

LIFE CYCLE ASSESSMENT

Water shows

By **REBECCA THYER**

WITH the least reliable rainfall of any inhabited continent, Australia's water supply has always faced, and will continue to confront, immense demand from different users. Now, new research is helping the minerals industry better inform future debate about its water-use credentials.

Through life cycle assessment (LCA) methodology, CSIRO Minerals found that the economic value per cubic metre of water consumed by the minerals industry exceeds that of the agricultural and industrial sectors, supporting the view that allocating water to the minerals industry has a strong underlying economic basis.

At an average value of \$80 per cubic metre, the economic value of

water used by the minerals industry is higher than that of the industrial sector (about \$40/m³) and the agricultural industry (\$5/m³) (see figures 1 & 2).

The economic comparisons were calculated using LCA, a method of analysing the environmental impacts of a process or product from 'the cradle to the grave' to optimise environmental performance.

By using LCA methodology, CSIRO Minerals researcher Terry Norgate was able to assess variations in water use associated with different metal production and processing routes and also provide insights into the value derived from water consumption. "This is how we were able to compare various industries and the value gained from water consumption," he says.

The LCA work found that water consumption for producing various metals ranged from three cubic metres of water per tonne of steel up to about 250,000m³/tonne for gold, with results largely reflecting the grade of the initial ore.

Mr Norgate explains that the minerals sector uses relatively little water during mining, with the majority used in processing and refining. "Operations such as grinding, flotation, gravity concentration, dense medium separation and hydrometallurgical processes all consume substantial amounts of water. Indirect consumption – in particular that due to electricity generation – can also make a significant contribution to the embodied water value," he says.

Although CSIRO Minerals has

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PHOTO: EVAN COLLIS

its worth

Undertaking an LCA

One of the first steps in undertaking a life cycle assessment (LCA) is to compile an inventory of the material and energy inputs at each stage in a process or product.

For example, how much water does the smelting stage for copper use?

Mr Norgate says compiling an inventory is probably the most time-consuming stage of an LCA, especially when it includes water consumption.

“Water consumption is one of the least-reported operating parameters of a plant or process, so getting this information can be tricky. But as more companies report their water use in environmental or sustainability reports, the situation has improved.”

Once the inventory is done, the process is fairly straightforward, he says.

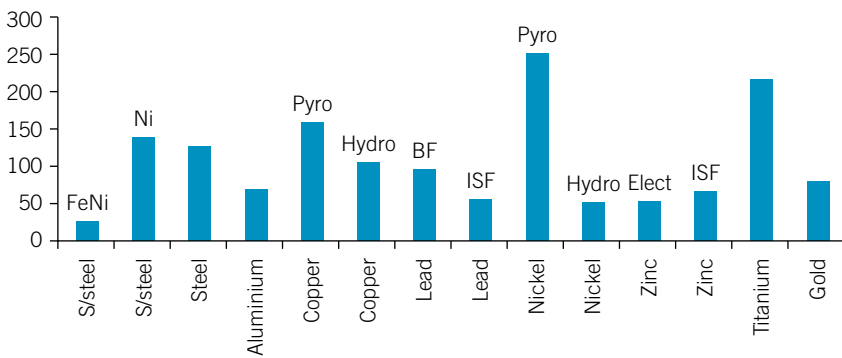
In the water LCA, typical water-consumption rates for processes were collated and added over the process life cycle. This information was then used to calculate the amount of water consumed per tonne of refined metal.

For example, to make one tonne of refined copper pyrometallurgically, 13.6m³ of water are needed in the mining and concentrating stage, 7.8m³ in the smelting stage and 0.6m³ in the refining stage.

Mr Norgate says understanding water use at each stage can help the industry reduce water consumption.

Figure 1 Metal's economic value per cubic metre of water consumed

Metal A\$ value / m³ water consumed

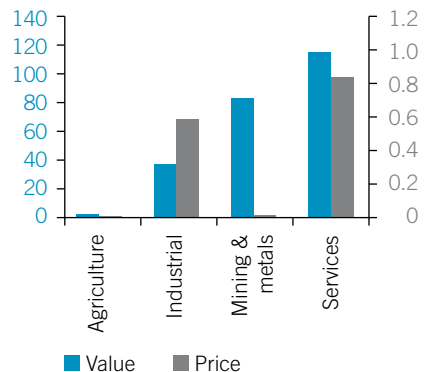


Source: CSIRO

Figure 2 Comparison of water value and price for various sectors

A\$ value/m³ water consumed

Water price (A\$/m³ or kl)



Value Price

Source: CSIRO

Water shows its worth

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used LCA to assess energy consumption and greenhouse gas emissions, this is the first study to assess water use and associated economic values.

“With increasing competition for water, the minerals industry, along with others, can be expected to come under increasing pressure to reduce fresh or raw water use and integrate water use from across sectors,” he says.

Mr Norgate says the LCA work shows it is worthwhile to allocate water to the minerals industry. “By showing the value in water consumption, we can discuss the demands all industries have for water and the ability to meet these needs.”

He says water reforms taking place in Australia aim to address issues such as competition for access, security of supply and increases in cost. LCA work will help the minerals industry contribute to this debate.

“LCAs can drive the environmental debate by replacing emotion with objectivity and information, allowing groups with different objectives to find common ground in approaching a problem like increasing demand for water,” Mr Norgate says.

The University of Queensland’s Professor Chris Moran, founding director of the Centre for Water in the Minerals Industry, agrees, saying LCA is important in helping the industry better understand its environmental footprint.

“Because LCA considers direct and indirect implications, you gain a much broader understanding of issues such as water use and greenhouse gas emissions.”

However, he believes there are challenges in terms of overall sustainability: “Just because a producer reduces their energy consumption in a bid to take better account of the upstream water used in energy generation, for example, does not mean that energy is being saved overall.

“Only if this results in less energy being generated is the water actually saved. Most institutions would not consider that their responsibility goes beyond their operation but one thing LCA teaches us is that this is not true.”

The second issue is to understand which audiences can use the LCA information in a constructive way, he says. “The same information is not



Counting energy costs

CSIRO Minerals’ work on life cycle assessment has helped engineering company Intec Ltd compare its copper process to other processes – flash smelting, four pressure oxidation hydrometallurgical processes and two biohydrometallurgical processes.

The comparison showed that the Intec process used less total energy than the other processes and registered lowest for greenhouse gas emissions and acid rain potential.

Mr Norgate says the research helped Intec benchmark its process against others and demonstrate the environmental benefits.

useful to all readers. For example, the owner of two steel mills may be very interested in the differences between these operations so that they can take action to improve. However, comparing alumina smelting and coal mining, for example, carries little operational content for taking action to save water.”

The minerals industry uses about 80 per cent groundwater, 15 per cent surface water and five per cent mains infrastructure water, with the majority sourced from purpose-built dams, rivers, lakes and groundwater sources.

It is used because of its processing benefits: water is an efficient, low-energy and low-cost way of transporting and mixing particles and supplying reagents. It is also a suitable medium for distributed force fields, such as centrifugal force, and is an essential chemical ingredient of some processes.

However, the minerals industry is already researching alternative processes and water sources to deal with any changes to water allocations.

Mr Norgate says this is where LCA work is also crucial. “Without knowing how much water is used at each step of a process, the industry has no way of understanding and minimising that use.”

He says using ‘fit for purpose’ and recycled water and dry processing are areas being researched by the industry and CSIRO.

“Water recycling is an obvious candidate to help reduce water consumption, but issues such as organic and inorganic matter build-up, microbial species and flotation collectors will influence the extent

to which this will be achieved.”

Mr Norgate says that although many operations already use water that is unfit for agricultural use, a flexible ‘fit for purpose’ water strategy that accounts for local conditions and synergies needs to be more broadly adopted by mining, mineral processing and metal production operations.

Water minimisation – through the use of analytical techniques to establish minimum water requirements – and dry processing techniques will also be important.

“Although dry processing, where little or no water is used, may be a more radical solution, it is possible that this could bring other problems such as dust.”

Mr Norgate says that any assessment of alternative metal production processes must take into consideration other impacts – such as greenhouse gases, community capacity and economics – and not just water consumption.

“Only by looking at the whole picture can any decisions about energy use or water consumption be made and this is where LCA can make a significant contribution,” he says.

LCA approaches to environmental impacts are gaining momentum nationally and internationally, with Mr Norgate presenting his water findings at the Green Processing Conference in June 2006 and the Water in Mining Conference in Brisbane in November 2006. “Our approach has generated significant interest,” he says.

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