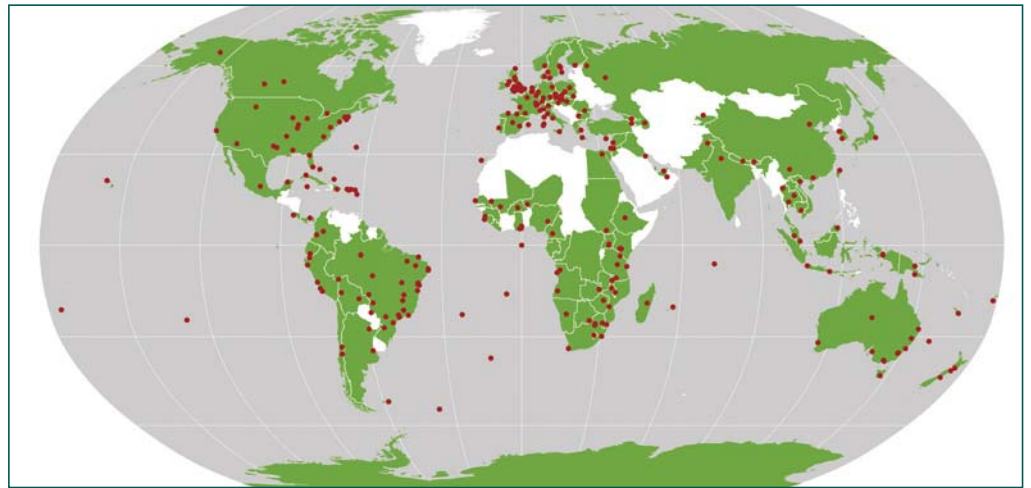


different audiences and also allow self-guided themed walks. Emerging technologies are providing the opportunity to transform the way science is communicated to the public, both on-site and through digital channels, and full use will be made of these to encourage our audience to seek out information on plants and fungi and the science behind the scenes. Our vision is for the development of a 'Virtual Kew' allowing people to 'e-walk' round the Gardens at different times of year, with plants linked to an online portal giving instant access to names and interesting information. In addition a plant science festival for children will be a new addition to the 2016 visitor programme. The festival will play a role in reinvigorating the way in which plants feature



Kew's scientific work spans 110 countries (shaded green) and involves over 400 collaborating institutions worldwide (red dots).

on the science education curriculum.

We will make Kew's scientific resources a global asset, bringing benefits to science, conservation policy and education. Understanding and

conserving plant and fungal diversity has never been more relevant for society at large. I am excited by the opportunities for Kew's scientists to continue world-class research and make an important and unique

contribution to addressing major challenges of our time.

To download the strategy and find out more, visit: www.kew.org/science-strategy

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DEVELOPING A CIRCULAR ECONOMY – the critical role of the waste and resources industry



Jacob Hayler
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The unprecedented pace and scale of Chinese development in the past decade has transformed the world order and placed unforeseen pressures on global resources. The expansion of the Chinese middle class has been perhaps the most spectacular story in the history of economic development and drove a worldwide commodity boom which reversed a long term trend of falling prices.

This focused the minds of the world's leaders on a new era of competition for resources. Despite recent falls in commodity prices (and oil in particular), increases in demand for goods and services are expected to occur as more of the developing world reaches income levels previously only enjoyed by Western consumers. The scale of this likely increase

in demand has driven calls for a new approach to economic systems which could provide the ultimate win-win scenario.

A circular economy, where we recover the materials and energy from our discarded materials and use them as inputs into production, provides a potential solution to future development. Economic drivers can be aligned

with reducing environmental pressures, thereby solving the critical problem of our age: how to raise living standards for all without despoiling the environment.

The recent highs in commodity prices drove change at all levels of the "waste hierarchy" (reduce waste, re-use, recycle, recover energy, with landfill used only as

a last resort). High input prices incentivised manufacturers to reduce material use at the front end and waste at the back end of their processes. The long term need to secure resources at reasonable prices encouraged the increasing use of recycled materials as a substitute for primary commodities. The recognition that we should make the best use of all of our waste is driving a shift away from disposal to energy recovery for that material which cannot be recycled.

The upside to the circular economy is huge. The Ellen MacArthur Foundation has estimated that implementing circular opportunities world wide could yield over \$1 trillion per annum in savings. In the UK, the Environmental Services Association has estimated that this could boost GDP by £3 billion while generating 50,000 new jobs. Such figures highlight some of the gains on offer. What does it mean in practice for waste and resource managers?

Circular processes can exist at different scales along the supply chain. Closing the material loop can happen within companies, within sectors and between sectors. Examples of the first exist where companies – usually operating where there is high value in their products, such as aerospace – change business models to retain ownership of their products and instead make service-based offerings to their customers.

There is an increasing trend for mobile telephones and other electronic devices to be recovered from consumers. In Europe this is helped by the implementation of the WEEE (waste electrical and electronic equipment) Directive but we can expect the underlying economics – high material costs and the presence of difficult to

obtain materials – to influence the closing of the resource loop.

The third scale – closing the loop between different sectors – is where the waste and resources industry comes in. It acts as facilitator, transforming a mix of different waste streams from households and businesses into a variety of products.

Taking advantage of all these opportunities will not be easy. Existing linear production processes are deeply ingrained into our economic system and enjoy significant incumbency advantages. Overcoming the costs which have already been sunk into existing infrastructure will require ambition, vision, and support from our political leaders. Only through the application of a clear and consistent long term policy framework will we be able to accelerate the transition to a circular economy and realise the large benefits on offer.

Beneath that broad policy support, there is another, more immediate, challenge which will have to be addressed if we are to be early adopters of the circular economy, thereby gaining a competitive advantage, and maximising the benefits: managing risk.

Circular economy projects which operate along supply chains (rather than within companies) possess multiple overlapping risks. There are input risks relating to the volume and composition of feedstocks (ie different waste types) that a project might be able to attract. There are process risks relating to the construction and operation of technologies which might be new to the market and which are therefore unable to provide examples of previous operations at scale or under local conditions. And there are output risks relating to the price of outputs (materials and

energy) and the availability of end destinations.

Historically, energy from waste projects has been able to gain long term contracts with local authorities, and hence to secure bank lending for large-scale facilities. The waste PFI programme has now closed and any new projects are faced with a mismatch problem between short term (two to three year) feedstock contracts with multiple smaller businesses, and trying to secure multi-million pound long term loans.

An additional problem for energy from waste projects in the UK is the continued outdated perception that “dirty incinerators” pose a health risk to local residents. But, according to the Environment Agency, it would take an average sized plant around 120 years to produce the same amount of dioxins as those produced by London’s New Year’s Eve fireworks display. These plants are operated safely and without opposition all over the world.

A mismatch problem has also arisen for recycling collection contracts where there has been a huge increase in the contribution of recyclate sales to overall contract values. These revenues are highly volatile which contrasts with local authorities’ (and other waste producers’) desire for stable collection charges. Recent falls in commodity prices have put some contractors, as well as recycling companies further along the supply chain, under pressure.

How can we get from where we are now to where we need to be? The European Commission’s 2014 Communication “towards a circular economy” and accompanying legislative proposals set out an ambitious programme of new targets and regulations. These were intended

to bring forward investment in new waste and resources services and infrastructure.

The proposals aimed at diverting material away from landfill and towards much higher recycling levels. They could have been criticised for not focusing sufficiently on incentivising increased European demand for recycled materials. The Commission withdrew the circular economy package at the end of last year but has promised to bring back more ambitious proposals which address this shortfall before the end of 2015. We hope this proves to be the case.

European waste management policy has been pretty successful at pushing up the supply of recycled materials. The lack of complementary policies aimed at developing markets for these resources has however meant that a significant proportion of recovered material currently goes overseas. There is now a significant opportunity for policy makers to integrate circular economy thinking into the design of industrial strategies that will deliver the resource efficient manufacturing sectors of the future. These could take secondary resources as their inputs and shift their dependence away from primary commodities with high and volatile prices. In this way stability would be improved for both the suppliers and users of recycled materials, strengthening the markets of the future.

The UK’s waste and resources sector has already moved a long way in a short period of time from being a logistics-based industry a decade ago to the heart of a new circular economy. Mitigating risks and improving incentives for new approaches could place the UK in a strong position to benefit from moves towards an increasingly circular world.