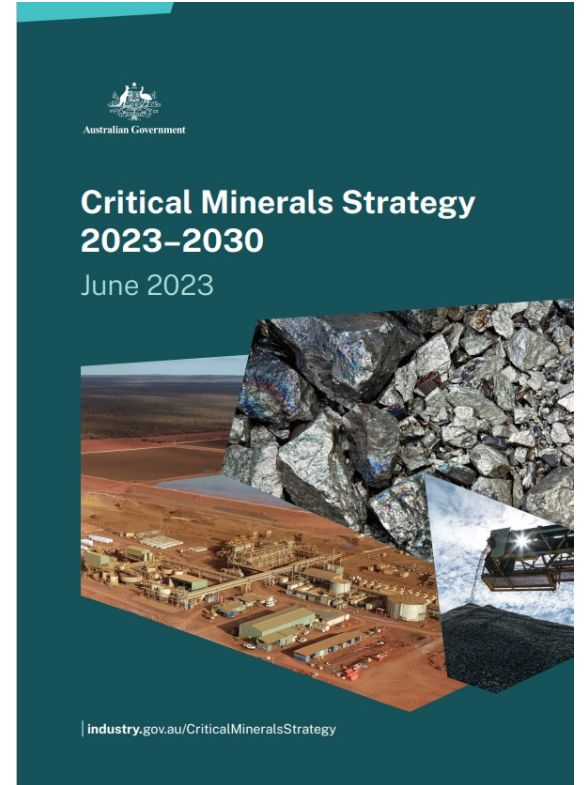
Australia's largest patent holder with over 650 patent families

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



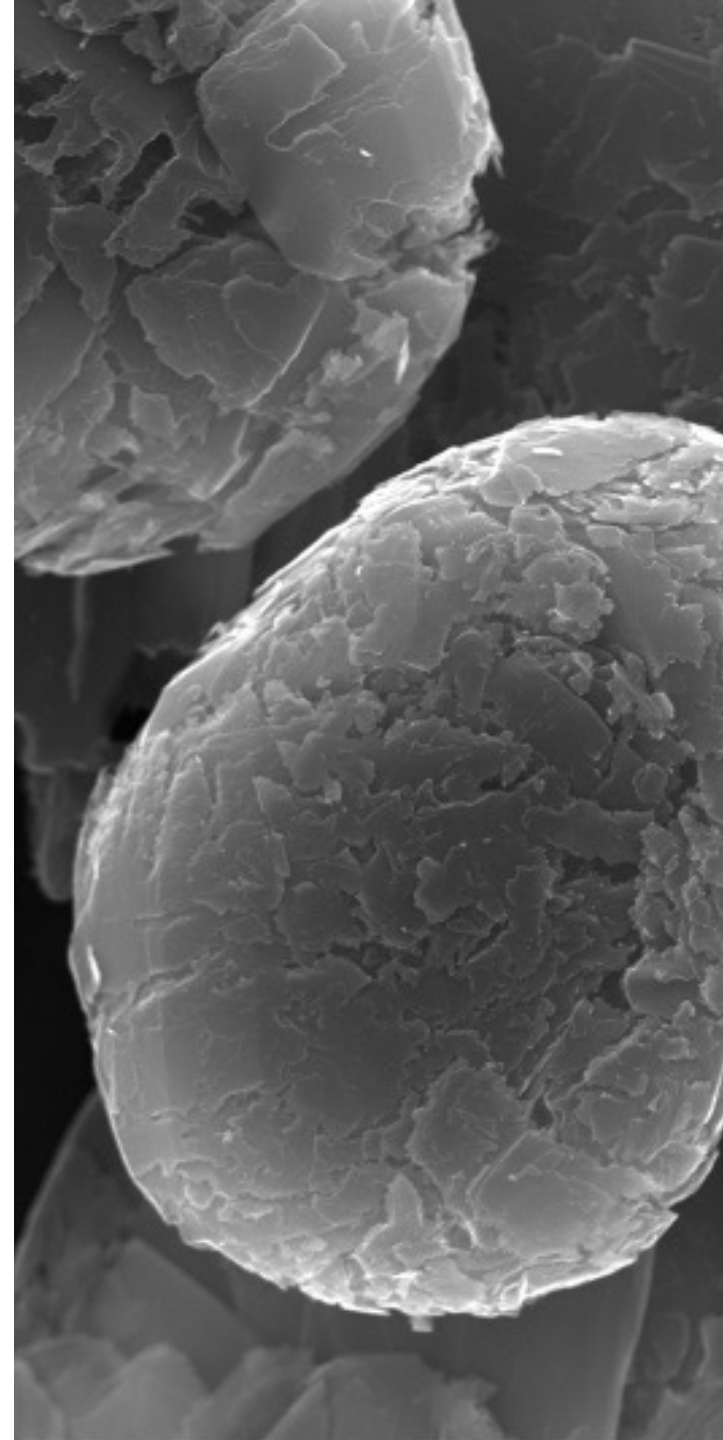
# CSIRO Australian Government - CSIRO Critical Mineral Initiatives

- **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



## 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
- **Ecoul**
  - 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

<b>Lithium</b> Rock/brines/waste	<b>Cobalt</b> CoSO <sub>4</sub>
<b>Manganese</b> MnO <sub>2</sub> MnSO <sub>4</sub>	<b>Graphite</b> Fluoride-free
<b>Nickel</b> NiSO <sub>4</sub>	<b>Vanadium -</b> V <sub>2</sub> O <sub>5</sub> (>99%)

## Recycling

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



## Battery materials

### Electrode precursors

inc. Li<sub>2</sub>CO<sub>3</sub> / LiOH / LiNO<sub>3</sub> NMC / NCA Graphite

### Electrolyte precursors

inc. LiPF<sub>6</sub> ionic liquids

### Li metal

inc. LithSonic™

## Batteries

### Lithium-ion (LIB)

- Anodes - graphite, metal foil
- Cathodes
- Electrolytes - PILBlox, ionic liquids
- Cell manufacture/testing

### Next generation

- Li-S
- Li-Air

### Packaging

- BMS
- Power Electronics
- Thermal Modelling
- Packaging

## Deployment

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



[csiro.au/lithium](http://csiro.au/lithium)

Australia's National Science Agency

CSIRO

# CSIRO Battery Activities

- High Purity NiSO<sub>4</sub> (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)



# CSIRO Opportunities for Partnership

- 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

## **CSIRO Mineral Resources**

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