Plenary Session

Tony Dixon
Innovative Waste Recycling and Energy Efficiency Solutions: 
A perspective from one of Australia’s largest integrated manufacturers

International Sustainability Symposium | Keynote Address | Mr Tony Dixon General Manager Sales & Marketing
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All balance sheet items are based on statutory financial information. Except as otherwise expressed, references in this document to net profit/loss after tax refer to net profit/loss attributable to equity holders of the parent. Segment results referred to throughout this presentation are those reported in the 2013 Full Financial Report. They are equivalent to segment underlying results.
AN INTRODUCTION TO ARRIUM
Arrium Business Structure

Arrium Mining
- Middleback Ranges
- Southern Iron
- Port Operations

Arrium Mining Consumables
- Moly-Cop International
- Moly-Cop Australasia
- AltaSteel

Arrium Steel
- Steel
- Recycling
Steel Overview

Integrated Australian steel operations
  • Scrap/iron ore → Manufacturing → Distribution

Australia’s only manufacturer of steel long products
  • EAF & integrated blast furnace production flexibility
  • Steelmake capacity ~2.6Mt pa
  • Large product range – structural, reinforcing, rail, wire, fencing and strand products and solutions

The leading distributor of metal products in Australia
  • National footprint
  • #1 in general Australian steel distribution
  • #1 in Australian reinforcing
  • #1 in Australian wire

“We use our expertise in steel manufacturing, sales, logistics, supply chain and processing to deliver a safe, fast, flexible and reliable product to all Australian customers”
Steel Interesting Facts

• We employ approximately 5,700 Australians directly or indirectly
• We trade with over 27,000 customers a year
• We schedule, cut and bend over 100 million lengths of rebar a year
• We make and handle over 7 million sheets of mesh a year
• We despatch over 1400 trucks and train wagons every day. That’s almost 400,000 a year

Arrium strives to ensure we provide a safe and sustainable environment
Our Integrated Steel Value Chain

Iron Making
- Whyalla Blast Furnace

Steel Making & Casting
- Whyalla BOS Combi Caster
- Whyalla Billet Caster
- Laverton EAF and Billet Caster
- Sydney EAF and Billet Caster

Product Mills
- Whyalla Structural & Rail Mill
- Laverton Bar
- Laverton Rod
- Sydney Bar Mill
- Newcastle Rod Mill

Processing & Distribution
- OneSteel Wire
- OneSteel Reinforcing
- ARC
- OneSteel Metalcentre
# Our Steel Businesses

<table>
<thead>
<tr>
<th>OneSteel Metalcentre</th>
<th>OneSteel Reinforcing</th>
<th>ARCl Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sites</strong></td>
<td><strong>People</strong></td>
<td><strong>Revenue</strong></td>
</tr>
<tr>
<td>70+</td>
<td>900+</td>
<td>$700m+</td>
</tr>
</tbody>
</table>

- **OneSteel Metalcentre**: The leading distributor of a broad range of products leveraging scale in market coverage, product range, operations & supply chain.
- **OneSteel Reinforcing**: Australia’s largest reinforcing provider focused on top-tier projects and helping customers with their construction risks.
- **ARCl Group**: The leading provider of reinforcing products to the mid-tier and smaller project markets.

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[Image of a stadium and construction site]
Our Steel Businesses

**onesteel**

**whyalla**

<table>
<thead>
<tr>
<th>Sites</th>
<th>People</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1100+</td>
<td>$0.95bn+</td>
</tr>
</tbody>
</table>

Reliable supplier of billet in our integrated channel with rail and structurals into our chosen distributor channels

**onesteel**

**rod & bar**

<table>
<thead>
<tr>
<th>Sites</th>
<th>People</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>800+</td>
<td>$1.3bn</td>
</tr>
</tbody>
</table>

Flexible and reliable supplier of rebar, rod & m ebar into our chosen distributor channels

**onesteel**

**wire**

<table>
<thead>
<tr>
<th>Sites</th>
<th>People</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>400+</td>
<td>$300m+</td>
</tr>
</tbody>
</table>

The largest processor & distributor of wire products into rural & construction markets
Steel Key Market Segments

- Residential, non-residential and engineering construction (including mining investment) drives demand for reinforcing bar and wire, rod for mesh, hot rolled structurals, merchant bar and rail
- Mining production drives demand for grinding bar which is feed for grinding media
- Agriculture drives demand for rural wire, rural posts and rural pipe products

Approximately 75% of Steel revenue is driven by construction
# Our Steel Value Proposition

## Customers’ Risks Mitigated
- ‘Customer’ is respected and a Core Value
- Full control of our end-to-end integrated manufacturing processes and transparent supply chain
- Long-term industry involvement with shared benefit and risk of local industry success

## Flexible to Market Dynamics
- Variety of business models enacted through locally empowered leaders
- “Sprint” capacity to match market needs
- Extensive national footprint
- Local and ready to listen

## Understand Markets’ Needs
- Knowledgeable of products, their applications, end-use markets and global trends
- Innovative solutions to solve customer problems
- Manufacture or import supply solutions to deliver meaningful products and services

## Value for Money
- “Straight forward” commercial relationships that make business easy
- Relentless focus on costs

## Predictable
- Do what we say we will
- Reliable
- Product consistency
- Scale through integrated supply chain from raw materials to sales

## Quality
- ‘Safety’ is a Core Value
- Meet standards and certification
- In-house engineering to optimise design
- Core metallurgical expertise

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STEEL & SUSTAINABILITY
Life Cycle Thinking
Design Considerations

Reduce

Reuse

Recycle

Flinders Link, Adelaide
5 Star Green Star

77 King Street, Sydney
Sustainable development utilising existing 19 storey development
ARRIUM’S SUSTAINABILITY JOURNEY
Arrium Sustainability Drivers & Core Values

The diagram illustrates the core values and sustainability drivers of Arrium, represented by a sphere divided into sections. The sections are labeled as follows:

- Economic
- Community
- Environment
- People
- Market

The core values are:

- Safety
- Customers
Arrium Sustainability Key Events

2000
OneSteel publicly listed on the Australian Securities Exchange
OneSteel Environmental Network (ORN) formed
Environmental Policy launched
Safety defined as a core value
Safety Excellence Awards launched
Governance Committee formed & OHS policy developed

2001
Employees 7,379
Email acquisition completed ISO 9001
Certification of Whyalla Environmental Management System
Employee Share Scheme launched

2002
Employees 6,989
Sydney Steel mill certified ISO 14001
BAMTEC® introduced by OneSteel Reinforcing
OneSteel Code of Conduct launched

2003
Whyalla Environment Consultation Group (ECG) & Community Improvement Plan established
OneSteel Responsible Workplace Program established
Last foils switched to Alpine Springs-Djurrubun Energy

2004
Employees 7,054
OneSteel acquired
ModuSteel
Blast Furnace at Whyalla Steelworks SHUT for refining

2005
Employees 7,395
Performance planning & management (PPM) process commenced
Customer defined as a core value
Sustainability Panel & Charter created
OneSteel Partner with USM in development & testing of Polymer Injection Technology in three-year program

2006
Employees 7,527
First Whyalla Environmental & Social Responsibility Report published & Vision developed
Young Steelers graduate program commenced
OneSteel joins Australian CO2 Breakthrough Program

2007
Employees 7,625
Australian Steel Institute (ASI) Sustainability Group formed
Whyalla Environmental Champions Network established
Sustainability focused section included in Annual Report
Member of OneSteel and Smorgon Steel

2008
Employees 11,679
Climate change sub-committee formed (OPRE & GAD)
Sustainability Principles published
Whyalla Water Reuse Program established

2009
Employees 10,004
Establishment of OneSteel Technical Energy Network (OSTEN)
Sustainability Principles published
Design for Deconstruction Guide published
Became a member of AGC & the Green Building Council of Australia

2010
Employees 10,593
Whyalla Red Dust Action Group dissolved having resolved community requirements
Worldsteel Climate Action Programme Membership awarded
100% Iron Ore Cape Vessel loaded in Winmar from new Trans Way facility
Awarded EPA Sustainability Licence
OneSteel 2010 Sustainability Report

2011
Employees 11,568
Life Cycle Inventory (LCI) for Building Product Innovation Council (BPIC) launched
OneSteel Queensland Flood Appeal School Program launched
Carbon Tax & Steel Transformation Plan details announced
Acquisition of the Holy-Cop Group from Anglo American plc

2012
Employees 11,007
Southern Iron Pty Ltd (including Peculiar Knob Operations) purchased
OneSteel changes its name to Arrium
Expansion of Mining and Port to 12 mtpa commenced

Preparation for final introduction of the CPRS (Carbon Price) on 1 July 2012
Whyalla Steelworks Deacidification Plant commissioned
Environment

Energy, Emissions & Biodiversity

✓ Energy Intensity Reduction
✓ Energy Awareness
✓ Energy and GHG Disclosure
✓ GHG Intensity Reduction
✓ Biodiversity
Environment

Polymer Injection Technology
Environment

Recycling, Materials & Waste

Reusable steel reel and recycled wire ropes

Water saving initiatives

Scrap handling improvements
Safety, Community & People
INDUSTRY COLLABORATION
A Sample of our Industry Collaboration

Steel Stewardship Forum
Responsible steel
Sustainability is Good Business

Arrium’s sustainability journey continues to reinforce that good practices in sustainability is good business.
QUESTIONS & THANKS
Plenary Session

Dr Peter Isdale
Reforming our Waste
Counting our Calories
THE WASTE HIERARCHY: 
...AVOIDING THE FINAL CURTAIN THROUGH WASTE TO ENERGY CONVERSION

- The Hierarchy? - a reminder
- What’s the score on WtE?
- Example that works, and one that might
- The (costly) Bottom Line
Integrated Solid Waste Management Principles

1. Reduce the amount of waste we produce;
2. Re-use materials wherever possible;
3. Recycle materials that cannot be re-used;
4. Recover value from materials that cannot be recycled for example through energy recovery;
5. Dispose of materials as a last resort

EU Waste Framework Directive
EU Landfill Directive
Energy Recovery:
- Global 16%
- Australia 1%
  (almost all LFG and AD)

Solid Waste - scorecards

Produce:
- Global: 1.5Bnt
- Australia: 50Mt

Recycle:
- Global: Low to 65%
- Australia: 40%+

Solid Waste:
- Global: 1 Bnt
- Australia: 24Mt

Biogenic:
- Global: 13Mt (5.5,6.5,1)
### MSW total recycling

**Year Range 2006-10**

- **Bulgaria**
- **Turkey**
- **Romania**
- **Croatia**
- **Lithuania**
- **Slovakia**
- **Latvia**
- **Malta**
- **Czech Republic**
- **Greece**
- **Portugal**
- **Cyprus**
- **Estonia**
- **Poland**
- **Hungary**
- **Iceland**
- **Canada 06**
- **UK07**
- **Slovenia**
- **Finland**
- **USA06**
- **Germany (including...**
- **Belgium**
- **Switzerland**
- **Sweden**
- **Luxembourg**
- **Denmark**
- **Norway**
- **Australia 07**
- **United Kingdom**
- **Ireland**
- **Italy**
- **France**
- **Spain**
- **Canada 06**
- **USA06**
- **Finland**
- **Slovenia**
- **UK07**
- **Australia 07**

### Australia:

- About 13-14Mt of organics to landfill each year
- About 70,000 GWh worth???
- ~20% of annual electricity use
Strategy:
Optimising the waste to allow a treatment method as high as possible on the waste treatment hierarchy; preparing for reuse, product and material recycling, energy recovery or safe disposal.

Why Energy Recovery or Waste to Energy is needed for Sustainable Waste Management

It’s important to point out that Energy Recovery is not the total or sole solution for waste management in Australia or the world. However, the statistics above show three inconvenient truths about our behaviour and waste management. They are:

- We are an increasingly wasteful society. Reducing waste volume is the most effective and sustainable action but we are not doing this.
- Recycling is vital but not everything can be recycled. There will always be residual waste items that need to be managed after recycling has been optimised.
- Landfilling is still increasing despite our best efforts.

These three facts prove there is a need for clean energy recovery processes from waste.

Source: New Energy Corp, 2013, WA
View from the WE world....

**ENERGY RECOVERY**

Chemistry is creating energy solutions for a strong, secure and sustainable future.

**POLICY PRIORITIES**

**ENERGY RECOVERY IS GOOD FOR COMMUNITIES**

Definitions of renewable energy should be broadened to include non-recycled and other recurring wastes.

Regulations and permitting processes should not discourage the establishment of new energy recovery capacity.

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**Chemistry is unlocking the energy in discarded materials:**

- **Recycling**
- **Energy Recovery**

- Plastic energy recovery - enough fuel to power 6 million cars
- Plastic energy recovery - to adequately supply 5.2 million homes

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**American Chemistry Council**
Discarded MSW is a viable energy source for electricity generation in a carbon constrained world. One notable difference between LFGTE and WTE is that the latter is capable of producing an order of magnitude more electricity from the same mass of waste.

**TABLE 3. Comparison of Total Power Generated**

<table>
<thead>
<tr>
<th>Total Electricity Generated from 166 Million Tons of MSW, TW h</th>
<th>Total Power GW</th>
<th>Electricity Generated from 1 Ton of MSW, (kW h)/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste-to-energy</td>
<td>78-160</td>
<td>470-930</td>
</tr>
<tr>
<td>Landfill-gas-to-energy</td>
<td>7-14</td>
<td>41-84</td>
</tr>
</tbody>
</table>

1 TW h/8000 h = TW; a capacity factor of approximately 0.91 was utilized.
View from the WtE world....

**Identified Barriers**

**Public acceptance** - Not in My Backyard (NIMBY)

**Costs are significant and uncertain**

**Limited operating experience**

**Legislative/regulatory uncertainty**

**Renewable fuel requirements**

**Level of pre-processing necessary**

**Conversion does not always mean recovery** - Processing of non-recycled plastics in gasification facilities may not be recognized as a contribution to mandated recovery and recycling rates. Gasification is considered conversion technology in some US states and recognized in the same category as WTE, so it is not always eligible for diversion credits.
Sceptics??

..mostly based on perceptions/experience of emissions
It costs...

Capex $50M to build again
Capacity 230 tpd.
40-50 day cycle
Mesophilic system (designed to use microbes that operate best at temperatures between 25 and 40 degrees centigrade.)

Outputs:
- pelletised digestate (organic fertiliser)
- 3MW
And it costs…

Capex $50M (new)
Capacity 150 tpd.
21 day cycle
Thermophilic system (fast 50/60 degrees)

Outputs:
- Compost (soil additive)
- 0.7MW

$50-100M
A typical high-efficiency gasification plant handling 250,000 tonnes of solid waste per year may cost more than $400M to commission.

Such investments have often proven to be beyond the reach of most global waste groups, and are mostly run as public-private partnerships or joint-ventures.

The technologies are well proven, and refinements in materials handling and better engineering have brought costs down.
But it’s all in the IRR…

Feedstock Certainty!!! ???

Landscape:
.. lots of promoters
  • 10 promising out of 470 WtEs logged
  • Laws of physics? Laws of commerce!

Logistics
Permits
People
Plant and Equipment
Performance
Perspiration
THERMAL CONVERSION... state of play

EU/US

• big units in place, population density in favour, capital ready, legislated mandates, subsidies, landfill expensive, combined cycle needs (urban heat)
• supply chain waste feedstock- long term agreements
• Result: old mass burn, new gasifiers, future could be plasma.

AUS

• no big units in place, population density not conducive, capital scarce, legislated controls, small subsidies (ARENA?), Metro landfills expensive and depleting, little need for urban heating
• long term feedstock agreements difficult
• Increasing compost, (disposal solution and low margins)
• Beginning AD... EP, AnaerCo, biogas (Utilitas)
• RDF coming forward (Coolaroo- internal use, CC), WA new big three
• Current: small biogas, some RDF, new gasifiers in planning.
#1: It might just work….

Reforming: Energy from Ag-Plastics
ENERGY VALUE OF PLASTICS VS. OTHER FUELS & WASTES

<table>
<thead>
<tr>
<th>Material</th>
<th>Btu/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Oil</td>
<td>~20,000</td>
</tr>
<tr>
<td>Polyethylene (LDPE &amp; HDPE)</td>
<td>19,900</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>19,850</td>
</tr>
<tr>
<td>Rubber</td>
<td>10,900</td>
</tr>
<tr>
<td>Coal (varies with type)</td>
<td>5K-12K</td>
</tr>
<tr>
<td>Wood &amp; Other Dry Vegetation</td>
<td>6,750</td>
</tr>
<tr>
<td>Average Municipal Solid Waste</td>
<td>4,500</td>
</tr>
</tbody>
</table>
Ag-Plastics: current disposal (US)
~ half of used ag plastics are burned on-farm
  • open burning emits high levels of pollutants: particulates, heavy metals, as well as dioxins that enter the food chain

~ most of the rest is dumped on-farm, leaving debris which:
  • is a choking hazard for livestock and wildlife
  • creates mosquito breeding habitat
  • clogs water channels
  • is not pretty, reducing aesthetics

one Federal study found that a few dozen bum barrels could produce the same amount of dioxins and related compounds as a 200-ton-a-day modern incinerator serving thousands of households (NYT Mar 7'05).”
Agricultural plastics: the tyranny of logistics

Logistics: Densification

Logistics: Cleaning

Logistics: Aggregation

Logistics: Education

Logistics: Transport

A full truckload containing 20 tonnes of cargo is the target “unit of exchange” referenced by most reprocessing markets. Seventeen tonnes is a sweet spot.

To maximize transportation efficiency—*i.e.*, in order to be able to fit at least 20 tonnes of plastic on a dry trailer—the minimum target bale density is 200kg/m³ with typically no more than 100kg/m² pressure. Balers differ in ability!

Bale weight is typically 500kg, which extrapolates to about 40 bales per full truckload.
#2: It does work…

Reforming hydrocarbons: Re-Refining Lube Oil
“oil doesn’t wear out; it just gets dirty”.

While the American Petroleum Institute statement is an oversimplification of the facts - it is in essence true that between 60% and 75% of used oil remains intact and can be converted back into base oil.
**ULO: Re-Refining Cycle**

Output includes:
- "Residual"
  - about 30ML/year
  - viscous sludge

600ML per year new lube oil,
350ML collected
60ML re-refined.
Re-refined oils take step in the right direction, but are limited

Re-refined:
- improvements from an environmental perspective (although not bio-based or renewable)

but
- limited in ability to deliver the improved performance required by new regulations

**New technology and higher performance is needed to meet long-term lubricant performance and sustainability needs**
Bio-based Oils

- Rapid advances in technology
- Low volumes - can they fill the gap?
- Feedstock competition issues
- Market acceptance
- “green”, re-renewable

Geo-oil

- Re-refinable
- Well supported by Product Stewardship
- Established logistics, technology
- High volumes, quality exports
- 40% lost to system each year

Good process, good product, good business
Conclusions...

- ISWM is the accepted global ideal. The Hierarchy rules!
- Harmonisation of objectives is paramount: industry, government, social and environmental
- Waste to Energy is commercially, socially, environmentally valid

And on a particular note:
- A great deal of recoverable energy slips over the Australian tip-face ($1.5Bn in “MWe-worth”/year?)
- Good technologies and affordable logistics can haul some back
- Big, efficient WtE solutions need partnerships

THANK YOU