Opportunities and Pathways for Large-Scale Utilisation of Renewable Power, Hydrogen, Ammonia and Oxygen in Mineral Processing and Metal Refining in WA

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FUTURE ENERGY EXPORTS
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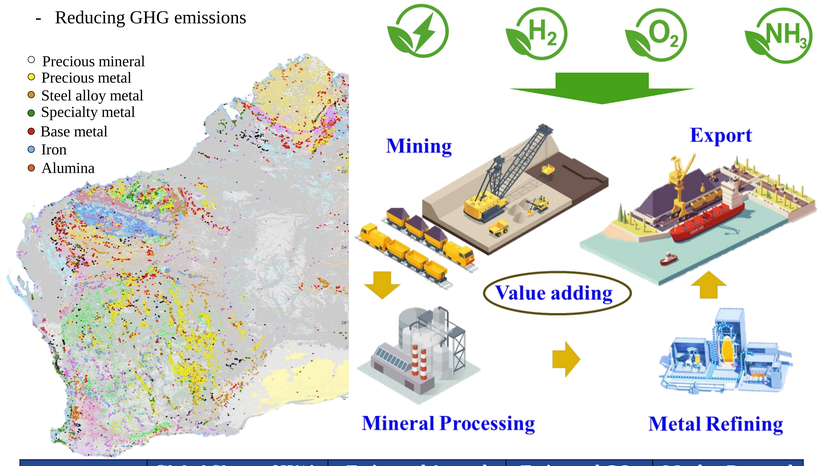
FENEX CRC THEME

- Hydrogen Export & Value Chains

IMPACT AND IMPORTANCE

- The mining, mineral processing, and metal refining industries are energy-intensive and have considerable environmental implications
- Green hydrogen is a clean energy vector, produced via water electrolysis driven by renewable power
- Hydrogen could be used both as a fuel and a reductant in industrial processes
- WA has competitive advantages in renewable energy resources and mineral resources
- Embedding renewables in minerals/metals for export
  - Enhancing value addition
  - Reducing GHG emissions

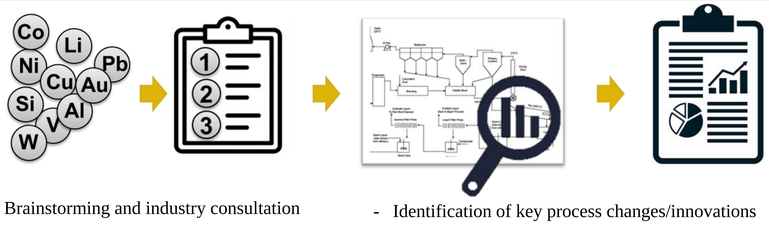


Commodity	Global Share of WA's Production (%)	Estimated Annual Energy Demand (PJ)	Estimated CO_2 Emission (Mt/yr)	Market Demand (Mt/yr)
Al	9.9	137.8	9	97
Li (Concentrate)	53	17.5	1.3	0.2
Li (LiOH)		14	1.2	
Au	7	42.5	3.8	0.004
Ni	4.7	37.8	2.1	3.1
Co	3.1	3.3	0.2	0.2
Cu	0.6	5.6	0.5	21.4
Ti (Ilmenite)	2.3	0.8	0.07	7.5
Ti (Rutile)	11.70	1.6	0.1	
Zr	16	0.8	0.6	1.2

PROJECT AIMS

- Identify opportunities for and evaluate potential pathways towards large-scale, beneficial utilisation of green H_2, O_2, NH_3 and electricity to decarbonise mineral processing and metal refining applications in WA
  - Screening applicable mineral resources
  - Analysing key potential opportunities
  - Identifying knowledge gaps and technical challenges
  - Evaluating potential pathways

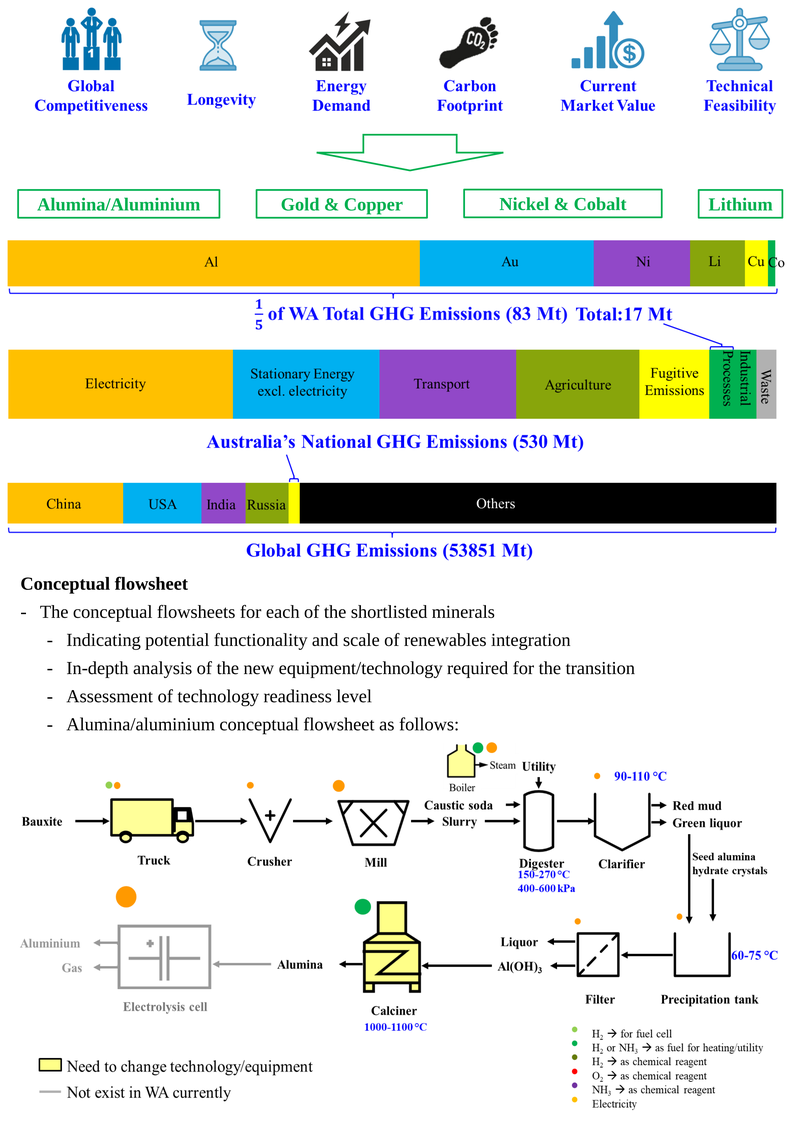
RESEARCH METHODOLOGY



- Brainstorming and industry consultation
- Literature review and data collection
- Identification of key process changes/innovations
- Mass and energy balance, value-chain analysis

PRELIMINARY WORK

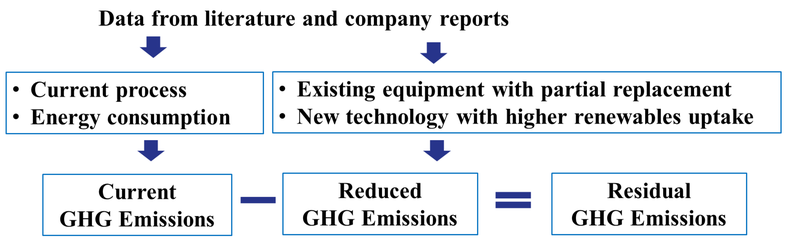
Mineral selection criteria & Shortlisted mineral resources



Conceptual flowsheet

- The conceptual flowsheets for each of the shortlisted minerals
  - Indicating potential functionality and scale of renewables integration
  - In-depth analysis of the new equipment/technology required for the transition
  - Assessment of technology readiness level
  - Alumina/aluminium conceptual flowsheet as follows:

Key potential opportunities analysis

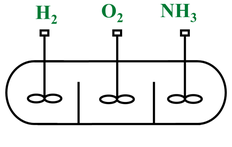


PRELIMINARY WORK

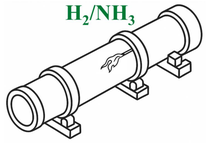
Evaluation of potential pathways

- Potential renewables uptake
  - H_2 or NH_3 as fuel for transport/heating/utility (TRL 6-7)
    - New technology/equipment needed
    - Conversion factors to be estimated
  - H_2, O_2, NH_3 as chemical reagent (TRL 9)
    - No major change
    - Amount of chemical reagents to remain same as current
  - Electricity for driving equipment (TRL 8-9)
    - New energy storage needed
    - Same amount of electricity needed for the process
    - Round-trip efficiency of electricity storage must be considered

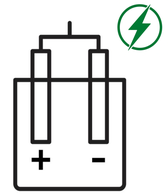
FCEV



Chemical reagent



Fuel



Electrowinning & Driving equipment

TRL	Description
1	Basic principles observed
2	Technology concept formulated
3	Experimental proof of concept
4	Technology validated in lab
5	Technology validated in relevant environment
6	Technology demonstrated in relevant environment
7	System prototype demonstration in operational environment
8	System complete and qualified
9	Actual system proven in operational environment

PROJECT TEAM

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ACKNOWLEDGEMENT

- Future Energy Export CRC
- BP p.l.c.
- CSC-UWA (China Scholarship Council – The University of Western Australia)

PROJECT PARTNERS

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