Treasure Troves Or Fool's Gold?

ISWA National Committee member, Ian Williams, discusses whether urban mining is a fashionable fad or here to stay...

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New concepts often challenge the status quo. Human beings are typically cautious and conservative when faced with potential change to established situations or ideas, especially when a new proposal represents a step-change. We are frequently advised that caution is a good thing:

- "Fools rush in where angels fear to tread" – Alexander Pope.
- "The second mouse gets the cheese!" – Terry Pratchett.

However, we should also remember that:

- Henry Ford was advised that the automobile "is a fad".
- The Wright brothers were told, "It is impossible for men in the future to fly like birds".
- Leicester City Football Club was a prime candidate for relegation from the English Premier League at the beginning of the 2015/16 season.

Making decisions about new concepts isn't easy, especially when the scale is large and the stakes are high.

The circular economy and urban mining are two relatively new "big" concepts that have been attracting a lot of recent attention. It is becoming fashionable for politicians, industrialists and businesses to talk about "closing the loop", ensuring "resource security" and "resource efficiency", and "joining the circular economy." Academics like me have suggested that this is a pivotal moment, the beginning-of-the-end for the current "take-make-dispose" model for waste management. The waste industry is less certain; the CIWM's 2014 report on the circular economy found "mixed views... ranging from cynicism that it is purely fashioned by marketing and policy makers with little new substance, through to genuine excitement that it is the future for the waste and resources industry."

So what are the circular economy and urban mining, why have they suddenly come to the fore, and what is their potential?

Definitions

A CIRCULAR economy is one in which products are made, used, and finally disposed. In a circular economy, resources are kept in use for as long as possible in order to extract the maximum value from them whilst in use, before recovery and regeneration of products and materials at the end of a resource's life. Material flows through the economy may be pictured as two types: biological nutrients, designed to re-enter the biosphere safely; and technical nutrients, designed to circulate at high quality without entering the biosphere. The circular economy is a significant departure from the previous focus on managing wastes safely and cheaply and its purpose is to:

- keep resources in economic use for as long as possible
- drive greater resource productivity
- address emerging resource security/scarcity issues
- reduce the environmental impacts of production and consumption.

As shown in Figure 1, over the page, urban mining is a subset of the circular economy concept. It may be defined as the process of reclaiming compounds and elements from any kind of anthropogenic stocks, including buildings, infrastructure, industries, products (in and out of use), environmental media receiving anthropogenic emissions, etc. An urban mine may take many forms, for example, an urban area such as a city can easily be visualised as a "mine" from which raw materials can be retrieved.

To fully understand urban mining, it is also important to distinguish between stock and flow resources. Stocks of materials – held in geological deposits, groundwater reservoirs, industrial and household buildings, infrastructure and scrap products – may not vary much when considered on an annual basis. However, flows of materials may change considerably from year to year, depending upon fashion, the contemporary economic situation, technical innovations, etc.

Distinct Urban Mines

THE TERM urban mining has sometimes been misunderstood and has frequently been used merely to describe the concept of recovering precious and scarce metals from e-waste. Urban mining is exceptionally relevant to electronic waste (e-waste) as currently large quantities of this mineral-rich waste are either landfilled, stockpiled or inefficiently treated within the urban space leading to, in some cases, 100 percent loss of valuable materials (eg, rare earth metals). However, there is no doubt that urban mining goes beyond the recovery of metals from electronics and can be applied to various fractions of municipal and industrial wastes.

Urban mining activities involve management of anthropogenic resource stocks and waste in order to conserve resources, protect the environment and derive economic benefits. Current approaches to urban mining involve categorisation of resources/waste into various groups, for instance, food, packaging, end-of-life vehicles, e-waste, etc, especially in Europe and other high-income countries. These approaches consider urban mines as a uniform space consisting of different categories of waste. Whilst this has worked well from an environmental protection perspective, ➥

it has not worked very well from the perspective of maximising resource recovery. A lot of valuable materials are still ending up in landfill. Maximising resource recovery from urban mines will require a paradigm shift.

Researchers from the University of Southampton have argued that urban mines should not be considered as uniform spaces. Similar to traditional mines, some urban mines could be considered as unique, or distinct. For instance, one mine may be rich in one type of material or product (eg, zinc, large e-waste, etc) and another may be rich in another (eg, plastics). There is a need to recognise these distinct characteristics and so we have introduced the concept of Distinct Urban Mines (DUM): a delimited space within the anthroposphere that has a high concentration of particular products or materials. This could be due, in part, to the social characteristics of that urban space. For instance, the community in the urban space could consist of a distinct social group with atypical consumption and disposal behaviour. By this definition, examples of DUMs include hospitals, shopping malls, food markets, building demolition sites, universities and even towns/cities. Methods of extracting of key materials from DUMs will vary from mine to mine in order to maximise cost-effectiveness and efficiency.

Why Now?

TWO HUNDRED years ago London had an organised system for collecting and disposing residual waste and

Potential for mining mobile phones.

- In 2014, the number of mobile phones (7.3bn) exceeded the world's population.
- Thirteen million global jobs were directly related to the "mobile ecosystem" in 2014.
- The number of global smartphone users will surpass 2bn in 2016.
- A typical mobile phone contains >40 chemical elements, including 300mg of silver, 30mg of gold, rare earth metals, and potentially hazardous elements such as mercury and lead.
- At present, only 27 of these elements are economically recoverable.
- Gold concentration in a phone is 50 times as great as it is in ore in a mine.
- The gold and silver used to manufacture mobile phones sold in 2016 are worth more than $2.5bn.
- Only three percent of the 1.8bn phones expected to be purchased globally in 2016 will be recycled.
- Americans have more than 200m old phones "hibernating" in their homes.
- Smelting coupled with electrolysis is the dominant recycling approach in the West.
- Processes based on strong acids are used in many developing countries.
- Electronics in landfills contain more rare-earth metals than are in all known global reserves.
- Less than one percent of rare-earth metals are currently recycled.

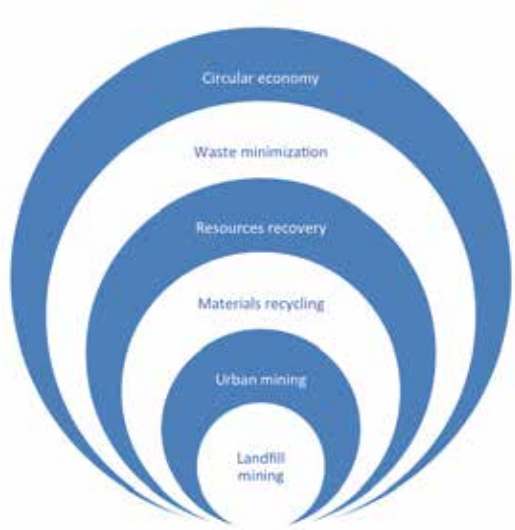

Figure 1: urban mining is a circular economy concept

an informal system for collecting and selling recyclables. The residual waste, predominantly coal ash from domestic fires, was collected by private contractors who established so-called "dust yards" where materials were separated for sale as feedstock for brick-making and soil conditioner for growing crops. As well as helping to cleanse the city, these yards generated lots of income, provided lots of employment and were forerunners of modern mechanical-biological treatment plants and materials recycling facilities. They provide an early example of a DUM and of the circular economy in action.

A key factor that is driving the current desire to exploit urban mines is fear of scarcity of resources. Securing supplies of critical raw materials (CRMs) is at the forefront of issues affecting industry. Elements such as aluminium, copper, gallium, indium and tantalum are essential for the manufacture of green and emerging technologies (electric cars, wind turbines, energy-efficient lighting, etc). The political imperative for change is highlighted by the European Commission's adoption of an ambitious Circular Economy Package in December 2015. The plans include revised legislative proposals on waste to stimulate Europe's transition towards a circular economy with the aims of fostering sustainable economic growth, boosting global competitiveness and generating new jobs. Plus ça change, plus c'est la même chose.

Treasure Troves?

YOU BET they are – in 2012, the total waste generated in the EU-28 by all economic activities and households amounted to 2,514m tonnes! Almost 50 percent of this total was landfilled and only 36 percent was recycled. As only four percent was classified as hazardous waste, there is a huge mountain of raw material (waste) ready to be mined for valuable materials. Given that some EU countries have recycling rates of approximately 70 percent for relatively "low hanging fruit", the potential for rapid improvement is clearly vast, especially for expensive materials that have traditionally been technically difficult to collect and process eg, platinum group and rare earth metals.

Let's consider just one small but well-known example – the ubiquitous mobile phone. The constant introduction of new and improved technology into these devices, coupled with increasing functionality such as cameras, film and music players, means that mobile phones have relatively short lifecycles. They are typically seen as obsolete by many users within little over a year despite large numbers of such phones still being perfectly functional. The reusability of mobile phones as well as their material composition implies that they represent perhaps what is in terms of mass and volume, one of the most valuable electronic products that are currently found in large numbers in waste streams (see box copy opposite) – a potentially significant DUM.

If we really aspire to create a sustainable world, takeback of mobile phones in order to recover the embedded resources is vital; according to the EPA, Americans actually throw away $60m in gold and silver annually by disposing their mobile phones! The technology and processes necessary to extract metals from mobile phones are under development by companies such as Umicore in Belgium.

The Status Quo Sucks

WHEN IT comes to our one-way linear resource use and disposal culture, I'm willing to bet that many people now agree with the stand-up comedian and social critic George Carlin: "The status quo sucks." The vast quantities of waste we generate are clearly a potential treasure trove to be exploited. We know that a global or even regional circular economy will not happen overnight. The exploitation of urban mines in Europe can only be achieved over a 10-30 year timescale, with a huge co-ordinated and concerted effort focused on waste prevention, minimisation and reuse. It is likely that multiple strategies and complex technical interventions will be required to realise the dream of shifting to a "closed-loop" circular system modelled on nature's successful strategies. This won't be cheap or easy to achieve.

Like most people, I'm naturally cautious – I wasn't one of the 47 people who backed Leicester City to win the Premier League at the start of the season with odds at 5,000/1. But I am willing to bet that urban mining is not a fad, a mad chase for "gold" that results merely in the acquisition of iron pyrites. Urban mining was efficient, effective and generated employment in nineteenth century London and it will do the same globally in the twenty-first century. You can quote me on that. ■

The Author

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