Urandaline Investments

Aluminium Supply and Copper Demand
Macquarie First South Securities
Cape Town, February 2012
This presentation is a tale of two metals: China’s copper demand & aluminium supply

Al
- The importance of China as producer of aluminium
- The structure of China’s aluminium industry
- Five year outlook for China’s aluminium production

Cu
- The importance of China as a consumer of copper
- Structure of China’s copper consumption
- Why most uses of copper are safe from substitution with aluminium
Copper and aluminium are two very different base metals.

**Aluminium**
- China the dominant producer and consumer
- Relatively low barriers to entry
- Price elastic consumer metal

**Copper**
- China the dominant consumer
- Relatively high barriers to entry
- Price inelastic industrial metal
China’s aluminium production has grown by a factor of five over the past decade.
With 40% of global production, China is the world’s dominant producer of aluminium.
After paying for power, alumina and carbon nothing left to service the investment.
Average power tariffs have more than doubled over the past seven years.
The doubling of power prices has increased production costs by ¥4,200 per ton.
Aluminium sector characterised by low barriers to entry and even lower exit barriers.
China’s aluminium sector has grown despite Beijing’s opposition

1. More than half the smelters are wholly or partially owned by local governments

2. Technical innovations have partially offset escalating power prices

3. Investment in integrated power stations assures continual supply (at a cost)

4. Chinese engineers can build new capacity at one-third the cost of comparable international projects
This is what China’s aluminium industry looks like now
Because of escalating power prices, aluminium sector is relocating to Xinjiang

- Undeveloped remote region, rich in coal and with a troublesome ethnic minority

- *Develop the West* Policy and local ethnic troubles, exempt Xinjiang from decrees forbidding aluminium expansion

- Low power tariffs more than offsetting additional freight and capital cost. Cash cost of ¥13,000 cf ¥16,000 elsewhere

- Integrated power direct to smelter and not via grid

- <10 Mtpa of new very productive (500 kA) capacity by 2015, mostly built by experienced producers who will ultimately convert existing sites to industrial parks
Savings of ¥3,400 per tonne is a compelling argument to relocate to Xinjiang.
China remains the key to future copper demand and outlook is still positive.

Forecasts of demand destruction have been overdone. No recognition of new applications.

New capacity projects continue to slip as does current supply due to water and power shortages, strikes etc.

Labour and equipment shortages affecting new project costs as well as current operations.
The rest of the copper world stood still while Chinese consumption expanded.
China now accounts for more than one-third of global copper consumption.
As the world’s largest consumer of refined copper, China is a key demand driver.
Over 60% of China's copper is used in price inelastic industrial applications.
China's copper demand seems insensitive to price (price-inelastic)
As the difference between LME and SHFE prices widens, copper imports increase.
China’s consumption of copper has a strong correlation to fixed asset investment.
The price inelastic power industry accounts for half of China’s copper demand.
Copper is the backbone of any modern power system

- Copper is used in generator windings, distribution transformers and reticulation (NOT transmission)
- Transformers are a mass of copper and special steel - 60 t of copper per 1 GVA
- Every 1 GW of generating capacity requires 3 to 5 GVA of transformer capacity
- Generators use around 10 t of copper per 1 GW
- Copper is also used in house wiring and reticulation
Planned increased grid expenditure is very good for copper

- State Grid Corporation (SGC) is the world’s largest purchaser of copper
- SGC purchased 1.15 to 1.25 Mt of copper last year. Up slightly from 2010
- New FYP provides ¥2.55 trillion grid expenditure by SGC, up 68% from preceding plan
- FYP is based on programs, not investment so grid investments will not be affected by the copper price
Following rapid build in capacity, time for China to develop copper intensive grid
China has under-invested in transmission and distribution
Aluminium is not a substitute for copper in electric power systems

- Aluminium has 62% of copper’s conductivity so aluminium wound transformers would be much larger. Prohibitively so?
- Aluminium cannot handle fluctuating magnetic forces as well as copper so high failure rate from broken windings.
- Copper is very much easier to work than aluminium.
- Aluminium windings require more specialty steel in the transformer core.
- In any case substitution is a long-term problem rather than an immediate concern.
Aluminium is even less suitable than copper for domestic wiring

- Many authorities prohibit the use of aluminium wire because it is a safety hazard when over-heated and connections loosen.
- Difference in the coefficient of thermal expansion causes aluminium to expand and contract at a different rate to copper which is used in fittings.
- Aluminium is subject to creep (deform) under sustained pressure and more so at high temperature.
- Use of copper avoids galvanic corrosion from use of dissimilar materials.
No sign of substitution: production of electric power cable continues to grow strongly
Sustained production of power and UHV transformers. Where is the substitution?
While monthly generator production varies, annual output is steady. Substitution?
It has been long enough...where is the evidence of substitution? Producer plans?
Domestic appliances, especially air conditioners, consume a lot of copper.

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Copper intensity (Kg per appliance)</th>
<th>Annual Demand (kt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerator</td>
<td>1.13 to 1.3</td>
<td>90.4 to 91</td>
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<tr>
<td>Washing machine</td>
<td>0.567</td>
<td>39.7</td>
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<tr>
<td>Air conditioner</td>
<td>7.15 to 8.3</td>
<td>929.5 to 1,079.1</td>
</tr>
<tr>
<td>Freezer</td>
<td>1.215</td>
<td>19.4</td>
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These Chinese domestic appliances require more than a million tonne of copper.

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Copper Demand (Mtpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerator</td>
<td>0.05</td>
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<tr>
<td>Freezer</td>
<td>0.02</td>
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<tr>
<td>Air conditioner</td>
<td>1.2</td>
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<tr>
<td>Washing machine</td>
<td>1.0</td>
</tr>
</tbody>
</table>
China continues to produce a lot of copper intensive consumer appliances.
New technology passenger vehicles are far more copper-intensive.
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