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BRINGING CSIRO RESEARCH TO THE MINERALS INDUSTRY

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## What goes around comes around - towards a circular economy

**A bold call to action has been released for a future 'circular economy' in Australia that harvests resources and wealth from waste, stems the tide of unsustainable disposal and offers national annual cost savings in the order of \$26 billion. TIM THWAITES reports**

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Global trends indicate we are wasting away with solid (nonfood) waste production predicted to double in the next decade.

In Australia, the Australian Bureau of Statistics reports that the amount of waste generated grew 145 per cent between 1997 and 2012, even though, the population grew by only 22 per cent, and the economy by 64 per cent.

These are trends, which cannot continue in the long term, says Associate Professor Damien Giurco of

the Institute for Sustainable Futures at the University of Technology, Sydney.

The consequences include increasing pollution, rising metal prices and dwindling resources.

"For instance, the amount of gold we have already processed 'above ground' is estimated to be greater than our reserves," says Professor Giurco.

The answer, he argues, lies in the concept of a circular economy in which waste generated becomes a resource for future production.

A circular economy contrasts with the typical linear consumption process of digging up minerals, extracting and processing the metals, manufacturing goods and disposing of them to landfill at the end of their useful life.



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At the recent World Resources Forum Asia Pacific conference in Sydney, the Institute for Sustainable Futures, on behalf of Australia's Wealth from Waste Cluster, released a vision for what could be done to pave the way towards a circular economy for Australia.

The Action Agenda for Resource Productivity and Innovation: Opportunities for Australia in the Circular Economy brings focus to the importance of resource productivity, innovation and collaboration to 'drive a new wave of responsible prosperity for Australia in the Asian Century.'

Among other opportunities the paper urges:

- the design of products and industries to make use of renewable solar energy for processing and to enable the materials embedded in them to be reused;
- the use of disruptive smart technologies, such as 3D printing to make efficient use of resources and smart sensing to track the flows of metals through the economy; and
- leveraging Australia's capacity for automation and management, so prevalent in the mining industry, to enable recycling and reuse of materials worldwide.

The World Economic Forum estimates the cost savings of a circular economy could be US\$1 trillion a year by 2025, of which Australia's share would be about A\$26 billion.

China has already written the idea of a circular economy into its next five-year plan and the European Union is working on adopting it.

While considering waste as a resource can be a win-win situation, there are many challenges – scientific, technological and organisational – to be overcome to realise its adoption.

Exploring the non-technical barriers is the Waste from Wealth Cluster; a three year collaborative program between CSIRO, University of Technology Sydney, the University of Queensland, Swinburne University of Technology, Monash University and Yale University in the US.

The project began in 2013, enabled through support from the CSIRO's Flagship Collaboration Fund and participating universities. Professor Damien Giurco is its director.

A particular Australian challenge arises through the small scale (in world terms) of some of our industries that can make recycling uneconomic.

Waste aluminium, for instance, that used to be resmelted locally, is now sent overseas. Even the Australian steel industry, which has an efficient recycling arm, only recycles some forms of scrap while sending others, including tin cans, abroad.

Part of the problem, according to cluster researcher Dr Glen Corder from the University of Queensland's Sustainable Minerals Institute, is a lack of data.

While the mining industry and Government organisations such as Geosciences Australia have accumulated a lot of information on where our minerals are below ground, there is little data on where they end up.

To help rectify this, Cluster researchers at Monash University are working on a database - a geographic information system - to show potential sources of scrap metals above ground.

Another difficulty for industries that wish to use waste as a resource, says Corder, is the lack of readily recognised measurements and procedures by which investors can judge the viability of establishing businesses that utilise waste.

“A mining company can identify an ore body, and define it to the market using standard, rigorous procedures for measuring its size and grade. There are no similar measures for users of waste.”

The technologies for treating waste are also many and varied, and at widely differing stages of development, all of which affects what is economic to handle.

As opposed to scrap steel, where the mechanisms for collection and reuse are relatively mature in Australia, the ability to recycle electronic waste is in its infancy. Yet it is a potential source of up to 60 different elements.

Corder and his colleague, Artem Golev, have recently published a typology of options for metal recycling containing information on the feasible pathways to close the loop for the various waste extraction industries.

Despite the challenges still ahead, there is already movement in some industries in Australia.



Professor Veema Sahajwalla has found a new use for old tyres.

One Steel, for instance, is mixing material from waste tyres with coke as sources of carbon for its electric arc furnaces, an approach based on R&D conducted by Laureate Professor Veena Sahajwalla and her team at the Centre for Sustainable Material Research and Technology (SMaRT) at the University of

New South Wales.

The waste material actually allows the furnaces to operate more efficiently and facilitates steel production. It makes economic sense.

As highlighted in the Action Agenda paper, extracting wealth from waste on a large scale involves far more than simple recycling.

Above all, the Agenda advocates a rethinking of attitudes to waste at all levels and this includes:

- smart design and manufacturing techniques;
- cooperation between different companies along the production chain to make use of the various by-products and wastes;
- employing flexible new technology to make recycling and reforming resources economic at smaller scales; and
- careful regulation to encourage the whole process.

So, when it comes to waste there really could be a silver lining.

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