CIRCULAR ECONOMY: TRENDS AND EMERGING IDEAS

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ISWA
International Solid Waste Association

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The International Solid Waste Association (ISWA) is a global, independent and non-profit making association, working in the public interest to promote and develop sustainable waste management.

ISWA has members in more than 60 countries and is the only worldwide association promoting sustainable, comprehensive and professional waste management

ISWA's objective is the worldwide exchange of information and experience on all aspects of waste management. The association promotes the adoption of acceptable systems of professional waste management through technological development and improvement of practices for the protection of human life, health and the environment as well as the conservation of materials and energy resources.

ISWA's vision is an Earth where no waste exists. Waste should be reused and reduced to a minimum, then collected, recycled and treated properly. Residual matter should be disposed of in a safely engineered way, ensuring a clean and healthy environment. All people on Earth should have the right to enjoy an environment with clean air, earth, seas and soils. To be able to achieve this, we need to work together.

Executive summary

The G7 Leaders' at their latest summit, 7-8th June 2015 established a G7 Alliance on Resource Efficiency.[1] It has been set up to tackle the urgent global challenge of a rising population driving demands for raw materials. They recognised this demand "translates into increasing business risks through higher material costs, as well as supply uncertainties and disruptions". The declaration further highlighted the need for ambitious action to build on "existing national and regional initiatives, including the Kobe 3R Action Plan (Reduce, Reuse, Recycle". Finally they set out a commitment to review progress ahead of the next G7 meeting and to invite the United Nations Environmental Programme (UNEP) "to prepare a synthesis report highlighting the most promising potentials and solutions for resource efficiency in industrialized countries as well as in emerging economies and developing countries".[2]

Leading OECD countries are now in the process of re-discovering recycling and efficient resource use.[3] Driven, initially by opposition to new waste disposal sites and rising waste disposal costs, further momentum has been gained as growing concerns about global warming, virgin resource depletion and resource scarcity have developed. Fiscal and legislative changes in virtually all OECD countries are now driving changes in the way wastes are managed.[4] In many countries such changes have prevented waste materials being landfilled and left the waste industry to find new outlets and markets for secondary raw materials. Waste to energy solutions have been built in many countries, and global recycling markets have emerged as alternative outlets for growing volumes of recovered secondary raw materials.

It is into this mix that we find a surge of activity around the concept of the circular economy and waves of technical innovation that open up new opportunities for using secondary raw materials.

Major commercial companies, trade bodies and NGO's suggest we are at the beginning of the next industrial revolution in which secondary raw materials, linked to innovative science will see a surge in productivity and a major growth in wealth. They predict we will see closed manufacturing circles, cascades of secondary raw material into multiple new uses and dwindling volumes of waste destined for final sinks. They also predict a fundamental shift away from commodities to services in which the ownership of products becomes less important than the services those products provide.

Key drivers in this acceleration of ideas have been instability in primary commodity prices and a rise in demand for raw materials that have challenged the conventional linear economy of extract, make, use and dispose. Key barriers to using secondary raw materials derived from waste have been legislative and legal, the lack of mature markets and sufficient demand for these materials from manufacturers and designers.

The waste industry sits at the centre of these changes and has an opportunity to work with industry[5] and policy makers to shift the balance between primary and secondary raw materials. The opportunity exists to create a new legislative construct for "materials management" that will drive up productivity, create new jobs and enhance growth whilst still delivering the final safe sinks required for materials that cannot be effectively recovered. It will require a new investment construct to unlock progress if the technology and skills required are to be developed in the waste industry to support such a shift in activity. The challenge we the waste industry face is to be at the forefront of this changing industrial landscape and to offer the next G7 summit many of the solutions they are seeking.

The UN global compact – accenture. CEO study on sustainability industry insight: mining and metals

2014

Absent almost entirely from our conversations in 2010, the concept of the circular economy has taken quick hold among CEOs focused on innovation and the potential of new business models. Already, a third of CEOs in this year's Study – and fully 46% in the mining & metals sector – report that they are actively seeking to employ circular economy models. With a potential $1tn opportunity in transitioning to the circular economy, companies are recognising that preservation makes as much economic sense as it does environmental.

[1] Leaders' Declaration G7 Summit, 7-8th June 2015 & Annex to the Leaders Declaration (2015) Schloss Elmau, G7 Germany.

[2] Resource Productivity in the G8 and the OECD (2011), A report in the Framework of the Kobe 3R Action Plan, OECD, Paris. http://www.oecd.org/env/waste/47944428.pdf

[3] OECD (2015) Global Waste Management outlook, OECD Publishing, Paris.

[4] Dutch Sustainable Business Association, (2015) Governments going circular – A global scan by De Groene Zaak, Netherlands. (www.govsgocircualr.com)

[5] Accenture (2014), The UN Global Compact: Accenture, CEO Study on Sustainability: Industry Insight: Mining and Metals. https://www.accenture.com/ae-en/insight-un-global-compact-sustainability-mining-metals.aspx

Prepared by the ISWA task force on resource management

Lead author:
Martin Brocklehurst
Independent environmental consultant
KempleyGreen Consultants
United Kingdom

Martin Brocklehurst is an Executive Manager with 14 years experience in the oil and gas business and 13 years within the Environment Agency (UK). He is an expert in EU and UK environmental regulation, waste and resource management, environmental impact assessment and health safety & environment auditing. He has had a central role in shaping and implementing waste policy in the UK. He is currently operating as an Independent Environmental Adviser developing a series of successful international EU funded partnerships testing new ideas in waste and resource management. During 2014 he was appointed "Special Adviser" to the UK Parliamentary Environment Audit Committee enquiry "Growing the Circular Economy – Ending the Throwaway Society".

Martin is a member of CIWM (2007), ISWA (2011), the Energy Institute (1992), Fellow of the RSA (2006), Member of the Aldersgate Group (2012) and a retired member of the Landscape Institute (1978).

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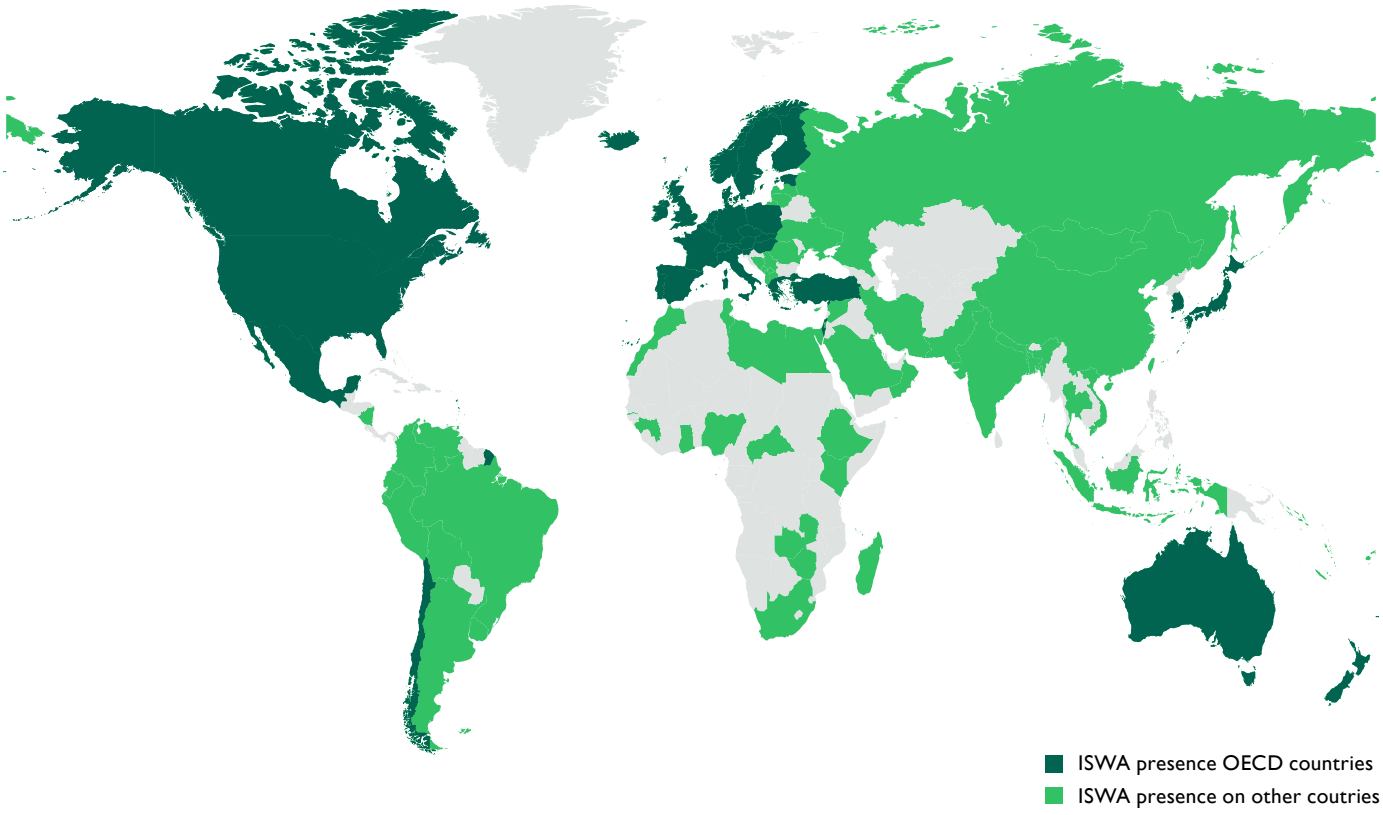
Introduction



In June 2014 the ISWA Board established the ISWA Task Force on Resource Management.

This report is one of six reports prepared by the Task Force and has been written to provide an overview of the current status and on-going activities in the field of resource management and the circular economy. The study is restricted to the 34 OECD countries[6] where some 4 billion metric tonnes[7] of waste are produced each year out of an estimated 12 billion metric tonnes globally. Where appropriate, reference is also made to the 6 BRIICS countries[8]. The rapid rise of the BRIICS is challenging the global dominance of the OECD countries impacting resource use. They have also become crucial to the way waste materials are recovered and re-used as new global supply chains for recyclate materials continue to develop.

The report is designed to:

- Briefly describe the main ideas driving resource management and the circular economy;
- Identify and describe the main stakeholders/driving organisations behind the concept of resource management and the circular economy and their current positions;
- Identify and screen on-going activities and useful, high-impact and important publications within the topic area;
- Outline the key role and challenges for the waste management sector, in the transition to a resource efficient circular economy.

[6] For a full list of OECD countries see: http://www.oecd.org/about/membersandpartners/list-oecd-member-countries.htm

[7] OECD (2015), Material Resources, Productivity and the Environment, OECD Green Growth Studies, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264190504-en

[8] For a detailed analysis of the BRIICS see - http://www.oecd.org/tad/tradedev/globalisationandemergingeconomies.htm

Global business models

The linear economy

The economies of the OECD countries have been dominated by the linear economy of extract, make, use, dispose since the early industrial revolution. In this economy between 80- 90% of what is used by consumers becomes waste within 6 months.[9] About one fifth of global material extraction becomes waste each year.

At every stage in the linear production model, materials are discarded and waste is produced. Large volumes of waste are produced when raw materials are sourced and when materials are processed through the various stages of manufacturing. Further waste is produced in the logistics, distribution and packaging phases of the linear economy and finally waste is produced at the point of consumption and use. As such economies grow volumes of waste rise. OECD estimates suggest that municipal solid waste (which is only part of the waste volume) will rise by 0.69% for every 1% increase in national income.[10] As the BRIICS mirror the economic development of the OECD countries global waste volumes rapidly rise.

In the linear economy urbanisation creates further challenges. Thirty three mega cities have emerged globally each with populations over 10 million. Many now have the biggest dumpsites in the world taking waste from their linear economies. Sixty four million people are now affected by these sites were open dumping and burning take place. This number is expected to grow to several hundreds of millions as urbanization and population growth continues unless a better use is found for secondary raw materials. They are also the final destination for an estimated $10-$12 billion of illegal hazardous waste shipments and large volumes of e-waste, often from OECD countries.[11] Such activity makes little economic sense.

In the linear economy opportunities to reduce manufacturing costs through improvements in productivity are now largely incremental. Many manufacturers therefore seek to increase profits by selling more goods, and to drive consumer demand by constantly marketing new products with more and more enhancements that differentiate their products in the market place. As prices are driven down the rebound effect results in consumers investing in the consumption of more goods. Consumers are encouraged to follow new fashions and to discard goods before the end of their useful life. Waste reduction, if tackled, is about driving down the economic cost of raw materials for their part of the supply chain.

Adopting resource management and the circular economy means moving away from our current linear economy (extract - make - use - dispose)

In the new economy products, and the materials they contain, are valued differently; creating a more robust economy in which society will get greater value from the raw materials they contain.

[9] See World Economic Forum briefing paper: http://www.weforum.org/pdf/sustainableconsumption/DSC%20Overview%20Briefing%20-%20Closed%20Loop%20Systems.pdf

[10] Antonis Mavropoulos, Waste Management 2030+ The future of waste management on an overcrowded planet. Waste Management World. See http://www.waste-management-world.com/articles/print/volume-11/issue-2/features/waste-management-2030.html

[11] Antonis Mavropoulos and David Newman, (2015),Waste Health, The Tragic Case of Dumpsites, ISWA, Vienna, Austria.

Fig. 1 | Linear economy

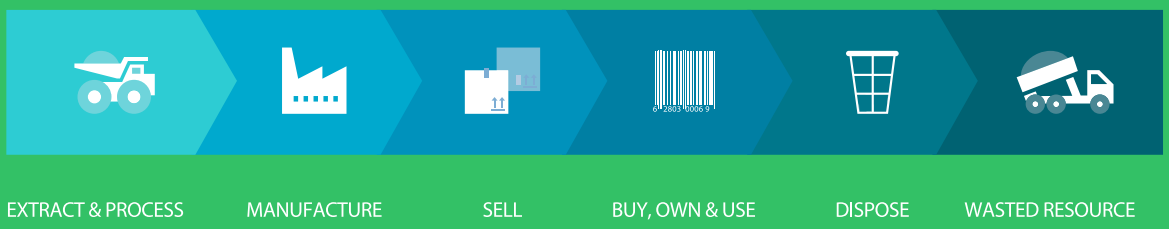
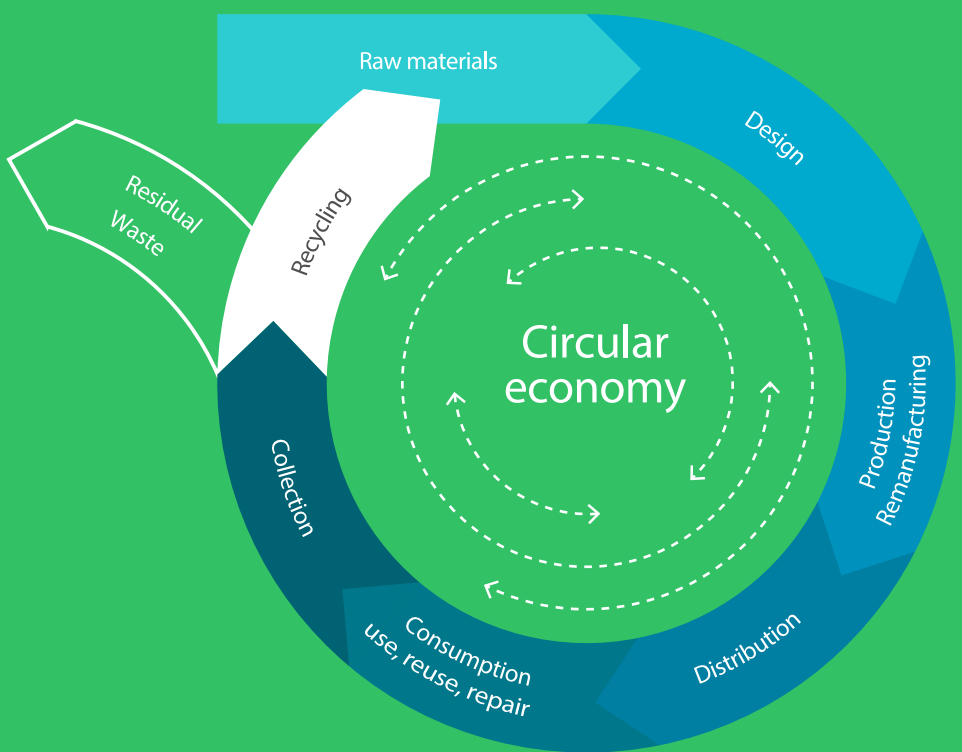


Fig. 2 | Model of european resource efficient economy



Source EU – Towards a circular economy:A zero waste programme for Europe.
Brussels 2.7.2014 COM (2014) 398 Final.

In the linear economy manufacturers often have a limited understanding about component raw materials used by their suppliers. As long as health safety and environmental legislative requirements are met and the component meets it operational requirements there is no need to seek further information or to question the use of different materials. Unless legal obligations are placed on manufacturers through producer responsibility schemes they have little interest in the way their products are discarded, once used. In the linear economy the main business drivers remain sale volumes and price. Once used, goods and materials are discarded as waste and new products are made from primary raw materials.

Product, health safety and environmental legislation in OECD countries has been designed around this linear process. Legislation, in the main, assumes that materials will be used and discarded. Second hand goods and secondary raw materials from waste have not been considered as good as new; they have a stigma associated with them, reinforced in many cases by legislation. Legislation prevents remanufactured components being sold as new, even with a manufacturers warranty. This barrier applies even if they are better than the components they replace.[12] Once a material has been discarded it is classified as waste and cannot be re-used and recovered without passing stringent "end of waste tests." These tests vary across OECD countries acting as a further barrier to the trade in secondary raw materials. The balance of legislation is set in favour of primary raw materials.

Few significant price signals are embedded in fiscal legislation to recognise the significant environmental benefits of secondary raw materials. Even where primary raw materials carry a much higher ecological and/or carbon footprint than secondary raw materials, this is rarely reflected in the price.[13] The balance is further tilted in favour of primary raw materials as many are produced in parts of the world where health safety and environmental legislation is still developing. Secondary raw materials meanwhile have to meet stringent legal obligations before they can be re-used further adding to the cost differential. Product and chemicals legislation (such as REACH) favours the linear economy, as it was not drafted to support the re-use of secondary raw materials. Materials are not designed for recovery and re-use and as a consequence the complex chemical mixtures often require excessively expensive testing protocols before they are accepted back into the market place. Finally in the mature markets for primary raw materials direct and indirect subsidies exist. For fossils fuels the IMF estimate these subsidies are worth €300 billion a year.[14] Such subsidies further tilt the balance against secondary raw materials.

The linear economy has also built up mature commodity markets where raw materials can be "bought blind," that is without seeing and sampling the commodity. Standards have been developed and are clearly understood in the markets where complex dispute resolution processes support the whole process. In such markets producers can protect themselves against major price fluctuations by implementing financial strategies that will guarantee a commodity's price (to minimise uncertainty) or lock in a worst-case-scenario price (to minimise potential losses). Futures and options are routinely used to hedge against commodity price risk. These mechanisms do not exist for many secondary raw materials inherently increasing financial risks when downturns in raw material prices take effect. The relatively immature markets for most secondary raw materials places them at a further economic disadvantage.

Finally the linear model re-enforces the desire in consumers to "own goods." Different business models that sell services rather than commodities face consumer resistance when they run against this consumer norm. The buying public expect to own goods. Business models that adopt leasing principles are compared to periods in the economy when this was a necessity through lack of wealth and are resisted by the public.

Since its invention the motorcar is an example of such consumer desire to own goods. Despite the fact that the car is parked for 92% of its time (even in use a 5 seat car will only have an occupancy rate of 1.5) the bulk of the population seek to own such a vehicle. Only as congestion has reached record levels in our cities is this model being challenged.[15]

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[12] Evidence by Caterpillar to the House of Commons Environment Audit Committee April 2014. http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environmental-audit-committee/growing-a-circular-economy/written/8776.pdf

[13] See http://www.aluminum.org/industries/production/secondary-production

[14] D. Coady, I. W.H. Parry, L. Sears, and B. Shang, (2015) How Large Are Global Energy Subsidies? IMF working paper.

[15] Ellen MacArthur Foundation & the McKinsey Centre for Business and Environment, (2015) Growth within: A circular economy vision for a competitive Europe. UK.

Resource management and the circular economy

The circular economy values raw materials in a different way. It has been discussed for nearly 40 years and developed by a range of academics including Professor Roland Clift (Surrey University), Professor Walter Stahel (Geneva Association), Dr Michael Braungart (Environment Protection and Encouragement Agency) and Janine Benyus (Natural Sciences Writer and Innovation Consultant). The need for a change was also spelt out in two key publications, Limits to Growth, which was published by the Club of Rome in 1972,[17] and the controversial report Prosperity Without Growth[18] that was published in the UK, by the Sustainable Development Commission in 2008. The consistent theme that emerges from this thinking is that the current linear production model is not sustainable in a world of 9 billion people, who all aspire to a higher standard of living. Neither is the energy demand that the use of these primary raw materials is currently driving.

In a circular economy business designs materials for recovery and re-use. Goods are either a source for raw materials that can be recovered and re-used or energy to displace primary fossil fuels. Raw materials can be recovered from both organic and inorganic materials that have previously been used.

The volume of primary raw materials required to manufacture the next generation of goods and services can be reduced. In a circular economy designers understand how to select and use materials that can be recovered and reused to displace primary raw materials. Nothing is wasted and when raw materials can no longer be reused the energy theycontain is extracted to displace virgin fuels.

The ash and gaseous emissions produced by combustion remain secondary raw materials. As with virgin fuels (where coal produces PFA which is used in construction activities), the ashes from burning secondary raw materials are re-used in construction.In such an economy all raw materials are tracked and optimised and boundaries between primary and secondary raw materials become irrelevant. The success of the circular economy depends on the economics of the recovery process of either manufactured components that still have a useful life or the raw materials that went into their manufacture.

[16] Chatham House Briefing Paper. (2012) A global redesign? Shaping the Circular Economy, Felix Preston. London. Chatham House (the Royal Institute of International Affairs) is an independent body which promotes the rigorous study of international questions and does not express opinions of its own. The opinions expressed in its publications are the responsibility of the authors.

[17] Donella H. Meadows, Dennis L. Meadows, Jørgen Randers and William W. Behrens III, (1972) The Club of Rome, Limits to Growth, Universe Books

[18] Dr Tim Jackson, (2008) Prosperity Without Growth, The Transition to a Sustainable Economy, Sustainable Development Commission, United Kingdom, London.

Chatham House - a global redesign? Shaping the circular economy, Felix Preston

March 2012

The circular economy offers a transformational agenda that aims to redesign global production and consumption systems. Many of the ideas are decades old, but a combination of environmental and resource price pressures, technological advancements and changes in consumer demand is finally building momentum. Both the private sector and governments increasingly recognize that future competitiveness will depend on leadership in resource related innovation.

Quote from Chatham House Briefing Paper[16]

In the case of organics their recovery and re-use aims to mimic ecological processes to recover soil organic materials, fertilisers and gases that can be burnt to produce energy. In the circular economy secondary organics are also refined to produce feedstocks for the chemical industry, reducing the demand for traditional fossils fuels as the main source of these materials.

The circular economy can operate in many different ways. The EU illustrated a model of how such an economy would deliver a resource efficient Europe (Figure 3).

The Ellen MacArthur Foundation outlines a second model (Figure 4) in which they portray the circular economy as a series of tightening circles. The tighter the circles the less a product has to be changed before it can be reused and the greater are the economic and environmental benefits that accrue. At the heart of the circular economy the aim is to design out waste. From the original conception, materials, products and services are designed for recovery, disassembly and reuse. The raw materials they contain are part of the materials inventory that secures the future of the on-going manufacturing process.

In the circular economy the key raw materials for future manufacturing come from the recovery of the products from the market place. The greater control a company has on these materials, through for instance leasing business models with consumers, the more secure the future becomes. Such organisations do not cease to use primary raw materials but their percentage contribution decreases over time as the change from a linear to circular economy takes place.

The Ellen MacArthur model suggests:

- Tight inner circles where minimum new materials are used before materials can be re-used, refurbished or re-manufactured. Such products offer the greatest savings in terms of embedded costs, materials, energy and labour. They also offer the greatest savings on environmental effects or externalities such as emissions to air, land or water, including reducing greenhouse gas emissions;

- Circles of use where the number of times materials can be used through consecutive circles is increased. Re-use, remanufacture or recycling is used to achieve this objective;

- Cascade use, where materials are recovered, re-engineered and cascaded into new uses from that originally envisaged. Good examples are recovered plastics used as insulation materials rather than packaging or cotton cascaded into a series of uses once it is no longer suitable for recovery and re-use in clothing; and

- Pure circles, where uncontaminated materials are returned for re-use in primary manufacturing.

In changing business models ownership of materials gives way to the provision of services. Such changes can support tight inner circles by ensuring that the ownership of raw materials is never lost. Such changes are radical and unlikely to become mainstream until a fundamental change takes place in the way people view ownership as a key measure of wealth and status.

The Ellen MacArthur model takes the view that non-recyclable waste[19] is converted into heat, electricity, or fuel through waste-to-energy processes including combustion of solid waste and the production of fuel gas that is produced from gasification, pyrolysis, and anaerobic digestion processes.

In both these models the role of energy needs wider discussion. It is clear waste to energy can displace virgin-fuels in the circular economy and be part of the drive away from fossil fuels in the world economy. It can be seen as a final sink for materials too difficult to recover with current technologies or as a fuel in its own right. It already plays a significant role in the migration towards a circular economy in the leading OECD countries where waste to landfill has been minimised such as Sweden, Denmark, Germany and Japan. A market is also rapidly forming in Europe where materials for waste to energy are now widely traded.[20]

Markets are already deciding the balance between using secondary raw materials for energy production and or raw material supply. This balance is affected by unexpected events such as that caused by the entry of shale gas as a new source of fossil fuels which had a profound and unexpected impact on global energy markets. In a market stacked against secondary raw materials such changes have significant effects on sunk investment in plastics recycling activities.

Two other terms are coming into us in respect of the circular economy. "Upcycling" and "Down Cycling." The term "upcycling" is attributed to Gunter Pauli[21] and refers to converting a waste material into something of better quality or better environmental value. "Down Cycling" is where materials are recovered and converted into materials of lesser quality or functionality. Examples could include demolition materials such as bricks, recovered for use in high quality new buildings, or the repair of historic buildings where their use adds value. "Downcycling" by comparison would see the materials crushed and converted for aggregate re-use. For organic materials "upcycling" would see the materials refined and reprocessed to produce high quality garden compost or chemical feedstocks that can be reused and sold at a premium. "Down cycling" would see the organics materials cross-contaminated with other waste materials and only suitable for re-use in land reclamation programmes.

Research is taking place to understand how waste materials can be upcycled. A good example is plastics where work is underway[22] on how to convert waste plastics into carbon nanotubes such as graphene. Further work by Bayer is now moving into commercial production where waste carbon dioxide from the energy industry is being used as a precursor for premium polyurethane foam. The first CO2 based polyols are expected to be on the market in 2016.[23] This type of research will continue, as society understand the potential to use secondary raw materials from waste as a primary source for new products.

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[19] Non-recyclable waste is taken to mean material that is not able to be processed or treated for re-use in some form with current technology and within current economic constraints.

[20] CIWM & Amec, (2013) Research into SRF and RDF Exports to Other EU Countries, Final Technical Report, Northampton, UK

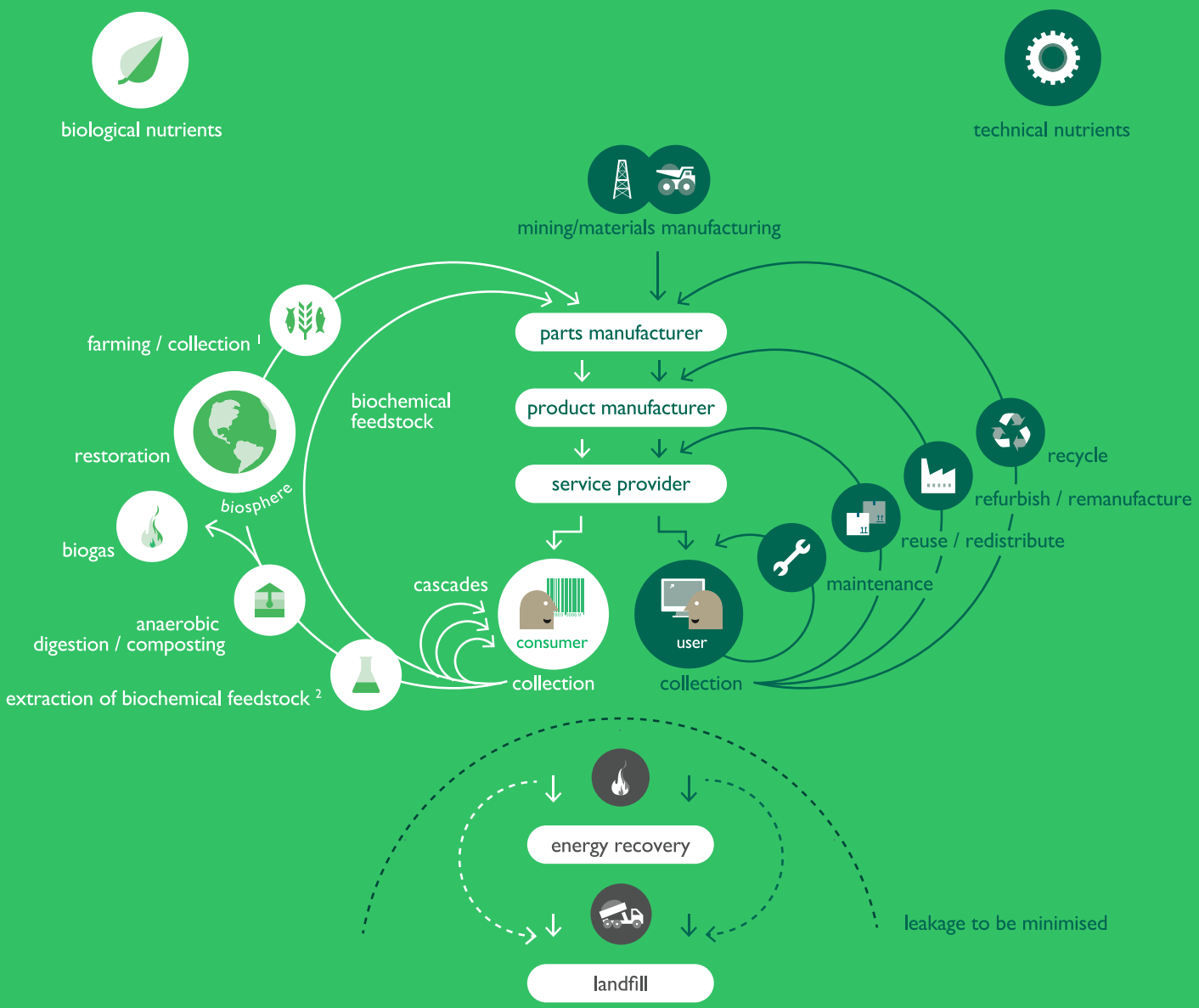
[21] Upcycling. Riemann Verlag (Munich), 1999, ISBN 978-3-570-50006-4

[22] Chuanwei Zhuo, Yiannis A. Levendis, (2013)Upcycling Waste Plastics into Carbon Nanomaterials: A Review, Department of Mechanical and Industrial Engineering, Northeastern University, Boston, Massachusetts. Wiley Periodicals, Inc. J. Appl. Polym. Sci. 2013, 000, 39928.

[23] European Commission (2015) From Niche to Norm, Suggestions by the Group of Experts on a 'Systemic Approach to Eco Innovation to achieve a low-carbon, Circular Economy', Luxembourg. ISBN 978-92-79-46832-2

Fig. 3 | The Ellen MacArthur model of the circular economy

1. Hunting and fishing
2. Can take both post-harvest and post-consumer waste as an input



Source: Towards the Circular Economy, 2013, The Ellen MacArthur Foundation
Prepared by McKinsey & Company

Key drivers of resource management

Introduction

The European Environment Agency, environmental indicator report

2014

In the new economy products, and the materials they contain, are valued differently; creating a more robust economy in which society will get greater value from the raw materials they contain.

European Environment Agency
Environmental impacts of production-consumption systems in Europe
ISBN 978-92-9213-487-7
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Business and government views on resource management and the circular economy in OECD countries are changing due to the rapid economic growth of BRIICS countries, growing global populations, a rapid rise in the standards of living in emerging economies across the globe and an exponential growth in demands for primary raw materials and food. These pressures are identifying cost of raw materials as a major factor for on-going business activities.

The circular economy challenges the status quo, is disruptive and contains major business risks. Unless the economic drivers for that change are clear companies will not adopt it. It requires real evidence to convince government and businesses to act. Only when the risks of raw material price instability, periods of material shortages and risks in the supply of critical raw materials are real, will the pace of change accelerate. Predicting that "tipping point", planning for it and reacting to it effectively will make the difference between business success and failure. This section explores the evidence that we have reached that point and how governments have started to react.

Prof Will Steffen of the Australian National University and the Stockholm Resilience Centre.

It's clear the economic system is driving us towards an unsustainable future and people of my daughter's generation will find it increasingly hard to survive," he said. "History has shown that civilisations have risen, stuck to their core values and then collapsed because they didn't change. That's where we are today.

Will Steffen et al, The trajectory of the Anthropocene: The Great Acceleration The Anthropocene Review 205301961456 4785, first published on January 16, 2015
Will Steffan et al, Planetary boundaries: Guiding human development on a changing planet, Science Magazine January 2015, Science DOI: 10.1126/science.1259855.
The findings of these studies were presented in seven seminars at the World Economic Forum in Davos 21-25 January 2015.

Commodity prices and raw material supply as drivers of change

Price signals for raw materials are a key driver in any change to the circular economy. Fundamental to any change to the linear supply model is evidence that the predicted impact on the supply of primary raw materials and prices is real. The linear economy has been fuelled by falling prices since 1900. With a few exceptions, raw material prices have fallen by 1-2 % per year over this time period. Such falls undermine any moves to adopt the circular economy.

A change to this situation emerged in 2000. Growth in demand for raw materials between 2000 and 2010 reversed that trend and in10 years all the price reduction gains of the last 100 years were wiped out. Only during World War I was a similar trend evident.

Work by the World Bank and the Ellen MacArthur Foundation circular economy team have mapped these price changes, which are shown below.

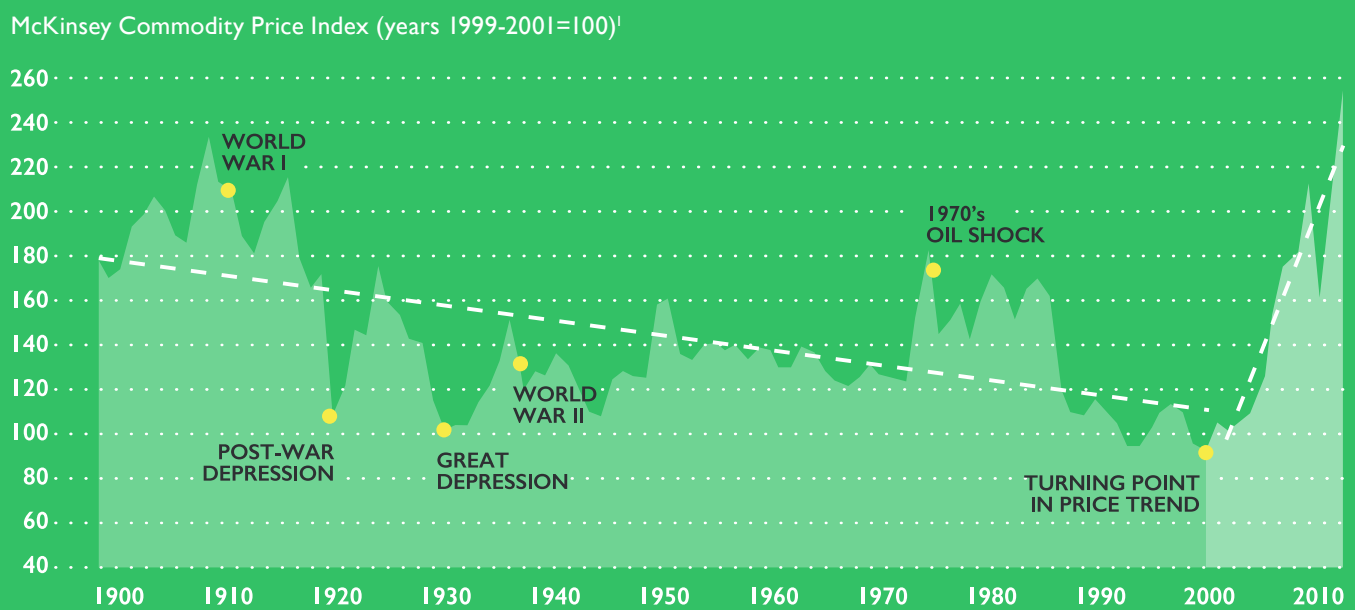
Commodity prices are, however, unpredictable and although the price spike is clear, whether or not we have reached a genuine tipping point, caused by global demand is still challenged. The unexpected fall in oil, copper, gold and iron ore prices late in 2014, has fuelled this debate. Oil prices in December 2014 had fallen by 40%, gold by 30%[24] and already we are seeing companies re-adjust and respond to these price impacts. Changes in geo-politics, global economics and technologies can all have a major impact on prices.

Others argue that the recent spike in commodity prices may be due to the unprecedented rush to secure resources across all regions of the world. Authors such as Damisbo Moyo[25] point out that in a world of diminishing resources all the OECD countries are in the middle of unprecedented times. Many countries but in particular China, have embarked on a programme to secure hard commodities (metals and minerals) and soft commodities (timber and food) on a scale that is one of the largest in history. They argue this may explain the sudden surge in prices and global demand after a century of falling prices.

[24] Daniel Azocar and Sam Phipps, (2015) Commodity prices briefing: Building a CSR strategy during an era of low commodity prices, Ethical Corporation

[25] Dambisa Moyo (2012) Winner Take All: China's Push for Resources and What It Means for the World. Basic Books

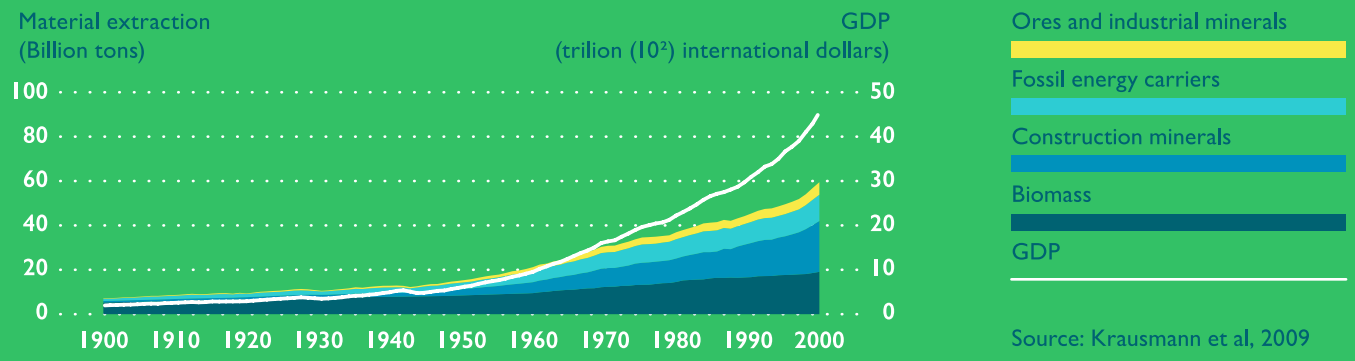
Fig. 4 | Sharp price increases in commodities since 2000 have erased all the real price declines of the 20th century



[1] Base on ar ithmetic average of 4 commodity sub-indices: food, non-food agricultural items, metals, and energy: 2011 prices based on average of first eight months of 2011.

Source: Towards the Circular Economy, 2013, The Ellen MacArthur Foundation
Prepared by McKinsey & Company

Fig. 5 | Global material extraction in billion tons, 1900-2005



Source: Krausmann et al, 2009

UNEP (2011) Decoupling natural resource use and environmental impacts from economic growth. A Report of the Working Group on Decoupling to the International Resource Panel. Fischer-Kowalski, M., Swilling, M., von Weizsacker, E.U., Ren, Y., Moriguchi, Y., Crane, W., Krausmann, F., Eisenmenger, N., Giljum, S., Hennicke, P., Romero Lankao, P., Siriban Manalang, A.

Source: Krausmann et al., 2009

Despite the fall in commodity prices, global trends suggest low prices will not last. The reasons for change are primarily the growth in demand for primary raw materials. The UNEP Report Decoupling 2. Technologies, Opportunities and Policy Options[26], provides details on the hard numbers and confirms that during the twentieth century the global community has seen:

- Extraction of ores and minerals grow by a factor of 34;
- Construction materials grow by a factor of 34;
- Fossil fuels grow by a factor of 12; and
- Biomass grows by a facto of 3.6.

This growth in demand is driven in turn by population growth and the increasing prosperity of people across the globe. The UN projects global population to grow by more than 2.5 billion by 2050 (UN2013[27]) and others predict the middle class aspiring to the same standards of living as western economies will grow by 3 billion people (Kharas, 2010[28]). If these trends continue the UN predicts annual resource extraction would need to triple by 2050 compared to extraction in 2000. Overall between 45-60 billion tonnes of resources are extracted globally every year and current trends could see this grow to 140 billion tonnes by 2050 (UNEP, 2011) with a further 40 billion tonnes extracted but not used as overburden and harvest revenues.

Former EU Environment Commissioner Janez Potocnik explained these drivers at the UK Environment Audit Committee Enquiry into Growing a Circular Economy – Ending the Throwaway Society[29] as follows:

"In one generation, we will have on the planet an additional 2 billion people, which is more than the overall population at the beginning of the 20th century, when it was 1.5 billion. That is more than 200,000 per day. … McKinsey estimates that, by 2030, 3 billion people who are currently living in poverty will join the middle-class level of consumption. If you take into account, all in all, that would mean that we would need something like three times more resources than we use today in 2050 - 70% more of food, feed and fibre in 2050 - we would likely be around 40% short of drinking water in 2030. If we take into account that already today we are using approximately 60% of our ecosystems in pretty much unsustainable ways that makes a pretty simple conclusion: how we produce, consume and live will have to be changed".

These trends have driven a re-think in how countries secure primary raw materials. A number have put in place policies and procedures to identify and secure critical raw materials (see EU Paper on Critical Raw Materials).[30]

[26] UNEP (2014) Decoupling 2: technologies, opportunities and policy options. A Report of the Working Group on Decoupling to the International Resources Panel. Von Weizsacker UNEP International Resources Panel von Weizsäcker, E.U., de Larderel, J, Hargroves, K., Hudson, C., Smith, M., Rodrigues, M. ISBN 978-92-807-3383-9

[27] World Population Prospects (2013) The 2012 Revision. Key findings and advance tables. UN. New, York USA.

[28] OECD Development Centre, Working Paper No 285, The Emerging Middle Class in Developing Countries, Homi Kharas Paris France.

[29] House of Commons Environment Audit Committee, (2014) Growing a circular economy: Ending the throwaway society, Third Report of Session 2014-15, The Stationary Office Ltd

[30] European Commission, Communication from the Commission. (2014) On the review of the list of critical raw materials for the EU and the implementation of the raw materials initiative, Brussels 26/5/2014 COM (2014) 297 Final.

Environmental legislation as a driver of change

The second major driver of change in many OECD countries is evidence of the unsustainable damage to our environment that the linear economy is producing. This has in turn led to a drive to tackle environmental externalities and include these in the cost of manufacturing. The same pattern is evident across the BRIICS countries, as in China where the environmental price of rapid linear economic growth; air, water and land pollution are now being tackled with legislative changes.

Environmental legislation has and continues to drive major change in all business activity. It is a major risk factor for many international companies. In the advanced economies successive rounds of legislation have driven improvements in water and air quality, protection for natural ecosystems and a growing understanding of the economic value of ecosystem services (such as pollination for agriculture and food production) has emerged. Policy makers have also started to tackle the causes of climate change with taxation on carbon emissions placing new costs on energy producers. Debate is underway on how to move taxation from labour to primary raw materials, as we recognise the need to use primary materials in a sustainable way.

For the Waste industry legislation has been applied across most OECD countries. In the EU the Waste Framework Directive has placed clear targets on all member states to divert organic waste from landfill and banned other materials completely. Coupled with bans on the disposal of organic and or recyclable materials in some EU Members States this has presented the waste industry with a challenge to find new uses or new markets for these waste materials. In other OECD countries such as Japan, Canada, the USA and South Korea a mix of taxes, legislation and landfill bans have had a similar effect.

Within the USA recycling has risen from less than 10% in the 1980 to over 34% in 2012 and waste to landfill has fallen from 89% to under 54%. Legislation has also driven the recovery of Methane (CH4). Landfills are the 3rd largest source of CH4 in the US and a major programme is in place to reduce these emissions by 2023.[31] CH4 is the second most prevalent greenhouse gas emitted, accounting for 9% of all US greenhouse gasses from human activity.[32] The link between reducing carbon emissions and how we use resources is now widely researched using Life Cycle Assessment Studies. It is clear from these studies that improvements in resource productivity and waste management will be a key parameter in achieving carbon reduction targets and minimising the effects of climate change.[33]

[31] The White House Washington (2014) Strategy to reduce methane emissions see: http://www.whitehouse.gov/sites/default/files/strategy_to_reduce_methane_emissions_2014-03-28_final.pdf
[32] US EPA Overview of Greenhouse gases – Methane Emissions: http://epa.gov/climatechange/ghgemissions/gases/ch4.html
[33] WRAP (2010) Securing the future – The role of resource efficiency, E Dawkins et al, University of Durham.

As with commodity prices, however, the signals are not always clear and consistent. Within the EU the offshoring of manufacturing, the down turn in the economy and the change in the EU Presidency show signs of a break on legislative drivers towards the Circular Economy. A major piece of environmental legislation from the EU forward programme for 2015, on waste management, in support of the Circular Economy package, was dropped late in 2014. In shelving these proposals the incoming Commission indicated stronger and better policies on waste and resource management and the circular economy would be delivered by the end of 2015. Consultations have now been issued on the Circular Economy[34] and on the Functioning of Waste Markets in the European Union.[35] It remains to be seen whether the pace of change originally envisage will be maintained. What is already clear is that legislative momentum has been interrupted and uncertainty has been introduced in the direction the Commission will take. Whether the new proposals will have the same hard measurable targets as the previous package remains to be seen.

This ambiguity is also evident in New Zealand where the 2010 Waste Strategy has taken the view that:

"While the 'zero waste' vision of the 2002 Strategy was ambitious, many of its targets were unable to be measured or achieved. The revised Strategy enables a more flexible approach to waste management and minimisation through two high level goals: reducing harm and improving efficiency".[36]

As with the EU changes to hard targets have been removed whilst the ambition on resource management remains. How these changes will affect the drive to the circular economy is not yet clear.

Within America as long ago as 2003 the US EPA recognized the need for a fundamental change to its core legislation, if effective waste and materials management was going to be achieved.[37] A core concept suggested was a fundamental re-think of the waste versus non-waste core regulatory construct. They suggested that one approach would be to treat all potentially hazardous materials to similar management controls/incentives based on their risk potential rather than as a waste – that is moving to "materials management" rather than "waste management". Under this fundamental change materials would only be managed as waste once they were destined for disposal. By reducing the distinction between waste and materials such changes were expected to dramatically improve recycling and re-use rates. Work within the UK on "End of Waste" criteria has demonstrated how powerful such a construct could be, releasing millions of tonnes of inorganic and organic materials back into productive use. Such a change would solve one of the unintended consequences of waste legislation across OECD countries. This has locked secondary materials as waste, setting hurdles for recovery and re-use in excess of those demanded of primary raw materials they are seeking to replace.

Overall legislative pressure has already created massive shifts in the linear economy in the way waste materials are managed. It has produced millions of tonnes of materials looking for markets and the globalisation of trade in non-hazardous waste materials and recyclate. Whilst difficult to measure the UN Basel Convention reports at least 8.5 million metric tonnes traded in 2001. Diverting waste from landfill has also stimulated the use of those materials to provide energy, particularly in countries lacking fossil fuels, such as Japan, Korea and parts of North West Europe. Waste to energy in such circumstance can have a positive impact on reducing carbon emissions when fossil fuels are displaced in the energy supply and waste heat and power are efficiently used.[38]

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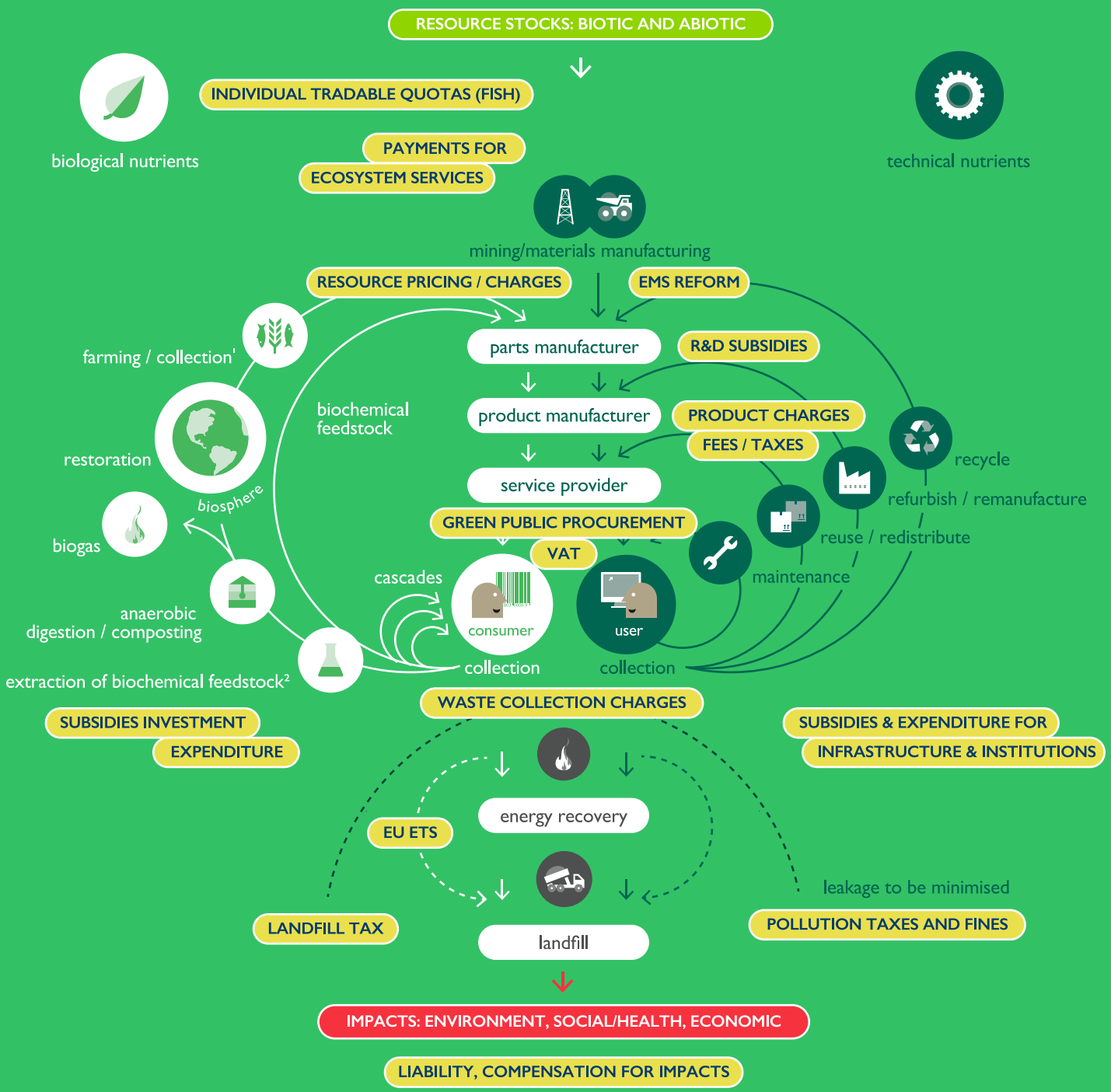
[34] http://ec.europa.eu/environment/consultations/closing_the_loop_en.html
[35] http://ec.europa.eu/environment/consultations/waste_market_en.html
[36] Ministry for the Environment, (2010) The New Zealand Waste Strategy. Reducing harm, improving efficiency, Wellington, New Zealand.
[37] US Environment Protection Agency (EPA). 2003 Position Paper, Beyond RCRA. Waste and Materials Management in the year 2020
[38] Thomas H Christiensen et al, (2015) Waste to Energy – The Carbon Perspective, Waste Management World January-February 2015 pp 24-28.

Fig. 6 | Possible green taxation to support the circular economy



Source: IEEP (2014) Building on Figure 2 from Ellen MacArthur Foundation (2012) Circular Economy, Executive summary

Green taxation as a driver of change

The third major driver of change is Green Taxation. Across OECD countries it is increasingly being seen as a tool for policy makers to drive environmental change and support the flows of secondary raw materials into the market place.

In the waste sector OECD countries, particularly in Europe, (where virtually all the EU countries have landfill taxes in place) taxation has also been used to drive the real costs of disposal back into the market place. As green taxation has been applied to landfill and incineration, gate fees have also risen to offset higher costs associated with effective environmental management of emissions.[39] For waste producers inactivity results in higher disposal costs, particularly in countries where tax escalator principles are used and the tax rises each year. Doing nothing becomes the most expensive option and over time such policies drive rapid change.

Evidence from KPMG suggests Green Taxation is growing and increasingly it is being used to support the Circular Economy. In a recent analysis of 21 countries 200 individual green tax incentives were identified related to sustainability, with 30 introduced since January 2011.[40]

The success or otherwise of these policies will determine if they are more widely adopted but the debate in OECD countries has clearly started. Countries are exploring how such taxes could be used to drive change. A good example is the Netherlands where they have commissioned work to explore how to use environmental taxation to drive the Circular economy and apply it to the Ellen MacArthur model (Figure 5).[41]

In the USA, companies can benefit from accelerated depreciation of 50% of the adjusted basis of assets purchased for the re-use and recycling of waste materials. Businesses can also recover a deemed input VAT for waste materials used in further manufacturing.

In China, an important country receiving recovered and recycled materials from OECD countries the Circular Economy Promotion Law is now in place. Here they have reduced or eliminated VAT on goods produced from recycled materials in order to promote the circular economy. VAT refunds range from 50-100%. Similar VAT incentives are emerging in places such as South Korea and tax credits have been introduced in Mexico. Unless such fiscal and tax incentives are matched in other OECD countries and in particular the EU the outflow of secondary raw materials towards these markets will simply increase and the economic advantage to OECD countries in moving to a circular economy will not be delivered.

It makes little sense for the EU to import 60% of its fossil fuels and then to export oil as recycled plastics when it could be put to productive use. It makes even less sense to landfill plastics when at the very least they could be converted into energy. Despite this obvious value, in 2012 waste plastics to landfill in Europe exceeded 66% in the UK, Greece and Bulgaria and 50% in Spain, Portugal, Romania and Hungary.

Conclusion

Global demand and escalating costs for primary raw materials are forcing Governments to challenge the conventional linear economy and seek the economic advantage of a more resource efficient economy. Governments are using "Green Taxation" and changes to primary legislation to drive major changes in the waste industry across OECD countries, creating flows of secondary raw materials looking for markets. In a global world it is clear that the circular economy will accelerate when global economic pressures force change. The pace of that future change is going to be variable and will require economic, legislative and fiscal measures to combine to become mainstream. A race has started between global nations to secure quality secondary raw materials and gain the economic advantage that flows from putting in place effective policy and fiscal change that will drive innovation to recover and use these materials.

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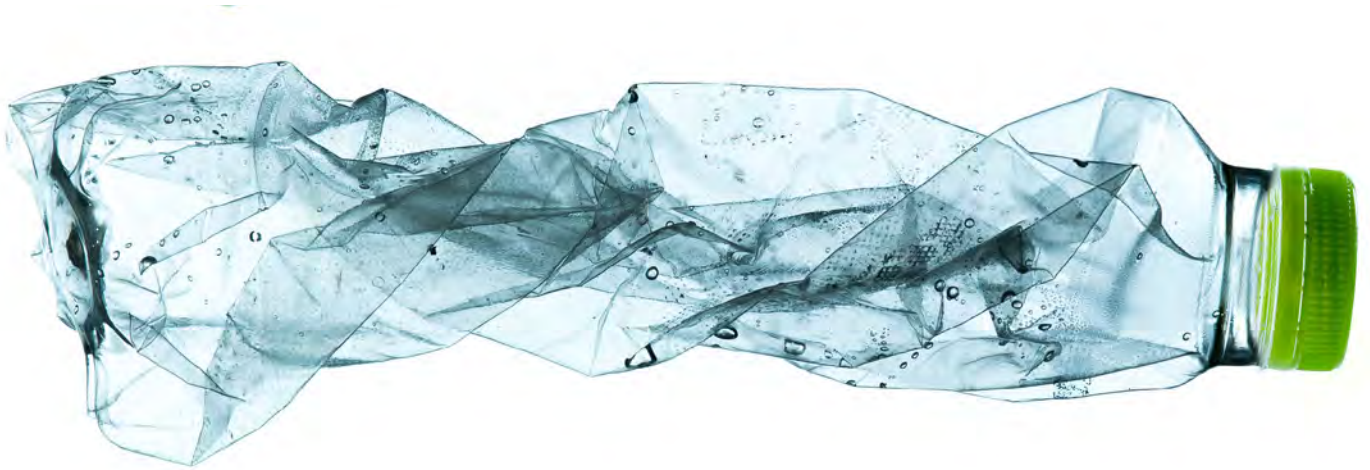
[39] Withana, S., ten Brink, P., Illes, A., Nanni, S., Watkins, E., (2014) Environmental tax reform in Europe: Opportunities for the future, A report by the Institute for European Environmental Policy (IEEP) for the Netherlands Ministry of Infrastructure and the Environment. Final Report. Brussels, Belgium

[40] KPMG (2013) The KPMG Tax Index. http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublication/green-tax/Pages/material-resource-efficiency-waste-management.aspx

[41] See footnote 39



The accelerating pace of change - what drives it?

Introduction

Across OECD countries the previous sections have outlined some of the rapid changes underway in the waste industry. Most of these changes have been in the outer circles of the Ellen MacArthur circular economy model. Two reports have looked further at the pace of change and leadership in delivering the circular economy.

In 2006 a report to the World Bank[42] identified the European Commission as being the most advanced in moving towards a circular economy in a review that included Japan, Germany, Netherlands and the USA. Reference is also made to the declaration by the Chinese to move to a circular economy (at the 5th Plenum of the 16th CPC Central Committee Beijing October 2005).

By 2014 the pendulum had started to shift as other economies recognized the economic potential of the circular economy. The World Economic Forum reviewed progress in January 2014 in their report Towards the Circular Economy: Accelerating the scale-up across global supply chains.[43] This study highlighted progress in Europe, China and Japan. In Japan they quote 98% recycling levels for metal, 89% of materials in electrical items and in 2007 only 5% waste to landfill. They highlight that as a rule recovered materials are used to manufacture the same type of products and that this is a closed system in operation in a recycling economy. In China they highlight Beijing as a city that has achieved 62% reduction in energy consumption per GDP in 2010, a 45% increase in treated wastewater recycling and a 45% reduction in consumption per capita from 2005.

It is clear the leadership being shown by the EU is quickly being adopted globally by leading economies. The pace of change is accelerating as the economic prize becomes clear.

[42] Institute Für angewandtes Stoffstrommanagement (IfaS), (2006) Professor Peter Heck, Circular Economy related international practices and policy trends: Current situation and practices on sustainable production and consumption and international circular economy. Birkenfield. http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/CircularEconomy_Policy_FinalDraft_EN.pdf

[43] World Economic Forum, (2014) Towards the Circular Economy: Accelerating the scale-up across global supply chains. Prepared in collaboration with the Ellen MacArthur Foundation and McKinsey & Company. Geneva Switzerland. http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf

Business leaders

Economic pressures are also forcing a radical re-think within major business interests. There is no doubt the Ellen MacArthur report has been a wake up call for business. Based on estimates in the Circular Economy report the annual material cost saving opportunity at EU level for a "transition scenario" is $340 to 380 billion per annum and for an "advanced scenario" $520 – 630 billion or a recurring 3-3.9% of 2010 EU GDP, all net of the materials used in the reverse-cycle processes.

Others have been quick to note this business opportunity. The UN Global Compact study by Accenture[44] on the views of CEO's on Sustainability in the Mining and Metals sector, covering 1,000 CEO's, 103 Countries and 27 Industries notes that:

"Absent almost entirely from our conversations in 2010, the concept of the circular economy has taken quick hold among CEOs focused on innovation and the potential of new business models. Already, a third of CEOs in this year's Study – and fully 46% in the mining & metals sector – report that they are actively seeking to employ circular economy models. With a potential $1tn opportunity in transitioning to the circular economy, companies are recognizing that preservation makes as much economic sense as it does environmental".

Other have highlighted that just implementing fully the existing EU Waste Directives would save €72 billion a year, increase the value of the waste industry in Europe by €42 billion and create 400,000 new jobs.[45]

Predictions of this magnitude, along with the suggested escalation in global commodity prices (despite the current fall) and the drive to cost environmental externalities provide business leaders with a challenge they cannot ignore. It is clear global businesses are reviewing company policies, their cost base, business models and future manufacturing strategies to deal with these risks. The Green Alliance in their evidence to the House of Commons Environment Audit Committee in the UK highlighted aluminium to illustrate how the impact of pricing in environmental externalities changes the economic balance between primary and secondary raw materials.

"If we were to price carbon adequately to get real change to tackle climate change … the price of aluminium would jump by 70% because of the amount of energy that goes into its production. Recycled aluminium would only jump by about 7%".

They also made the point that:

"where companies control the full cycle of a material or product, they choose circular models to offset the need to hedge for the price volatility of new materials. This also avoids the (normally uninsured) risk that lack of availability of resources will constrain production".

Any major company that fails to build these risks into its future business plans leaves itself at the mercy of unpredictable global changes.

[44] The UN Global Compact & Accenture, (2014) CEO Study on Sustainability – Industry Insight: Mining and Metals. https://www.accenture.com/ae-en/insight-un-global-compact-sustainability-mining-metals.aspx

[45] House of Commons Environment Audit Committee. (2014) Growing a Circular Economy: Ending the throwaway society. Third Report of Session 2014-15. The Stationery Office London, UK.

Governments

OECD Governments have been leading actors in the drive to the Circular Economy. Europe, China and Japan are all now leading players that have set out innovative frameworks for that purpose.

As an early leader the EU has mapped out the next stage in how to turn Europe into a resource efficient economy. That thinking was outlined in the 7th Environment Action Programme (7th EAP) which set out a long-term vision promoting 'living well, within the limits of our planet'.

The 7th EAP foresees a Europe in 2050 in which:

- our prosperity stems from an innovative, circular economy where nothing is wasted and natural resources are managed sustainably;
- biodiversity is protected, valued and restored in ways that enhance our society's resilience;
- our low-carbon growth has long been decoupled from resource use.

Although the Commission proposal "Communication - Towards a circular economy: A zero waste programme for Europe"[46] was dropped by the incoming EU Commission in 2014, the aspiration to drive a resource efficient Europe was not.

As in New Zealand we may not see hard targets repeated but the economic prize that has been clearly articulated will remain a key objective. The targets the Commission originally proposed and are now the subject of further debate were to:

- recycle a minimum of 70% of municipal waste by 2030;
- increase the recycling rate for packaging to 80% by 2030;
- ban the landfilling of recyclable plastics, metals, glass, paper and cardboard, and biodegradable waste by 2025, while Member States should endeavour to virtually eliminate landfill by 2030;
- further promote the development of markets for high quality secondary raw materials, including through evaluating the added value of end-of-waste criteria for specific materials;
- Clarify the calculation method for recycled materials in order to ensure a high recycling quality level;
- To request that Member States put in place programmes to reduce food waste by 30% by 2025; and
- Consider a target of a 30% improvement in resource productivity as a way to make a positive impact on the growth of GDP.

EU funding through its grant and research programmes to support these ambitions has remained unchanged. The EU also remains committed to bringing forward a series of policy proposals to support the recovery and re-use of secondary raw materials. Proposals for more ambitious changes to waste legislation including aspects of product design and toxicity of resources are planned for late 2015.[47]

[46] European Commission, Communication, (2014) Towards a circular economy: A zero waste programme for Europe, Brussels 2/7/14 COM (2014) 398 Final.
[48] G7 Summit Germany (2015) "Think Ahead. Act together". Annex to the Leaders' Declaration G7 Summit, Schloss Elmau.

Meanwhile others are adopting ambitious programmes to drive a resource efficient economy. Across the OECD and BRIICS countries the KOBE 3R Action Plan (Reduce – Reuse – Recycle) agreed by G8 Environment Ministers in May 2008 is being tracked by the OECD. This work shows that in terms of material consumption per capita consumption over the last 10 years has begun to stabilise at around 20t per person in G8 countries and 19 tonnes per person in OECD countries. They suggest that at a threshold level of income of around $25,000 per year per capita consumption stops increasing or even decreases if adequate policies are in place. Tracking these numbers is helpful in exploring the relationship between per capita domestic consumption and waste volumes produced.

Overall they report that solid waste has decreased by almost 4% over the past 10 years in the OECD countries while GDP continued to grow. The two tables on the next page show this relationship.

They report that virtually all OECD countries have introduced ambitious recycling policies and that across the G8 countries recycling has increased from 21-36%. They also highlight that of the 60 metals surveyed that only 18 are currently recycled at rates above 50% with 36 metals at rates below 10%. The opportunities to grow the circular economy in this area therefore remain substantial.

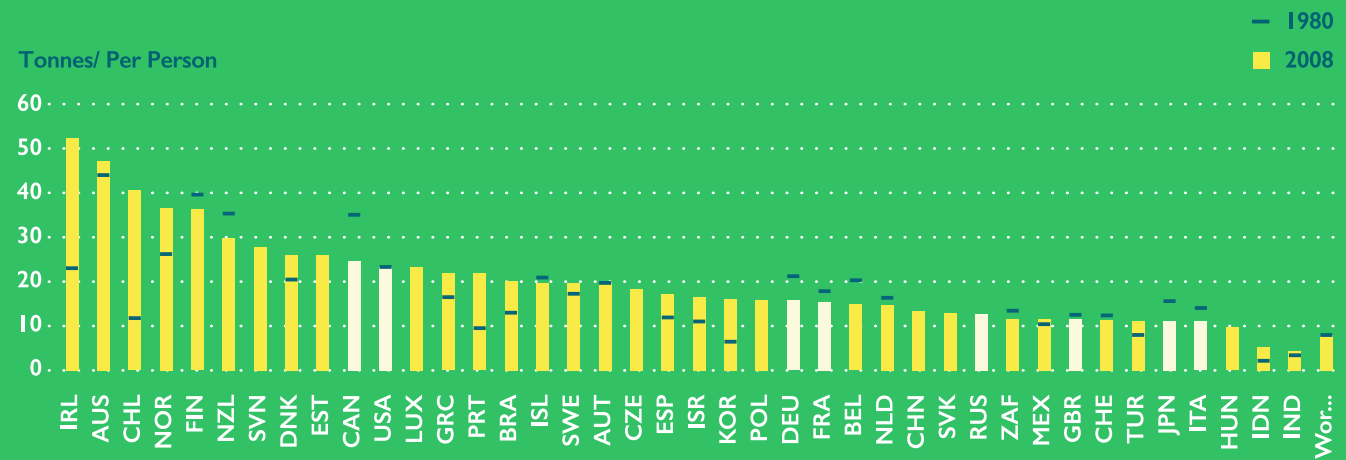
The G7 Leaders at their summit in Schloss Elmau Germany (7-8th June 2015) in the Annex to the Leaders Declaration agreed to establish an Alliance on Resource Efficiency.[48] The G7 agreed that it *"will be designed to provide a forum to exchange and promote best practices and foster innovation together with business (Business 7) and other stakeholders, including from the public sector, research institutions, academia, consumers and civil society, on a voluntary, nonbinding basis".*

A series of workshops are proposed covering the following topics:

- business initiatives and best practices (in cooperation with Business 7);
- policies to create favourable framework conditions;
- life-cycle-based decision-making tools, data, concepts, and methodologies of resource efficiency;
- industrial symbiosis, i.e., the sharing of services, utilities, and by-product resources among industries, e. g. through Eco-Industrial Towns;
- support for small and medium-sized enterprises (SMEs), including practical tools;
- policy approaches and best practices in specific sectors ;
- sustainable products and purchasing, green public procurement, local supply chains and the integration of resource efficiency into decision-making in government agencies;
- **circular economies, eco-design, sharing economies and remanufacturing ;**
- fostering research and innovation for resource efficiency and integrating resource efficiency into education and training;
- relevant activities in international forums and international organisations;
- experience from bilateral cooperation with developing countries and possible ways for the G7 to collaborate with and in support of these countries; and
- the potential of substituting non-renewable resources with sustainable renewable resources.

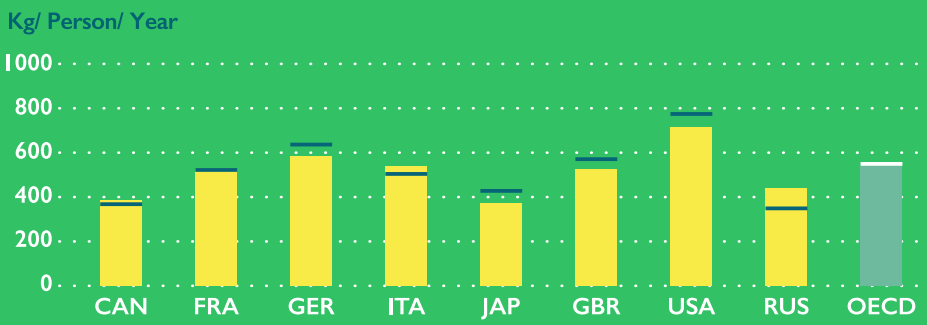
[47] Karl Falkenburg, (2015) Commission Director-General for Environment, Public hearing of the European Parliament's Committee on the Environment, Public Health & Food Safety (ENVI) 22nd January 2015.

Fig. 7 | Per capita domestic material consumption (DMC), OECD and BRIIC countries, 1980 - 2008



Source Resource Productivity in the G8 and the OECD. A Report Framework of the Kobe 3R Action Plan

Fig. 8 | Resource productivity in the G8 and the OECD. A report framework of the Kobe 3R action plan



Source: OECD stat
Notes:
CAN: Household waste, 2009: 2008 data.
JPN: 2009: 2008 data.
RUS: 2009: 2007 data. OECD 2010 Factbook

New partnerships NGO's - non government organisations and global business

The power of new partnerships, between NGO's, business and the financial community to drive the circular economy is also becoming clear.

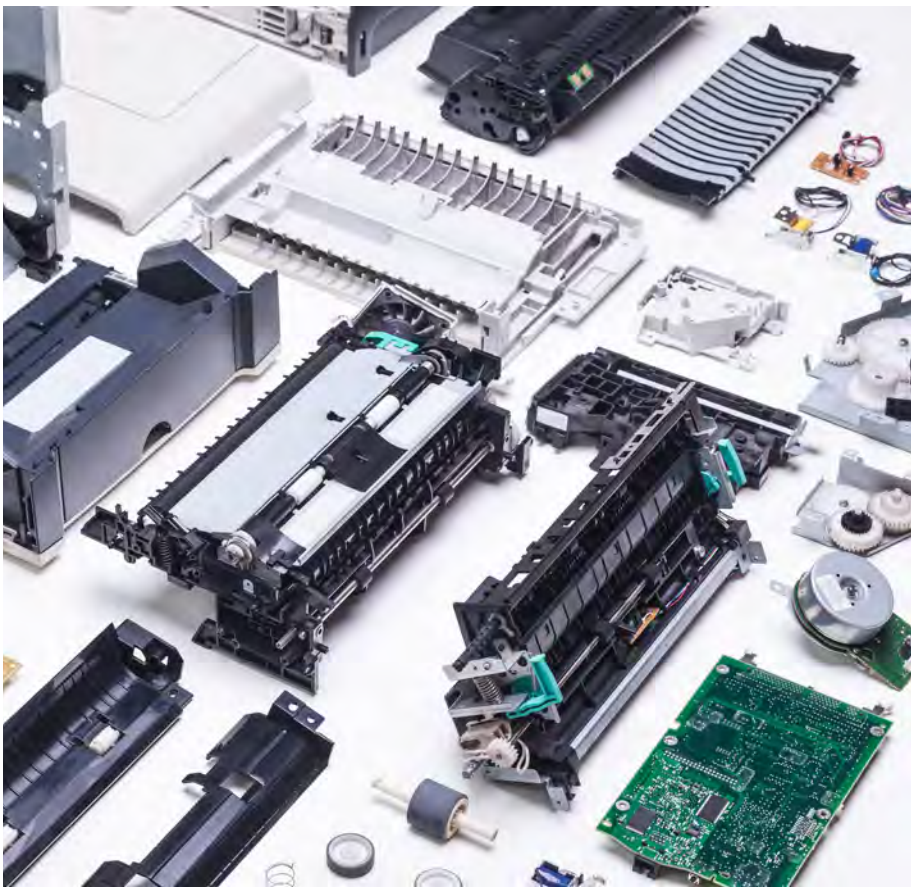
An example of these new partnerships can be found in the EU where the European innovation partnership on raw materials (EIT Raw Materials) was established in December 2014. With an initial budget of €4 million in its first year, the new Knowledge and Innovation Community (KIC) brings together 100 partners from 20 EU Member States. The KIC aims to create 64 new business start-ups and 5 new primary/secondary sources of critical raw materials. A key part of its business model will be recycling and material chain optimisation for End-of-Life products as well as work on the design of products and services in order to maximise the opportunities of the Circular Economy.[49]

In America the Government is investing $120 million in the Ames Laboratory Critical Raw Materials Institute[50] which coordinates the work of 250 researchers across 18 institutions and in its first year has pioneered new recycling techniques for rare earths from old electronics.[51]

Both these new collaborations demonstrate the commitments of governments to forge new partnerships with academic and commercial organisations to overcome the barriers to effective resource management.

The Ellen MacArthur Foundation, has also rapidly emerged as a global champion for the circular economy. Funded in a major partnership with business this NGO has developed and presented its ideas from a business perspective. In the same way that the Stern Report[52] crystalized the economic impacts that failure to tackle climate change would bring, so too the Ellen MacArthur Foundation have highlighted the economic benefit moving from our linear production model to a circular economy would bring to the European Economy. As outlined earlier they estimate the value to the EU Economy of about $520 – 630 billion or a recurring 3-3.9% of 2010 EU GDP.

The concepts are graphically displayed in the 2013 Ellen MacArthur Foundation report[53], prepared by McKinsey & Company. It builds on the work of William McDonough and Michael Braungart[54] who developed the idea of the "cradle to cradle" principle in which raw materials are recovered for re-use. These reports have had a global effect and have featured in discussions about the World Economic Forum in Davos. They have focused discussion on how business could operate differently in a resource-constrained world and the substantial profits and jobs growth that would follow. They have been followed by two further reports in June 2015.[55;56] These two reports were the centrepiece at the re-launch of the EU's drive to develop a more ambitious Circular Economy package.



[49] http://eit.europa.eu/newsroom/eit-selects-new-strategic-partnerships-milestone-europe-areas-health-and-raw-mat .erials https://cmi.ameslab.gov
[50] http://phys.org/news/2015-02-recycles-valuable-rare-earth-metals.html
[51] https://cmi.ameslab.gov
[52] The Stern Review, (2006) The economics of climate change, HMO 2006, London
[53] Ellen Macarthur Foundation, (2013) Towards the Circular Economy, The Ellen MacArthur Foundation, UK.
[54] William McDonough & Michael Braungart, (2002) Cradle to Cradle: remaking the way we make things, New York North Point Press.
[55] Ellen Macarthur Foundation, (2015) Growth Within: A circular economy vision for a competitive Europe, Ellen Macarthur Foundation & McKinsey Center for Business & Environment, (2015) UK
[56] Ellen Macarthur Foundation, (2015) Delivering the Circular Economy, A toolkit for policymakers, Ellen MacArthur Foundation, UK.

The first re-inforces earlier messages about the economic value of the circular economy for Europe identifying a €1.8 trillion saving by the year 2030. Such a saving would translate into a 7% GDP increase relative to the current development scenario. They also estimate that applying this model to three main sectors, mobility, food and housing, across the 3 sectors a 48% fall in CO2 emissions could be delivered by 2030.

The second is a toolkit for policy makers indicating how the circular economy model could be delivered. The toolkit has been applied in Denmark to show how it could work.

The Ellen MacArthur Foundation is not alone in building this momentum for change. Part of the reason is the decline of the role of the nation-state in the "globalized" international economy. Roughly 1300 companies in 2011 represented 60% of global revenues. With only 6 of the worlds top 100 transnational companies based outside the OECD (2012 data) countries,[57] opportunities for business driven change remain strong. Partnerships with such companies can be a powerful base for driving change in global business. UNCTAD calculated in 2011 that these companies held some $4-5 trillion in cash holdings. In 2011 they increased sales by 20% in developing countries and 13% in developed countries. Clearly their leadership is crucial in any discussions to deliver a global circular economy and is reflected in the recent announcements from the G7 referred to earlier.

Other NGO's such as the Institute of Environmental Management (IEMA) are drawing on the same industry partnerships to highlight the need for industry to prepare for what they call the "perfect storm". They highlight a number of factors that make up the perfect storm of scarcer and scarcer raw materials; rising commodity prices; rapid population growth; volatility of materials supply & energy prices; and climatic uncertainty and extreme weather. They argue that business will need new environmental and sustainability skills to

survive and stay competitive and that only 13% of major companies surveyed were confident they had the skills to compete in a sustainable economy.[58]

They highlight how climate change and resource volatility combined can devastate supply chains. The example they quote is the 2011 Thailand floods which shut 40% of the countries output at a time that Thailand produced 50% of the worlds hard drives.

With such risks to supply chains emerging many leading businesses are not waiting for Governments to legislate. They are teaming up with NGO's and academics to understand how they can adapt their business activities to take advantage of the economic opportunities the circular economy can offer.

[57] UNCATD, (2012) - World Investment Report 2012 - Towards a new generation of investment policies

[58] IEMA, (2014) Preparing for the perfect storm - Skills for a sustainable economy, United Kingdom

A technology shift

The above drivers for change, in resource management, are affected by the rapid pace of change in technology.

The global industrial history of the world has been driven by five waves of innovation.Each wave has been linked to new ideas such as:

- water power and mechanisation;
- steam power, railways, steel and cotton;
- the internal combustion energy, electricity and chemicals;
- petrochemicals, electronics and aviation;
- the internet, digital networks and biotechnology, the later linked to an explosion of both the quantity and scale of open data.

Linked to these waves of innovation the first industrial revolution was built around low cost primary raw materials and the innovation and skills to exploit them through mechanisation in the late 18th century. The early 20th century saw industrializing countries move through the second industrial revolution when they built their industrial base and wealth through mass production using those raw materials. Such countries have maintained that position with falling raw material prices and increases in labour productivity for nearly a hundred years. During that time they have built an economy with massive raw material supplies embedded into the infrastructure and the goods and commodities their communities use.

The same model has survived as OECD countries have offshored manufacturing (largely driven by lower labour and manufacturing costs) to the new economies such as China, India, Brazil, Vietnam and Bangladesh who are all growing strongly. As a consequence the global community has seen a growing scramble for the globes resources, which is clearly not sustainable.

Many now believe that we are going through the third industrial revolution affected by waves of innovation that are converging to provide the solutions to the global problems that are emerging around resource management, climate change and population growth.[59]

The Report the Next Manufacturing Revolution[60] agrees and argues that OECD countries are on the cusp of the next major manufacturing revolution. That in effect our society is at the point of a paradigm shift. The evidence they quote is summarized below as seven requirements that will drive this manufacturing revolution:

- A crisis - Economic, Environmental and Social all leading to a substantial increase in manufacturing costs;
- A return to first principles - as companies seek solutions to these problems;
- Better solutions are evident - Pioneering companies demonstrate the substantial economic benefits of a changing business approach;
- Resistance to change is evident - many Company's ignore the evidence and maintain linear production models;
- Gradual growth is evident - New ideas are starting to take root as the economic advantages of change becomes evident;
- A step change that is irreversible is evident - The new business approach embracing resource efficiency and the circular economy is so fundamental that once taken company's become locked into the new approach. There is no going back to the linear economy.
- The new approach is poorly defined - Leaders use different terminology to explain the changes.

The main reports listed in this study make it clear the economic case for change is massive. Growth in jobs, GDP and profits are predicted and underpin the overall policy approach from the EU and many economies around the world. Environmental issues drove the original arguments for the circular economy, but this is no longer the case. The arguments for the circular economy are arguments that this is a secure and more profitable business behaviour.

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[59] Economist, (2012) The third industrial revolution, April 21st 2012. http://www.economist.com/node/21553017

[60] Dr Greg Lavery et al, (2013) The Next Manufacturing Revolution - Non-labour Resource Productivity and its Potential for UK Manufacturing. The Next Manufacturing Revolution, UK. http://www.nextmanufacturingrevolution.org/nmr-report-download/

As part of this change it is expected that society will increasingly see manufacturing relocated close to the source of secondary raw materials and its main markets, securing access to tomorrows raw materials at yesterday's prices. As the value of secondary raw materials rises we can expect to see competition to access and secure them. It is here where the tighter inner circles of the Ellen MacArthur model start to make economic sense as companies seek to maintain ownership of those raw materials to secure their on-going future.

As the environmental externalities get factored into the traditional disposal of these materials business opportunity opens up the potential for innovation. The speed at which these changes can take place can be daunting and sets challenges for the waste industry. Former McKinsey Director Steven Heck and Director Matt Rogers argue that industry has the biggest business opportunity in a century as this resource revolution emerges. They point out that these pressures are a challenge to humanity, a challenge to innovation and a challenge to ingenuity. They give examples of the speed of change now evident in technological advances and highlight some of the unpredictability of the changes our society is seeing.

Nothing in modern times can illustrate this more graphically than the sudden swings in oil and gas prices triggered by the unexpected and rapid rise of shale gas in the USA. The discovery of shale gas, turned the US from a net importer of gas to a net exporter over a period of 5 years. It has led to a reaction from other global producers that have seen the latest price of crude oil fall to $45 per barrel before easing back to $50-60 per barrel. This dramatic price fall was not predicted.

They give further examples where technology has delivered rapid price falls for solar energy from $8/ watt peak to $2.5 / watt peak in a little over 3-4 years, of electric car batteries where costs are predicted to fall by a third and range increase to 250 miles and the rise in lease car systems within cities that increase vehicle utilisation from 4% to near 30%. Such changes could have further dramatic impacts on oil prices and will have impacts on the price of secondary raw materials and the pace of change.

They further argue that by "bringing together information technology with industrial technology, the application of biological technologies to resource problems, the use of new materials and nanoscale science to these industrial and resource productivity challenges all of a sudden it enables us to capture the kind of productivity growth that society needs, and more – so that it becomes possible to grow an economy while not actually increasing the demand for resources nearly as significantly, or while making the production of resources much cheaper than anyone expects".

These are persuasive arguments that the linear economy through its scientific and technical progress has created the opportunity for business to move into a new era in which the vast quantities of waste and raw materials in our economies becomes the driver for greater prosperity and growth. The key to business success lies in understanding both the risks and the rewards of these sudden technology shifts and in positioning the waste industry to benefit from them.

Understanding the impacts on the waste industry

"Looking into the future is a fool's occupation, but it is the bigger fool who dares not to."
- Voltaire

Introduction

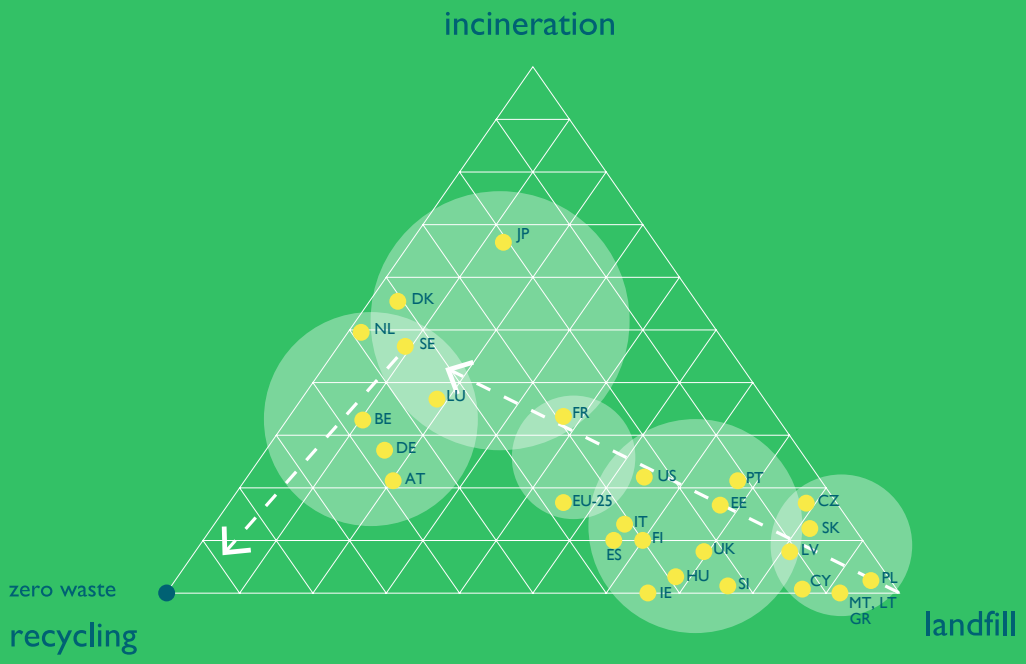
This report has reviewed the pressure on raw materials and outlined a changing world in the way resources are managed, commodities priced, and services delivered. This section reviews the current contribution of the waste industry in moving to a resource management – circular economy, the future contributions the waste management sector can make, the transition the sector has to undergo and the barriers the sector is likely to encounter during the transition.

Current contribution of the waste industry

The waste industry is at the heart of current legislative and economic pressures that are releasing a maelstrom of change across OECD countries in the way waste and secondary raw materials are managed. On-going ISWA work has suggested that the EU waste industry is being driven on a journey from managing waste to landfill, to managing waste for energy production and then to managing waste in a closed loop economy. What is clear is that other OECD countries like the US, Japan, Korea, New Zealand are on the same journey. Waste companies are also changing with major international companies rebranding their operations from waste management to "recycling and resource recovery" Within OECD countries it is mainly legislation and green tax changes that have triggering this change in the industry. Although globally landfill volumes are still set to rise enough examples exist across the OECD countries to demonstrate that it is feasible to all but phase out waste to landfill.

The early pioneers (circa Denmark, Netherlands, Germany, Japan, Sweden, Korea) now landfill less than 5% waste and have become highly efficient at generating energy from waste. Such countries have encouraged social behavioural change to support the development of the infrastructure

Fig. 9 | Evolution of waste management towards recycling[61]



Source: ISWA, (2011), Key Issue Paper - Waste Prevention, Waste Minimisation and Resource Management. Goorhuis, M., Barti, A.

required to process materials formerly landfilled. They are now going further as they explore how to cascade materials efficiently and integrate energy production in this process. Their waste industry and governments are seeking to balance the needs of society to both manage secondary resources effectively and ensure its embedded energy plays a key role in future energy supplies. They are also beginning to explore how waste volumes overall can be reduced.

A second group of OECD countries (circa UK , France, USA, Canada, New Zealand, Ireland) are in the middle of a major change process and whilst still dependent on landfill have moved large volumes of materials to alternate treatment systems. They are developing solid waste management plans that reflect national and local needs and tackling the social behavioural changes required. In many cases the infrastructure is not yet in place to process and use all the diverted materials and as a consequence a rapid growth in materials exported for recovery in other countries has taken place.

A third group of OECD countries (circa Greece, Spain, Turkey, Chile, Mexico and Israel) are still consolidating waste management around landfill operations and starting the journey to divert waste materials for recovery and re-use. Such countries are able to learn from the experience of those who have moved away from landfill as the main disposal route for waste.

The waste industry is therefore mainly active in the outer circles of the circular economy dealing with recycling of paper, plastics & metals as well as organic processing such as composting and anaerobic digestion. The industry is rapidly developing new technical processes to recover raw materials and energy from waste. It also provides safe final sinks for those materials that cannot be recovered either in engineered landfill sites or in highly efficient waste to energy plants.

As the pace of change accelerates the proximity principle has been eroded. The waste industry has been faced with the need for a home for materials displaced from landfill. The bulk of these materials were not designed for recovery and often consist of complex mixtures of metals, plastics and resins that are difficult to recover.

[61] ISWA (2011). Working Group Recycling and Waste Minimisation. Key Issue Paper on Waste Prevention, Waste Minimisation and Resource Management. Lead Authors Maarten Goorhuis and Andreas Bartl. Vienna, Austria.

The story of recovered plastics

288 million
tonnes of plastic manufactured in 2012

15 million
tonnes waste plastics traded

87%
by weight of EU plastic waste exported to China

Less than 5%
of new plastics production in 2012 traded as waste plastics

Source ISWA September 2014

As new nano materials are introduced along with new composite materials recovery becomes more complex and the need for more sophisticated processing develops. As we move through this transition period the waste industry has responded by developing a complex mix of emerging treatment technologies, waste to energy opportunities and export markets to overseas manufacturers.

Huge flows of plastics, paper, electronics and in the last 2 years Refuse Derived Fuels (RDF) and Solid Recovered Fuels (SRF) have built up. Materials now move from western countries to the new manufacturing centres across the globe. They also move to where capacity exists for energy production from waste. As an example between 2000-2008 European exports of plastic increased by 250% with 87% to China, yet only 5% as waste plastics are traded compared to the volume of new plastics manufactured in 2012. [62]

A market is also developing in SRF/RDF in North West Europe. Waste to energy plants in Scandinavia, Germany and cement works in the Baltic States have a need for waste fuels. In the UK and Ireland the export of SRF/RDF has risen from virtually nil to nearly 2 million tonnes by 2012.[63] The UK has a market potential of 26.9 million tonnes. Until capacity exists in the UK market to use these materials exports are likely to continue. Other OECD countries are in a similar position to the UK. As a consequence markets in these materials can be expected to continue for some time.

The waste industry has by and large responded to legislative and fiscal pressures from governments that have in effect pushed waste materials from landfill when no obvious market exists for the displaced raw materials. Indeed it could be argued that governments have largely failed to provide the market incentives that would generate demand from manufacturers for recovered raw materials. It has been left to pioneering manufacturers to open up the market opportunities to use recovered raw materials.

They operate in markets where the legislative and fiscal advantage in using primary raw materials remains substantial. The inbuilt bias is clearly shown from a recent IMF report that calculated the direct and indirect subsidies for the fossil fuel industry in Europe total some €300 billion a year. The price of crude has a substantial impact on the price of many secondary raw materials and a profound impact on the price of recovered plastics.

Across OECD states the complex way these pressures merge can be understood by taking the example of organic waste, including food waste. The volumes of food waste in a modern economy are substantial and in the EU reached over 100 million tonnes in 2014.[64] They are estimated to rise to 126 million tonnes by 2020 if nothing is done. Food waste can be tackled at source (waste minimisation) and this is clearly the most beneficial activity but once landfill is not the disposal option alternate treatment system must be developed.

Examples of successful programmes are not confined to the EU. South Korea has implemented food waste reduction plans that have delivered dramatic falls in food waste through the implementation of pricing policies. Food waste was banned to landfill in South Korea in 2005 and by 2011 some 95.3% of food waste generated was either recycled as animal feed or compost. Since then experiments with pricing systems have shown food waste can be reduced at source. In the pilots undertaken in the City of Gimcheon by January 2012 40% of the food waste had been reduced. Waste collection fees also fell by one third and 75% of residents indicted that the charging system had helped them reduce food waste.[65]

Best practice has been developed by the waste industry, which now fits the circular economy approach to dealing with organic waste. As a consequence a series of developments are emerging, to turn these waste materials into value added products including bio-gas, fertilisers, animal feeds and organic soil materials. Food waste is being converted into Bio-diesel in Sweden, and experimental work is underway to produce jet fuel and hydrogen in the UK. In Sweden some 55% of all gas used to power vehicles in Sweden now comes from bio-methane. Country by country reports are available[66] on the changes in the way organic materials are treated across the EU and illustrate how the waste industry is changing. They illustrate the effects of legislation in driving change and the growth of alternate treatment systems for organic materials.

[62] Velis C.A. (2014) Global recycling markets – plastic waste: A story for one player – China. ISWA September 2014, Vienna, Austria

[63] AMEC Environment & Infrastructure UK Ltd (2013). Research into SRF & RDF Exports to other EU Countries. Chartered Institution of Wastes Management Technical Report, Northampton, UK

[64] http://ec.europa.eu/food/safety/food_waste/index_en.htm

[65] OECD, (2014) Working party on agricultural policies and markets – Waste along the food chain,(- see http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/CA/APM/WP(2013)4/FINAL&docLanguage=En

[66] http://www.compostnetwork.info/sweden.html

Current waste legislation is mainly prescriptive command and control based. It is designed to control key waste streams either into disposal or towards recovery and reuse. In many cases the early phases of change have triggered incremental innovation, building on existing knowledge, resources and technologies. The legislation in place has been effective in driving this innovation as more efficient waste to energy programmes have evolved in countries with strong legislative controls such as Japan, Korea, Sweden, Denmark, Holland and Germany. It has been less effective at driving disruptive innovation that is capable of delivering quality secondary raw materials that can compete with primary raw materials. It is also at best ambivalent in supporting the creation of a circular economy in which "up-cycling"[67] rather than "down-cycling"[68] should be the first objective. It currently provides limited support to overcome the financial barriers that early movers face in establishing these new markets.

Where traditional command and control legislation has been combined with green taxes strong evidence exists to show that together they have been extremely effective in delivering change. Examples include, landfill, incineration, aggregates, and packaging taxation systems and more recently Green Taxes to support the Circular economy in China and the USA.

It is abundantly clear that secondary raw materials are regulated in a way that is very different from primary materials creating additional costs that lead to "market failures" when commodity market prices fall and place primary materials at a commercial advantage. This market failure is compounded by the lack of any substantive fiscal recognition of the carbon benefit of secondary raw materials which is substantial for many materials such as aluminium.[69]

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[67] "Up-cycling" is the process of converting waste materials into new materials of products of better quality or for better environmental value.
[68] "Down-cycling" is the process of converting waste materials into new materials of lesser quality and reduced functionality.
[69] WRAP, (2010) Environmental benefits of recycling, Banbury, UK.

Understanding future impacts on the waste industry

Turning the ISWA vision of an earth where no waste exists and where residual matter is safely disposed gains greater urgency as global leaders identify the scale of the challenge. The G7 summit leaders declaration 7-8th June 2015 highlights the need for greater action on resource efficiency alongside the need to tackle plastic litter which is now a global challenge directly affecting marine coastal life, ecosystems and potentially human health.

This study has reviewed the literature to gain an understanding of the predicted impacts on the waste industry of a move to a resource management economy in the OECD countries in which the vision of a circular economy continues to gain ground. Such a change is fully aligned with the ISWA vision.

Leaders in the waste industry articulate that the circular economy gives the industry an opportunity to extend its journey beyond recycling and engage with forward thinkers in design and manufacturing. By being part of this change process the waste industry can identify the opportunities for materials in the waste stream to be designed into new products, retained in remanufactured products and to displace primary raw materials and primary manufactured components. They see that waste companies have the opportunity to engage in the design of products & services and show designers how they can recover and reuse secondary materials to improve the profitability of new business models as they emerge.

By taking such action they believe that the waste industry will be better positioned to advise on best practice for cascading materials through cycles of re-use, to identify the optimum opportunities to extract energy from these materials and to design in strategic safe final sinks for unusable materials. To stand back from this process will be to allow others to dictate the direction of travel and leave the waste industry to deal with the consequences.

Leaders are now developing new skills and a new breed of entrepreneurs able to engage with designers and manufacturers. They will have at their fingertips accurate data on the flows of secondary raw materials as the waste industry continues to make improvements to its data systems. They will have a growing understanding of the technical processes that can be used to recover those materials and who can deliver raw materials to specification and on time to key manufactures. The Waste Industry is also working to evolve mature markets where manufacturers and the waste industry can trade materials in the full knowledge of what they are dealing with. A place where companies can buy and sell "blind"[70], where "futures" can be traded to balance the commodity price risks and ensure secondary materials have the same opportunity in the market place and can compete effectively with primary raw materials. A future where market traders are able to deal in secondary raw materials just as they currently do with primary raw materials. Manufacturers and designers will then have the confidence that they can blend primary and secondary resources in the full knowledge that our industry can deliver a quality product to specification and just in time.

Such changes will challenge where the boundaries of the industry are and will raise fundamental questions on the ownership of waste as it ceases to be a cost on society and moves to be a valuable asset. The current market for secondary raw materials is already worth $200 billion and estimated at 700-800 million tonnes.[71] It is dominated by recovered metals (nearly 50% by value) and paper (recovered paper now makes up 50% of the global paper market). Opportunities are growing for the recovery of plastics, raw materials from E waste and textiles.

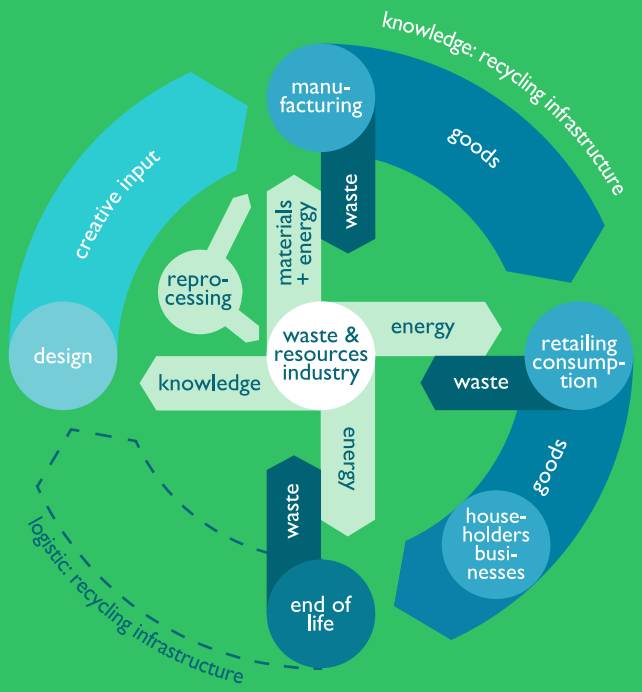
What is clear is that significant opportunities exist to exploit current market failure to capture and use secondary raw materials and that the waste industry has the potential to be at the heart of this process.[72]

A good example can be taken from what is happening in Europe, a continent that is now the largest importer of virgin raw materials in the world. Exploiting the circular economy opportunities here open up massive opportunities. Poor resource management opportunities are costing the EU between €253 - €468 billion per year. As a consequence even before the current debate on the circular economy took place legislation had set a 50% recycling target and a 35% target for landfilling of biodegradable waste.

Overall across the EU investment needs to meet the biodegradable waste diversion target are estimated to be around € 20 billion and would lead to the creation of 36,100 direct jobs.

[70] Essentially buying secondary raw materials without seeing them based on their description and specification.
[71] OECD (2015), Material Resources, Productivity and the Environment, OECD Green – Green Growth Studies, OECD Publishing, Paris.
[72] ESA (2014) Going for Growth – A practical route to the circular economy, London. UK http://www.esauk.org/esa_reports/Circular_Economy_Report_FINAL_High_Res_For_Release.pdf

Fig. 10 | The waste industry at the heart of the circular economy



Source: ESA, (2014) Going for growth - A pratical route to the Circular Economy

In the UK alone the Ellen MacArthur Foundation estimate that:
"The U.K. could save $1.1 billion a year on landfill cost by keeping organic food waste out of landfills - this would also reduce greenhouse gas emissions by 7.4 million tonnes p.a. and could deliver up to 2 GWh worth of electricity and provide much-needed soil restoration and speciality chemicals".

For other materials such as platinum in Germany the export of second hand goods strips out this critical raw material. Hageluken et al (2005)[73] estimated 30% of the platinum needed in German manufacturing industry was lost in the catalytic converters exported in second hand cars with over 100,000 annually shipped to Africa and the Middle East where it is likely these materials were lost.

WRAP[74] estimate that by 2020 the UK will have 12 million tonnes of electronic waste that will contain on current market prices precious raw materials worth over €8 billion. Currently only 30% of this material reaches recovery facilities where most is crushed, sorted and exported. Another example is mobile phones which contain gold in small concentrations, but still five times more concentrated than in most primary ores.[75] It makes no economic sense to loose these raw materials.

Elsewhere across OECD countries in South Korea the value and potential in discarded waste materials for metals and rare metals in waste is nearly €38 billion. In Japan work by the National Institute for Material Sciences estimated hidden metal reserves comparable in size to metal deposits of the leading producers.

When efforts to reuse and recover these materials are made it becomes clear the infrastructure is not available and the standards for recovery are not clear. Work by Jaguar/Landrover[76] into sources of aluminium for its next generation vehicles identified 40,500 tonnes of UK aluminium landfilled in 2009 and a lack of infrastructure to recover dirty aluminium. It also highlighted uncertainty on the metal alloy standards required to ensure that recovered aluminium was fit for use in new car manufacturing. Research was needed to establish the contamination levels that were tolerable in the metal alloys recovered.

A second example is work by ISWA[77] on recycling denim for jeans which initially highlighted the lack of infrastructure for spinning recovered denim fabric within the EU. Re-spinning denim offers significant savings on the production of virgin cotton both in cost and environmental benefits. Up to 60% secondary denim can be used in new jeans.

All these examples illustrate the economic power of the circular economy and why many OECD Governments and leaders in business are so attracted to the overall process. The business opportunities spelt out by these case examples give some idea of the opportunity the waste industry has over the next 10-20 years to change its business model and move to the heart of the circular economy. The challenge this sets for the waste industry is how to respond and become a core part of the change process.

[73] Hagelüken, C., M. Buchert, P. Ryan. (2005). Material flows of platinum group metals. GFMS. London.
[74] WRAP Facts & Figures - http://www.wrap.org.uk/content/facts-and-figures
[75] Hywel Jones, (2011) Sheffield Hallam University – What's in my stuff lecture, RSC.
[76] Adrian Tautscher, (2012) Jaguar/Landrover. Real Car Project Leader – Presentation at the CIWM Midlands Region AGM 2012
[77] Saxion University of Applied Science, (2013) Marijn Heerink et al, Experiences and bottlenecks with recycling of jeans, ISWA/NVRD Project Chain Management Jeans. Denmark.

Critical barriers to change

Introduction

This study was asked to identify the critical barriers that have been highlighted by key organisations, that stand in the way of the waste industry growing as a significant driver in the move to resource management and a circular economy. The pressures and challenges the waste industry face in becoming a major player in the circular economy have been outlined along with the economic opportunity that is emerging.

With the right global framework the waste industry will be able to not only address the growing problems of the safe disposal of waste to final sinks, but also make a major contribution to the development of open markets in secondary raw materials able to operate and compete with primary raw materials in a fair and equitable way.

What is clear from the literature is that the greatest impediment to change is the inertia that the current linear global business model exerts on change. Business interests now argue, for instance, that some OECD countries such as the EU have already set standards in recycling and recovery that have allowed the majority of economic value from secondary raw materials to be recovered. That in effect to go further would add costs to European business that would place it at an economic disadvantage with other manufacturing centres around the world and that the transition costs are too high.

The recent conference on the Circular Economy addressed by Environment Commissioner Karmenu Vella has made the case extremely clearly that this is not the case.[78] With Europe now exporting 9.5 million tonnes of waste to China the opportunity to create jobs in Europe is clear. He estimates that 400,000 new jobs will come from implementing the existing EU waste legislation and a further 200,000 from setting higher recycling targets. At the same meeting the Ellen MacArthur foundation estimate that changing to a circular economy vision for the EU would create a net benefit of €1.8 trillion by 2030, some €0.9 trillion more than in the current linear development path.[79] Whilst the prize is clear, however, the route map to that goal is not.

For the Waste Industry this study has been able to identify six areas that emerge from the literature that appear to be major barriers. The key six areas identified are explained in the next sub-sections.

[78] Speech by Karmenu Vella 25th June 2015 to the EU Closing the Loop Conference on the Circular Economy. http://ec.europa.eu/commission/2014-2019/vella/announcements/closing-loop-conference-circular-economy-introductory-remarks-karmenu-vella-25-june-2015_en

[79] Ellen MacArthur Foundation (2015) Growth within: A circular economy vision for a competitive Europe, UK

The european opportunity

"The scale the single market has to offer has not been exploited to its full potential for resources from waste. The 28 EU Member States are still organising their waste streams along 28 separated waste management infrastructures.

To move forward, Europe needs to start developing a single market for waste by target setting and driving harmonised policies on waste prevention recycling and end of life solutions"

From Niche to Norm - Suggestion by the group of experts on a systemic approach to Eco-Innovation to achieve a low carbon.
Circular Economy (2015) Brussels.

Six key barriers to change

Financing the waste industry to support the circular economy

Finance is clearly critical in any change process as significant as a change from a linear to a circular economy. Any change process has risks and it is clear with the changes currently underway that investment offers both high rewards and high risk.

Due to the fact that landfilling is still the predominant treatment route across most OECD countries and in virtue of the increase of municipal waste amounts substantial investments are required to deliver a circular economy. A new financing approach to better tackle investment needs for this niche of projects in the solid waste sector is needed in which partnerships are built with key manufacturing and retailing concerns. Although the Solid Waste sector is in a phase of growth that offers attractive opportunities for private and public investment the instability in secondary raw material prices will not be overcome without better partnerships with both suppliers of secondary raw materials and market users of the outputs.

Across OECD countries waste markets are also fragmented and some technologies are still facing issues of acceptance. Therefore, a new paradigm for funding waste projects by institutions has to be found. This will complement well-established financing products for major projects with innovative instrument to better address the need for "small" waste management facilities.

Within European OECD countries financing institutions have been supporting comprehensive solid waste management schemes including different kinds of technologies. Solutions found for the EU markets will have wider relevance across OECD countries. The EU as a global leader in the circular economy will be watched and mirrored by others. ISWA has the opportunity to ensure the experience is shared across OECD and BRIICS countries to accelerate the pace of change.

Regulations to support "materials management"

It is widely recognised that the prescriptive command and control waste regulation is not suited to solving the problems presented by the recovery and re-use of secondary raw materials. The fractured methods of implementation create further barriers in an industry that now routinely moves recovered raw materials across global markets. Innovators in the use of secondary raw materials and in the development of innovative treatment methods want consistent decisions that can be applied across OECD and global markets. Decisions that affect recyclate quality now have implications for OECD trade, they impact primary raw material resource flows, they change the dynamics of markets and they have world trade implications. The recovery and re-use of secondary raw materials are also affected by decisions covering product regulations and economic regulations. In effect the Waste Industry and pioneering manufacturers have a poor regulatory framework to support the recovery of secondary raw materials, one that generally stifles innovation. The problem of market failure in the recovery of secondary raw materials is being recognised in Europe, but the global nature of trade means wider solutions are needed.

A new regulatory construct that moves from "waste" to "materials management" is required. In most OECD countries the regulatory construct is fit for purpose for waste management, it is not fit for purpose for secondary raw materials management. Regulations therefore remain a major barrier to progress. The USA has suggested, a radical re-think of the waste versus non-waste core regulatory construct. A regulatory framework is needed that will move to a world where all (primary and secondary) materials have similar management controls/incentives based on their risk potential rather than as a waste – that is moving to a "materials management" rather than "waste management" regime. This would apply to all materials including those used in the energy supply industries. In such a world waste would only exist when it was designated for final disposal in landfill or in incineration where the prime purpose was its safe containment or destruction. It is clear from leading OECD countries that this percentage can be well below 5% and with the best in Sweden now at 0.7% to landfill. [80]

Many now point out that regulatory change must be linked to fiscal change. It cannot be right that the use of primary raw materials are subsidized to a point where the economic advantage of using secondary raw materials is cancelled out. Fiscal incentives are also required to ensure that business as usual for manufacturing companies becomes the most expensive solution as the real price of externalities is factored into the price of primary raw materials. The balance between the early movers and the status quo for manufacturers must change. As the Niche to Norm report makes clear "The aim should be that businesses in transition should face lower overall taxes, whilst "business as usual" industries should be provided with incentives to change. Where such fiscal solutions have been put in place (circa the landfill taxes in many OECD countries), change has been rapid and has inspired radical new solutions and the emergence of new technologies.

With such an approach the waste industry can be the catalyst that makes it possible for manufacturers and energy suppliers to use secondary raw materials as their main or substantive raw material supplemented by primary raw materials and fossil fuels as required. Once manufacturers and energy suppliers take the step change it becomes irreversible and puts the waste management industry at the centre of the change process.

Such a regulatory construct would encourage:

- an effective cascade of materials securing highest value at lowest cost and support the emergence of new technology in waste management;
- high grade recyclate materials with clear key end markets;
- common minimum standards that build confidence in secondary raw materials;
- international co-operation on enforcement, so that markets in secondary raw materials can operate effectively.

[80] Swedish Waste Management (2014) Avfall Sverige, Malmo, Sweden.

Commodity markets for secondary raw materials.

The lack of commodity markets for secondary raw materials has been recognised in both the USA and the EU. For such markets to work a series of changes need to take place in the way policy makers view and regulate waste. Without these changes it remains a complex challenge to drive up recycling standards in rapidly urbanizing OECD countries and to give confidence to designers to specify secondary raw materials.

Commodity markets for secondary raw materials are yet to fully emerge. Trials to establish such markets with the exception of secondary metals have by and large failed to achieve material size. Early trials in the USA between 1993-1995 with the Chicago Board of Trade (CBOT) were unsuccessful. The lessons from these trials have been clearly laid out in two reports prepared for the LIFE+ project, "European Pathway to Zero Waste", by D Doherty.[81;82] The lack of effective commodity markets for secondary raw materials remains a major blockage to driving up standards. OECD countries have the potential to develop global commodity markets for secondary raw materials building on the experience of the London Metals Market, CBOT and the work undertaken by the LIFE+ project EPOW. This was recognised in the original EU Resource Efficiency Roadmap.

Secondary raw material markets need to provide the same services as those currently operational for primary raw materials. That is markets were participants can expect to:

- buy and sell materials sight un-seen;
- have price transparency;
- have low transactional costs;
- have built in systems to protect against price fluctuations and "futures" trading is common place;
- have regulatory certainty; and
- have computerised data and information systems to underpin that market.

These conclusions are supported by the OECD. In a report prepared in 2006[83] and summarized in a policy brief in 2007[84] they identified 5 potentially significant barriers and failures in markets for recyclable materials:

- search and transaction costs;
- information failures;
- consumer perceptions and risk aversion;
- technological externalities; and
- market power.

Quality standards are fundamental to any commodity market. For secondary raw materials common standards are needed that will work across OECD countries and answer both regulatory (End of Waste) and market (Quality Requirements) questions. No designer will use secondary raw materials unless the properties of those materials are understood, the quality is guaranteed and the supply chain is secure. Such markets will move the management of secondary resources from "push" (supply driven by regulation) to "pull" (driven by commercial needs and wants). Whilst secondary raw materials are regulated as waste across OECD countries, common End of Waste standards are critical to their effective recovery and add costs not born by primary raw materials. Work in the EU[85] and the UK[86] has shown how progress can be made within the existing legal framework but it is both time consuming and costly, even when online tools are provided to help such as ISITWASTE.[87]

[81] Doherty , D, (2010) reported for the ERDF project "A pathway to zero waste" on the reasons for the failure of the CABOT pilot. A report for the Environment Agency, Bristol, UK

[82] Doherty, D (2010) Developing a commodity market for recovered materials. A report for the ERDF project A pathway to zero waste. RA report for the Environment Agency, Bristol, UK.

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[87] https://isitwaste.org/equal/en/#/new/END_OF_WASTE

Data & information systems

Data and information on secondary raw materials remains poor. Although data on waste flows has improved across OECD countries, data on commercial and industrial waste is still inconsistent, often of poor quality and not timely. To move to a resource efficient economy it is essential that the waste industry develop as close to real time data as possible for all major waste flows. As society recognises the value of recovered secondary raw materials, and seek to add value by moving materials back into productive use, such data is crucial for investment decisions. Such real time systems are emerging in Korea, Australia, Japan, and across parts of the EU. In an era of "big data" it is essential that such systems become geographically comprehensive and that aggregated data is globally shared through such systems as UNEP Live[88] or similar platforms.

It is perverse that across OECD countries we allow secondary resources to be lost from the economic system through a lack of knowledge on where they are and in what quantities. Many are cheaper to exploit, have higher concentrations than can be found in virgin deposits and in most cases have a lower carbon footprint to bring to market than the primary raw materials they seek to displace. Secondary aluminium is an excellent example along with gold in electronic devices. Data is key to mining this resource and making the economic case for this to change.

[88] http://uneplive.unep.org

Best practice and skills exchange

The Waste industry in OECD countries is evolving at a widely different pace between the market leaders, early followers and those who are seeking to catch up. The industry faces significant challenges in building the skills needed to move from a waste industry to a resource management industry and to attract the qualified engineers that will be required to operate complex plant required to recover secondary raw materials. Exchange of best practice is slow to evolve and many challenges remain in both policy and technology transfer across OECD countries, challenges that increase in complexity in BRIICS and other developing countries.[89]

It is clear that solutions exist to the challenges faced by countries that have been slow to move to a recycling economy. Opportunities exist to exchange best practice across OECD countries but the scale of change required gives an indication of the challenge the industry currently faces. By way of example within the EU if the aspirations of the Road Map to a Resource Efficient Europe were to have been met the rate of change for the slower countries would have needed to be at a pace not achieved by the early pioneers in a move away from landfill. In the wider OECD if society is to avoid the problems highlighted by the UNEP International Resources Panel the waste industry will have to transfer and re-skill the workforce, adopt best practice and innovative ideas at an accelerating pace to avoid the resource shortages currently mapped out and allow countries to jump technologies and move into the circular economy.

Recognition is also needed of the fundamental shift in skills and expertise that moving to a resource management economy demands of the existing waste and resource management industry. Initiatives such as those put in place to build skills for the building sector to deliver energy and climate change objectives under the Intelligent Energy Europe programme, are needed for the waste industry to move to a resource management industry. Skills transfer programmes developed by ISWA, and others such as CIWM and the Renewable Energy Association will need to be scaled up. [90]

[89] Editorial, (2015) Waste Management & Research Vol 33 Issue 2 February 2015 (p93-95).
[90] See The Renewable Energy Association (REA) 2012 at:: http://www.r-e-a.net/news/advanced-biogas-learning-in-europe-able-eu-leonardo-project. Also Chartered Institution of Wastes Management (CIWM) City of Copenhagen and Avfall Sverige Leonardo Programme: http://www.ciwm.co.uk/CIWM/RegionalCentres/Midlands/Leonardo/Leonardo_Programme.aspx Also ISWA Study Tours: http://www.iswa.org/nc/en/185/iswa_calendar/eventlist/noaction/trainings.html

International co-operation

It is clear in a global market place that international co-operation is essential if the global strategic advantage of a circular economy is to be achieved. As with primary raw materials both the waste industry and leading manufacturers need global agreements on quality, consistency in regulation and cooperation in the provision of data on the flows of raw materials contained in the waste sector. Both need an open and transparent commodity market through which they can buy and sell secondary raw materials and have the confidence to buy "blind" with the full realisation that dispute resolution processes exist.

Conclusion

It is clear from this study that a third industrial revolution is underway that is having a profound impact across OECD countries. This change is supported by the age of the internet that facilitates the exchange of ideas at a pace never seen before. A race has begun between states to see who can reposition to gain first mover economic advantage. OECD states are beginning to use their financial and regulatory capacity to kick-start a circular economy model that treats all resources as valuable and productive. In the process it is inevitable they will break down the silo mentality between the use of primary and secondary raw materials. The opportunity for the waste and resource management industry is to be able to use its expertise and knowledge to map out how this change can be delivered.

This study has set out to ensure all ISWA Members:

- understand the critical thinking behind the circular economy and resource management;
- understand who the main stakeholders/ driving organizations are behind the concept of the circular economy and resource management and their current positions;
- are aware of the high-impact and important publications within the topic area;
- are clear about the possible contribution the waste management sector can make in the field of resource management; and
- have an understanding of the transition the sector will undergo and the barriers the sector will overcome during the transition.

No transition is ever easy, nor will it run at the same pace in each of the OECD Member Countries. Winners and losers will emerge but without doubt the opportunity is clear for a vibrant engaged waste industry to be at the core of these changes.

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Members of the ISWA task force on resource management

Björn Appelqvist
Chair
City of Copenhagen, Denmark

Ana Loureiro
EGF, Portugal

Andreas Bartl
Vienna University of Technology, Austria

Bettina Kamuk
Rambøll, Denmark

Costas Velis
University of Leeds, UK

Gary Crawford
Veolia, France

Jane Gilbert
Carbon Clarity, UK

Martin Brocklehurst
Chartered Institution of
Waste Management, UK

Tore Hulgaard
Ramboll, Denmark

Kata Tisza
ISWA General Secretariat

Prepared by the ISWA task force on
Resource Management with the support:

KEMPLEYGREEN CONSULTANTS

ISWA
International Solid Waste Association
Auerspergstrasse 15, Top 41
1080 VIENNA — AUSTRIA
Telephone +43 (1) 253 6001
Tefefax +43 (1) 253 6001 99
www.iswa.org iswa@iswa.org