



Session 3

Innovation and engagement

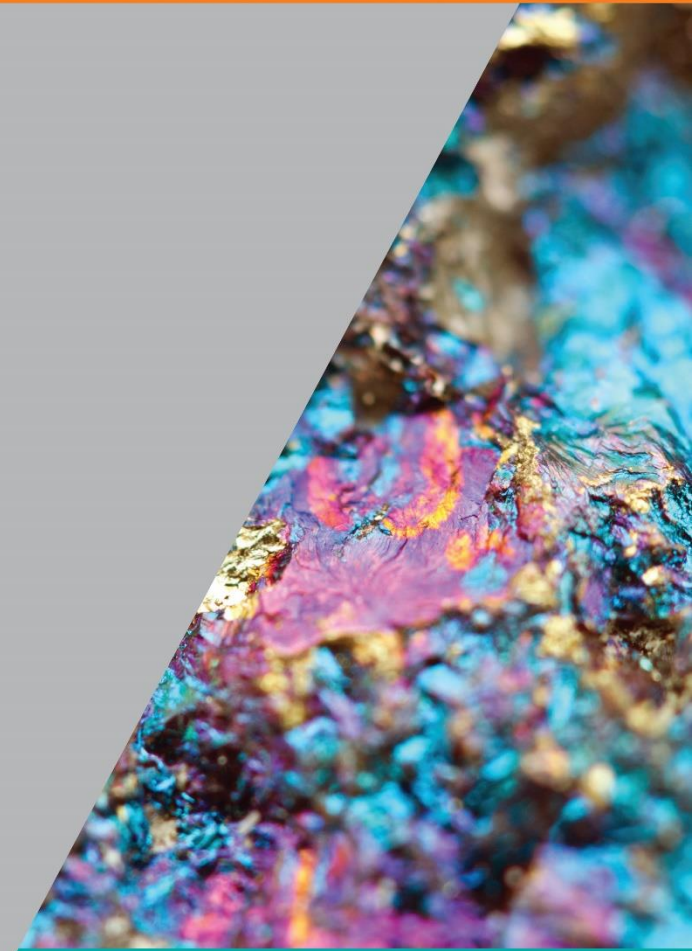
Chair: Terry Burgess
Independent mining expert



SOUTH
AUSTRALIA



Government of South Australia
Department for Energy and Mining

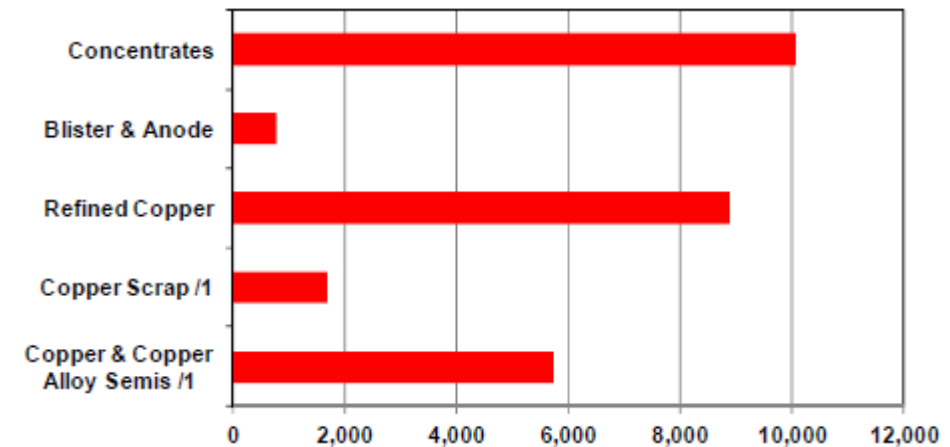


Copper Value Chain – Jacqui McGill

Where is the Value Generated?

- Value is predominantly generated upstream.
 - 90% at Mine
 - 7 % at Smelter
 - 3% at Refinery

World Copper Exports by Product Category, 2017 /2
Thousand metric tonnes copper (unless otherwise noted)
Source: ICSG



Copper Smelting Technology

Dr Ray Shaw
Minetometal Pty Ltd.

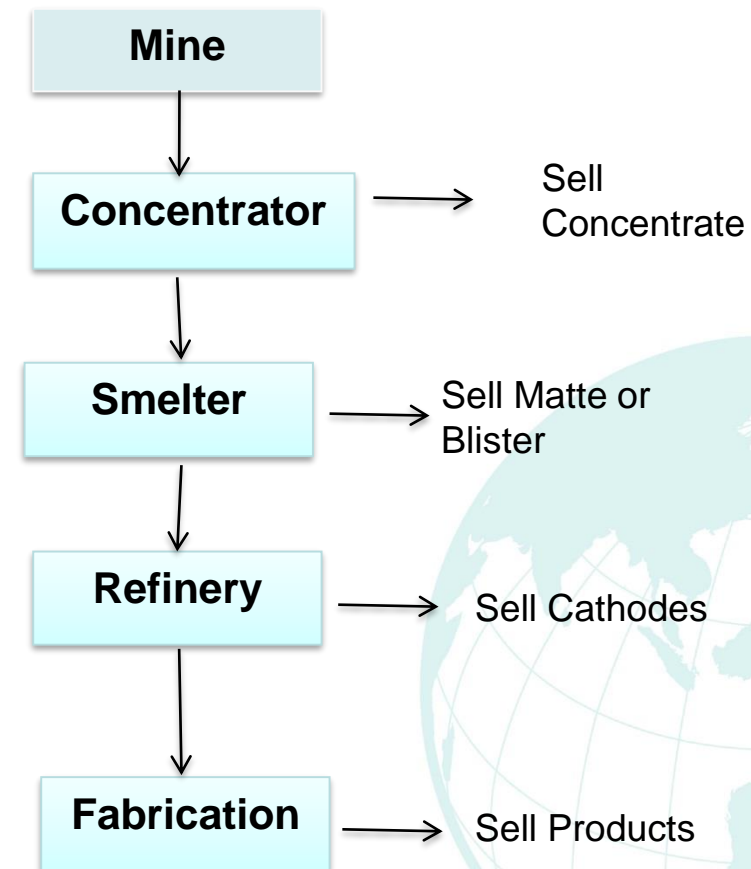
CSIRO Research Fellow



Copper Production – 100ktpa

Energy (Hourly)	Water (Hourly)	Material	Output (t/yr)
		Ore 1 %Cu Mine Waste	11.5 Mt 20 Mt
Elec. 40 MW	750 M ³	Concentrate Tailings	400 kt 11.1 Mt
Elec. 10-15 MW Gas 20-50 GJ	30-40 M ³	Blister Acid Slag	102 kt 255 kt 190 kt
Elec. 5 MW		Copper Metal	100 kt

- Smelting has Modest Energy Requirement
- Largest Output is Sulphuric Acid



Main Drivers for “Local” Smelting

Acid Value – if Achievable

- Leaching
- Fertiliser – Chemicals

Concentrate Transport Costs

- Cost varies but typically \$50-100/t
- Significant cf TC/RC

Managing Impurities



Some Recent New Smelters

A Range of Sizes and Technologies – not all are large

Company/Location	Country	Type	Tonnage
Kazzinc	Kazakhstan	TSL	90kt
Henan Jincheng Smelter	China	BBRs	100kt
Qinghai	China	BBRs	100kt
Yuguan	China	BBRs	120kt
Hongyue	China	TSL	150kt
Dongying Fangyuan	China	BBRs	300kt
Kansanshi	Zambia	TSL	300kt
Nanguo	China	SBF	300kt
Ngdie	China	FCF	400kt

TSL = Top Submerged Lancing
FCF = Flash Furnace & Converting
BBR = Bottom Blown Smelters
SBF = Side Blown Smelters

Other Recent FCF's and SBF's not listed
have been large



SA Copper Smelter Technology

NERIN Paper on Chinese Developments

- Selection Depends on Multiple Factors
- **There is no best, only the most appropriate**
- Last 8 plants have included 4 different technologies

Front runners for SA

1. Top Submerged Lancing IsaSmelt – Ausmelt
 - Australian Developed – Local Support
2. Bottom Blown Smelting (Chinese)
 - Both With Continuous Converting

- ✓ Can meet Environmental Requirements
- ✓ OPEX likely to be similar
- ✓ CAPEX will be critical
- ✓ Small Size is a factor in choice
- ✓ Local Support will be important



Environmental Performance

Copper Smelters Performance Globally is Variable (SO₂)

- Japanese (eg Tamano) >99.8% Capture for >30years
- USA Kennecott >99.5%
- Europe Norddeutsche >99.5%
- China Mixed – new plants >99.5%
- Older Plants (eg Chile, China must improve or face closure)

Tighter Regulations now in Place in most Countries

- Particulate Emissions also now very low in "good" Plants
- Effluent Emissions also can be well controlled
- Environmental Performance not a technology barrier
- Do need to manage community perceptions and perform



A Modern New Smelter

Ningde (China) 400,000tpa Smelter - Resembles a Factory

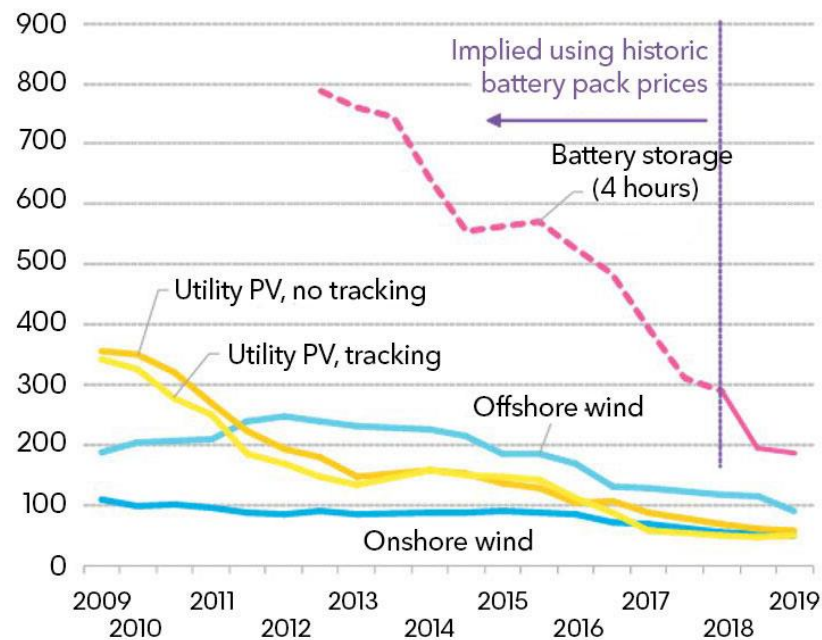


Energy supply - Phil O'Neil

Cost of generation and battery storage

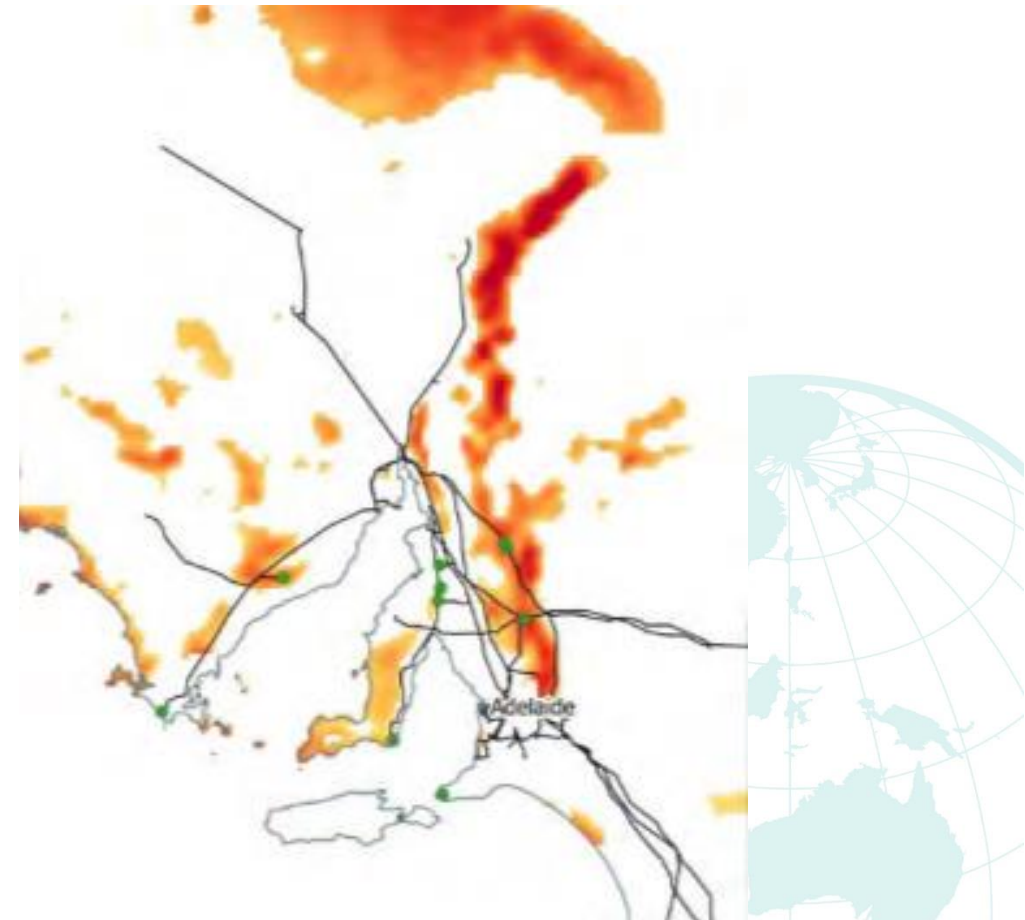
Global benchmarks - PV, wind and batteries

LCOE (\$/MWh, 2018 real)



Source: BloombergNEF. Note: The global benchmark is a country weighed-average using the latest annual capacity additions. The storage LCOE is reflective of a utility-scale Li-ion battery storage system running at a daily cycle and includes charging costs assumed to be 60% of whole sale base power price in each country.

SA Wind / Solar co-location



Source: AECOM – Colocation investigation, ARENA 2016

Role of METS in Cu value-adding – Ian Dover

Consumer tech - EVs - Renewables
Copper customer trends
Technologies + Capabilities
BHAG-driven clustering
Miners + METS + Markets
Transformative Automation
ARC ITRP & CRC-Ps
Project Funds

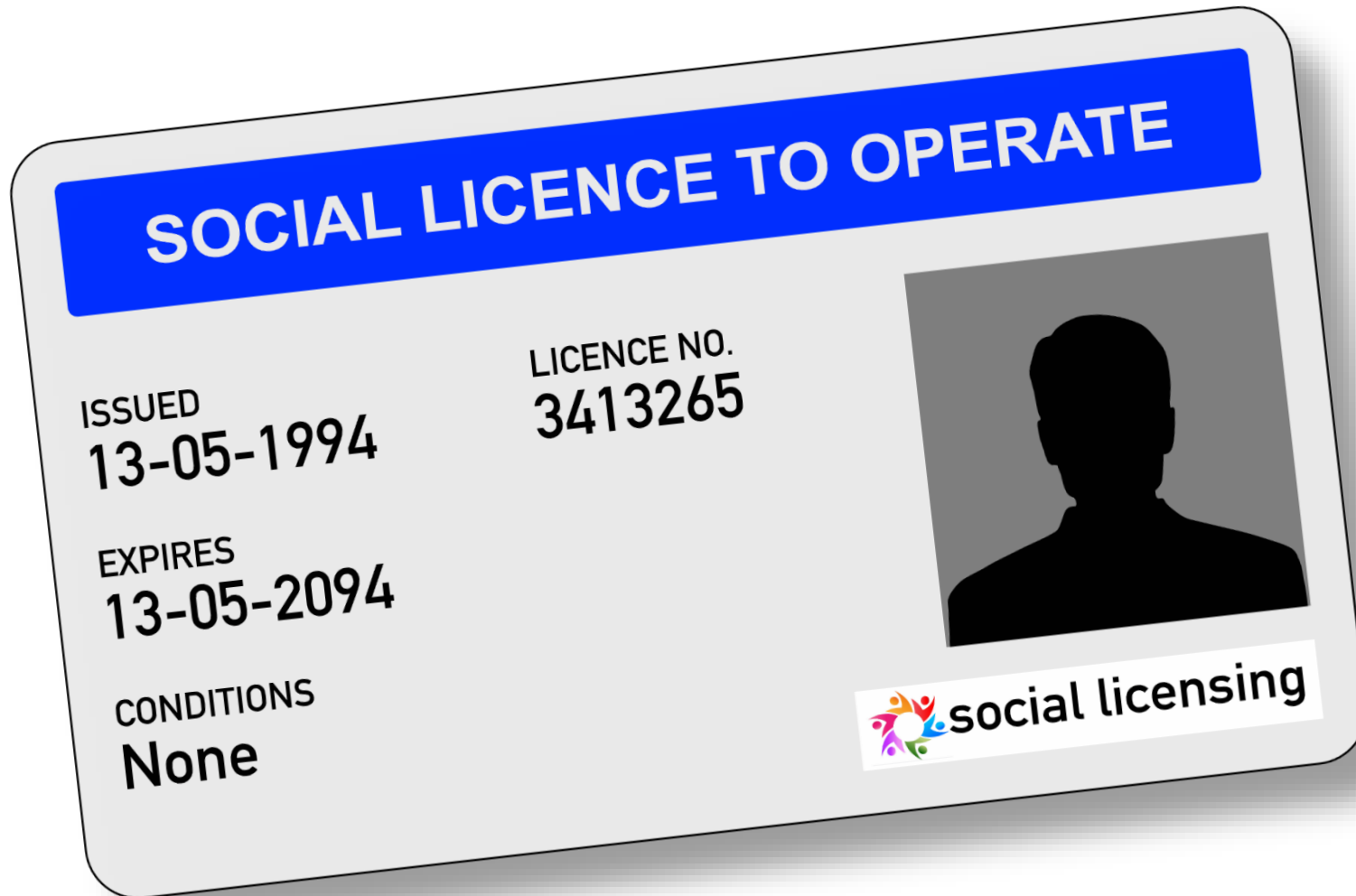


Australian Government
Department of Industry,
Innovation and Science

Industry
Growth
Centres



Simon Corrigan



A working definition

The level of acceptance or approval continually granted to an organisation by society.

Adapted from: Black, L. (2013). *The social licence to operate: Your management framework for complex times*. Sheffield, UK: Greenleaf Publishing.



Global

National

Regional

Local

