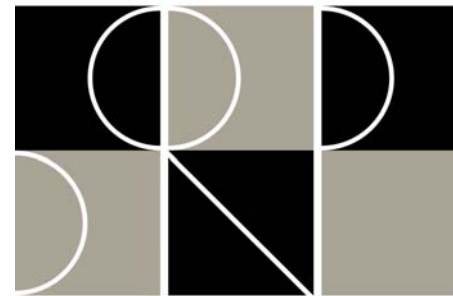


# Towards Zero Waste



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*To progressively **eliminate waste and emissions in the minerals cycle**, while enhancing business performance and meeting community expectations*

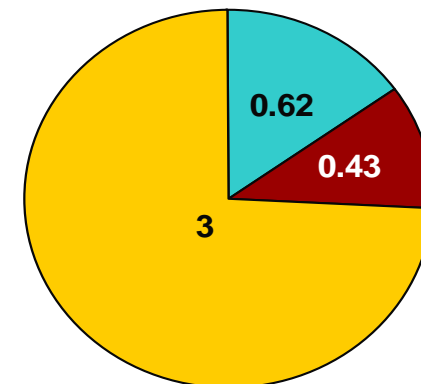
# How Sustainable Are We?

## Australia's

- ✿ Water consumption 1.54 million litres per capita per year
  - World highest rate per capita
  - World average 0.67 ML/c/y
- ✿ GHG emission 27 tonnes/capita per year
  - World highest rate per capita
- ✿ Domestic waste 0.62 t/c/y
  - Second only to USA

Yet only a fraction of industrial/  
mining waste

**Australia's Waste  
Production  
(tonnes/capita/year)**



# Wastes are Bad Business



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Wastes incur the costs of processing,  
generate no revenue,  
satisfy no human need and  
potentially harm the natural environment

- **Unsold production**
- **Environmental liabilities**
- **Community concerns**

# Value Capture from Wastes



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Mineral processing and metal production generates large volumes of wastes in the form of tailings, residues, slags, ash, fumes, sludges, spent refractories

Unlock  
values

Iron and other metals  
Energy  
Reductants  
Chemicals  
Building & construction materials  
Soil conditioners

# CSRP Initiatives



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## The CSRP will explore 'no waste' strategies

### The CSRP Programs

- 1. Strategic analysis and methodologies**
- 2. Eco-efficiency of existing operations**
- 3. Regional and supply chain synergies**
- 4. Breakthrough enabling technologies**

- Applications for Zero Waste concept to Red Mud and other industry's highest volume process residue
- Geopolymers, based on mineral industry wastes, as a low CO<sub>2</sub> alternative to concrete
- Industrial ecology in Kwinana and Gladstone
- Biomass as fuel and reductant
- Management of minor elements

# Which Waste Stream?



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- ✿ A Decision Support Framework was used to guide information gathering and prioritisation of over 20 waste streams
- ✿ The objective hierarchy for screening of wastes covered key criteria
  - Technical and economics
  - Environmental
  - Social/political

# Ranking of Waste Streams



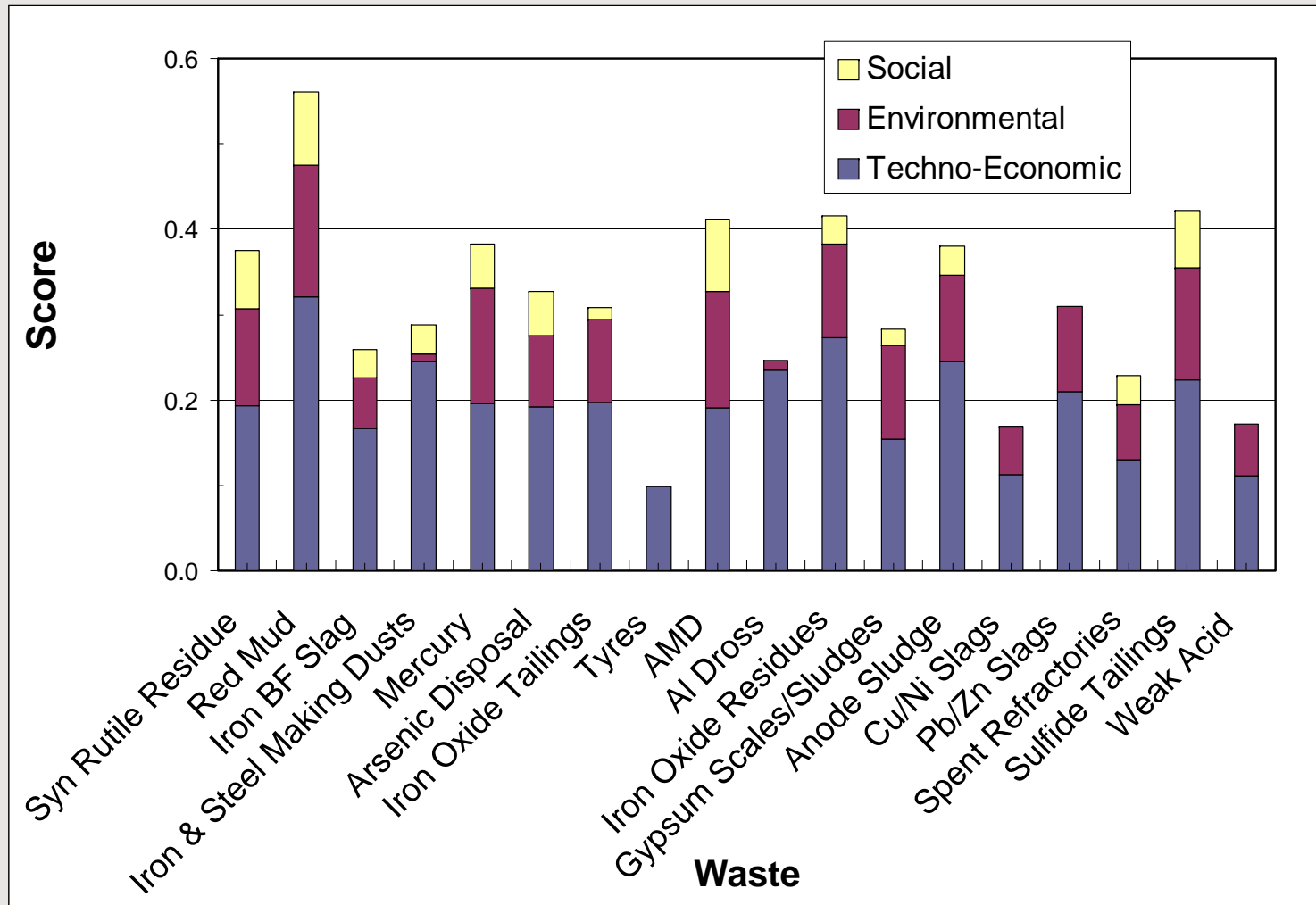
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**Ansto**  
**onesteel**

The University of Sydney



# Bauxite Residue (Red Mud)

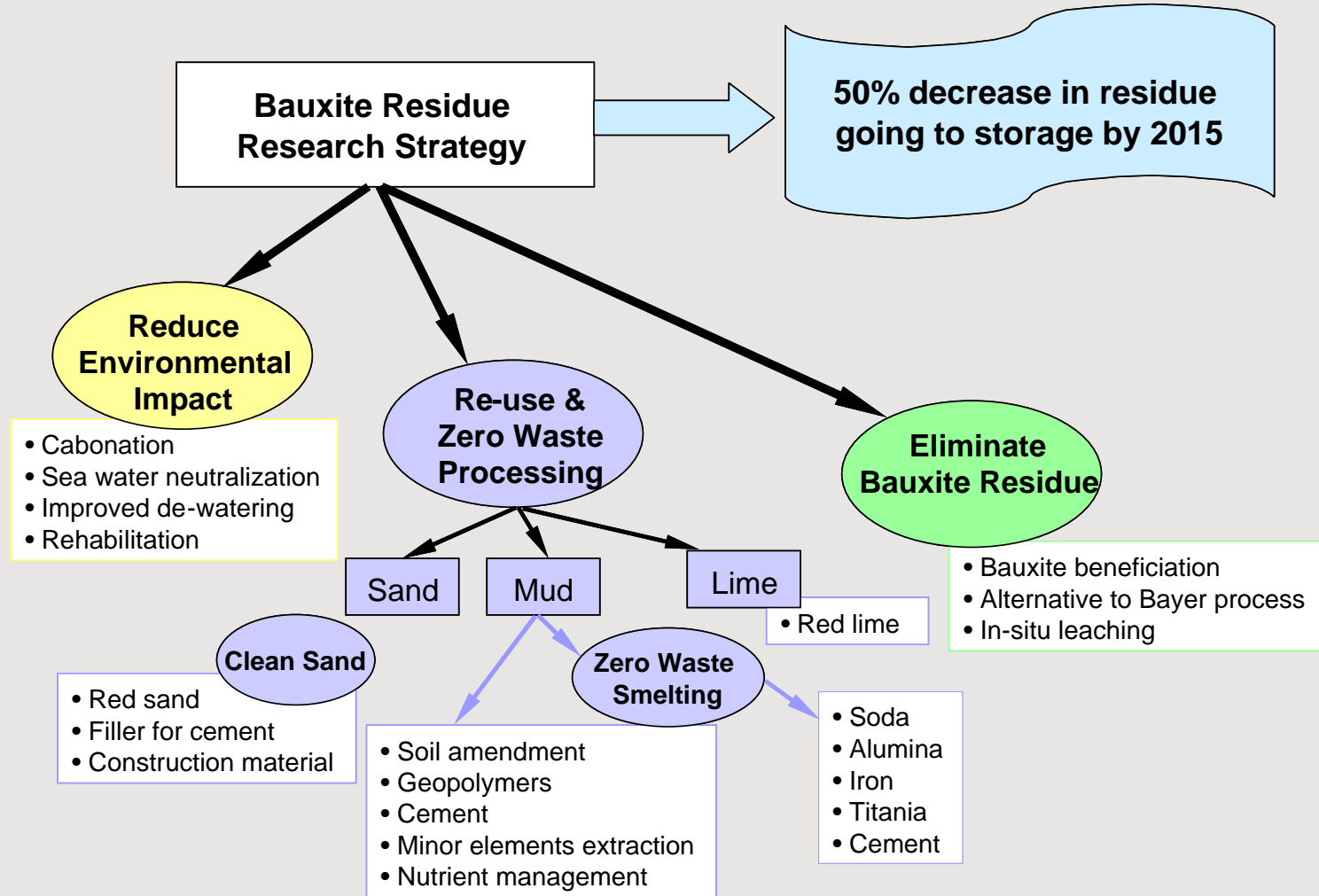


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- ✿ Bayer process recovers 50-80% of the alumina
- ✿ Rest reports to DSP/Red Mud
- ✿ Australia produces ~30 million tpa of red mud (~40% of world production)
- ✿ Red mud contains 15-20 mineral phases with
  - 3-13% caustic soda (\$215/t)      3-10% silica
  - 10-22% alumina (\$390/t)      2-18% lime
  - 7-15% titania (\$570/t)
  - 14-35% iron (\$350/t)
  - Minor/trace elements (Hg, Cd, U, Th, ..) and organics
- ✿ Red mud has environmental liability with negative social/political awareness

# CSRP – Bauxite Residue Plan



# Zero Waste & Value Recovery



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## Full value recovery requires chemical and phase transformation

- High temperature processing enables such transformation
- Pyromet combined with hydromet and mineral processing steps can lead to a full value recovery and zero waste goal

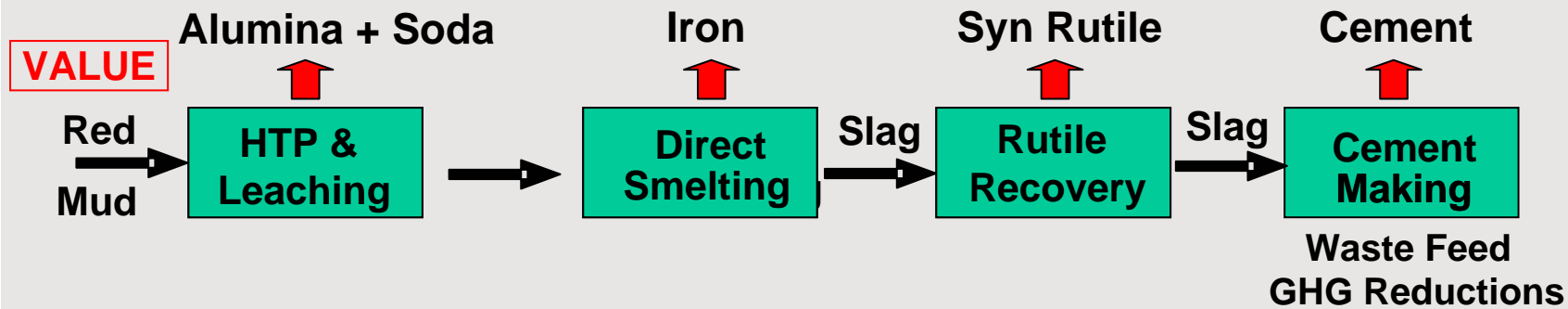
# Zero Waste - Red Mud Processing (Extended Systems Innovation)



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System innovation builds on industrial ecology, regional synergies, and collaboration across normal business boundaries

# Preliminary Techno-economic Evaluation



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- Results show full recovery of valuable components could be economic:
  - Positive NPV (15% discount rate)
  - IRR of 18%
  - Pay back period of <5 yrs for capital investment of \$100s millions.



# Other Opportunities



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- ✿ CSRP is developing cost effective flowsheets for
  - Conversion of haematite tailing to saleable iron, steel and copper
  - Recovery of zinc from EAF dust and recycling the iron into steelmaking vessels
  - Treatment of sulphide tailings to address AMD and produce saleable product streams
- ✿ Key success factors are multi-disciplinary approach and working across the normal boundaries

# Concluding Remarks



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- ❁ Solid wastes from mineral industry are a challenging resource and an exciting opportunity for the industry and researchers
  - Do not consider wastes as a given cost to business, but an untapped potential opportunity to value add
  - A philosophy of zero waste is good for business
- ❁ Breakthrough and promising flowsheets are emerging through the zero waste concept and a multi-disciplinary approach
- ❁ System innovation, that builds on industrial ecology and collaboration across the normal business boundaries, is a key success factor



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*Mission: To progressively **eliminate waste and emissions in the minerals cycle**, while enhancing business performance and meeting community expectations*