THE WARREN CENTRE

THE CIRCULAR ECONOMY

Global trends and future challenges

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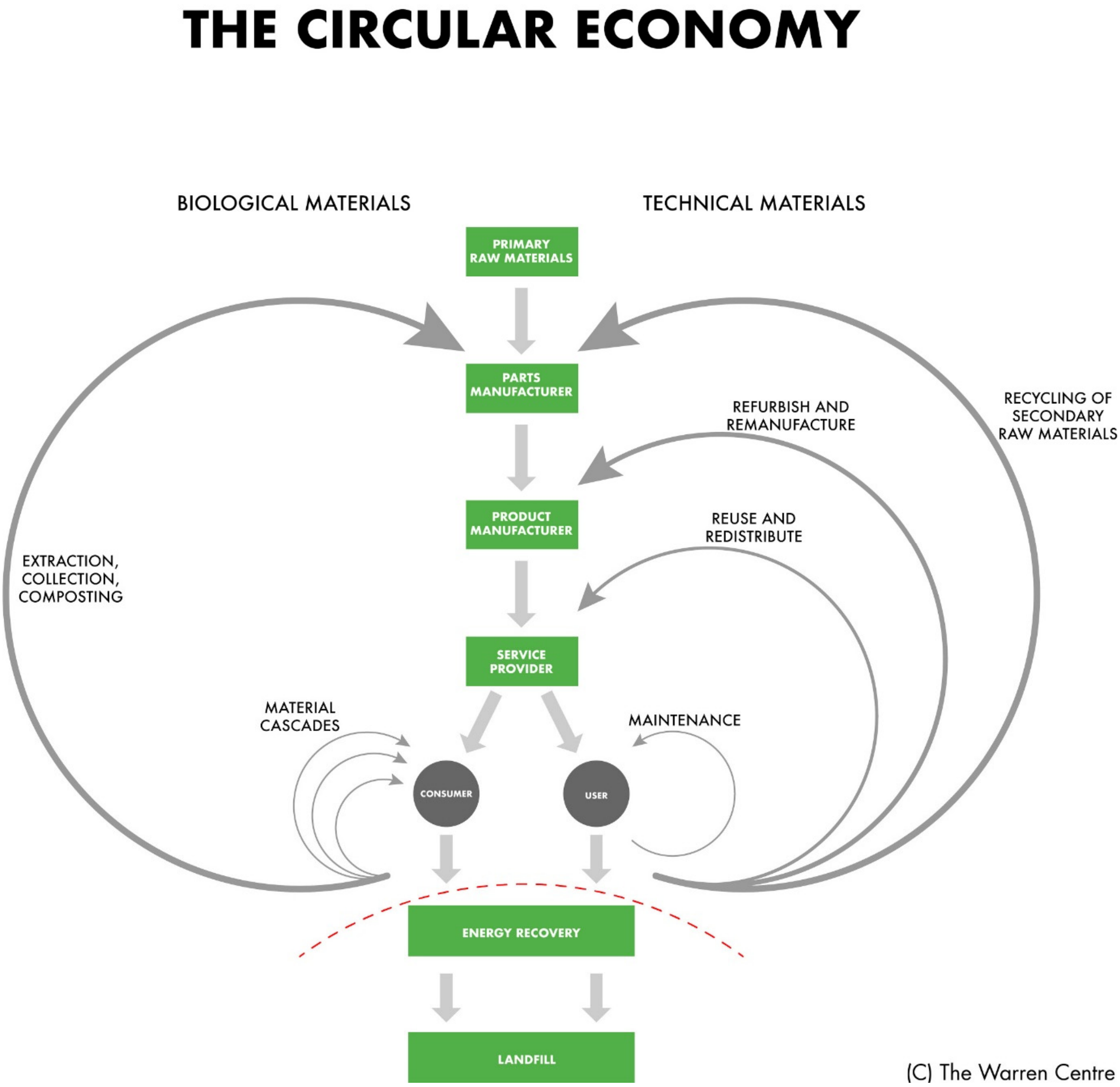
THE WARREN CENTRE

The Circular Economy:
Global Trends and Future Challenges

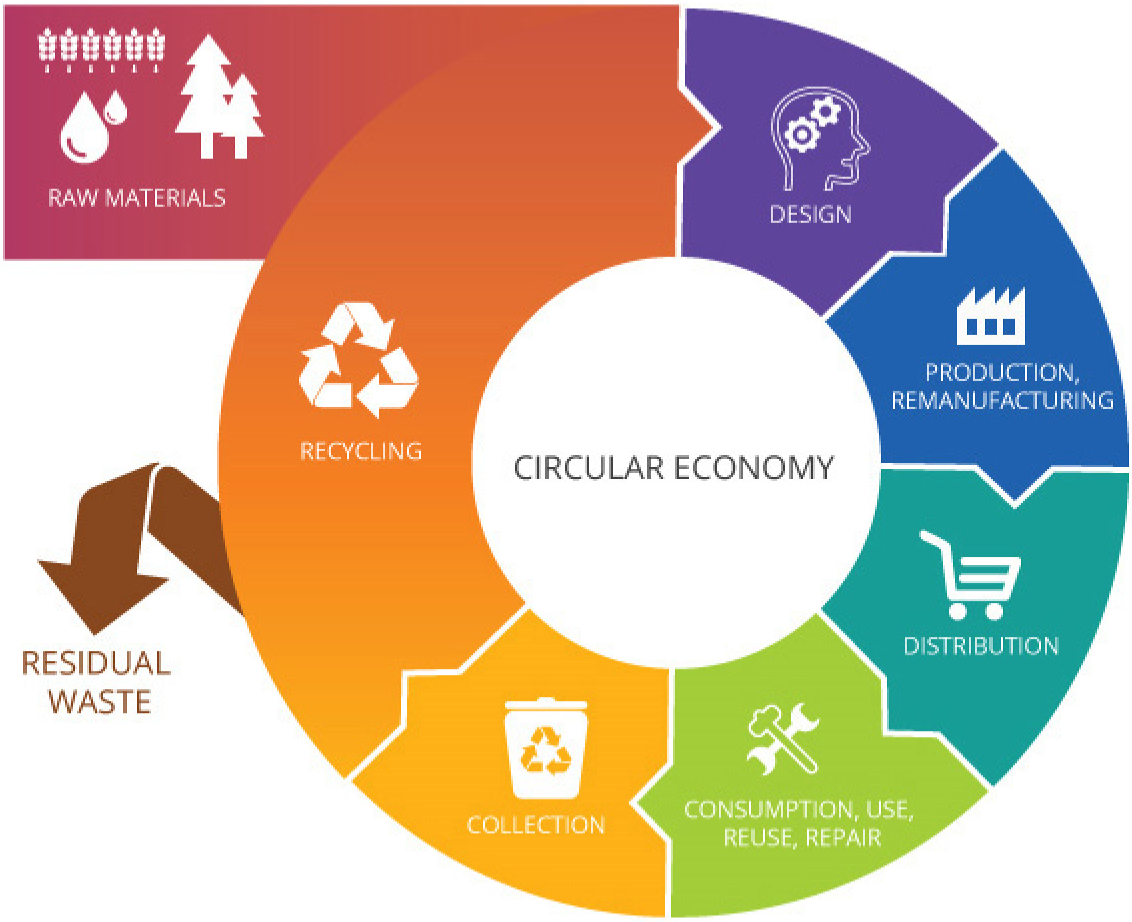


(C) The Warren Centre

The concept of a circular economy refers to a system where resources are redeployed and reused and waste flows are turned into inputs for further production. These processes can happen at any scale from the composting of organic waste for gardening to entire industrial systems which exchange waste streams. The current linear economy operates as a 'take-make-use-dispose' model where inputs are extracted natural resources and output is waste like landfill, air pollution or unharnessed energy. Within a model like this, producers increase profits by increasing sales rather than improving productivity.[1] Producers incentivise mass consumption and unfortunately mass waste. Subsequently, 80-90% of goods become

[1] International Solid Waste Association, 'Circular Economy: Trends and Emerging Ideas', Sep 2012

waste within six months of consumption.[2] With natural resource supplies dwindling and prices rising, it has become more important than ever to reform industrial and economic systems to achieve a closed resource loop. This model should mirror the efficient resource cycling found in the natural environment. Not only will the circular economy model reduce waste, but it also could mean huge cost savings, with McKinsey estimating $630 billion saved in material costs for just a subset of the EU manufacturing sector.[3] The creation and enactment of a circular economy will involve reform at a system level, product level and consumer level.



The Circular Economy Process (C) European Union, 1995-2017

The circular economy requires a large overhaul of industrial systems to fully enable a closed resource loop and ensure full resource productivity. This means moving away from traditional methods of waste disposal like landfill and incineration to recycling and reusing. At its most efficient, waste streams from one industry will become a resource for the other, containing waste within this closed loop. For example, by-products of burning coal can be used in fertilisers, concrete and plasterboard. This requires a certain level of co-location of the factories and industries within these loops. Already, China is legislating and creating eco-industrial parks where chemical, steel, cement and other industries are located to exchange waste streams as resource inputs.[4] Logistical constraints mean that co-location is not always possible, and so markets for secondary commodities must also be developed.

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2 ibid

3 Felix Preston, 'A Global Redesign? Shaping the Circular Economy', Chatham House (the Royal Institute of International Affairs), Mar 2012

4 Biwei Su, Almas Hashmati, Yong Geng, Xiaoman Yu, 'A Review of the Circular Economy in China: Moving from Rhetoric to Implementation', *Journal of Cleaner Production*, volume 42, Elsevier, 28 Nov 2012

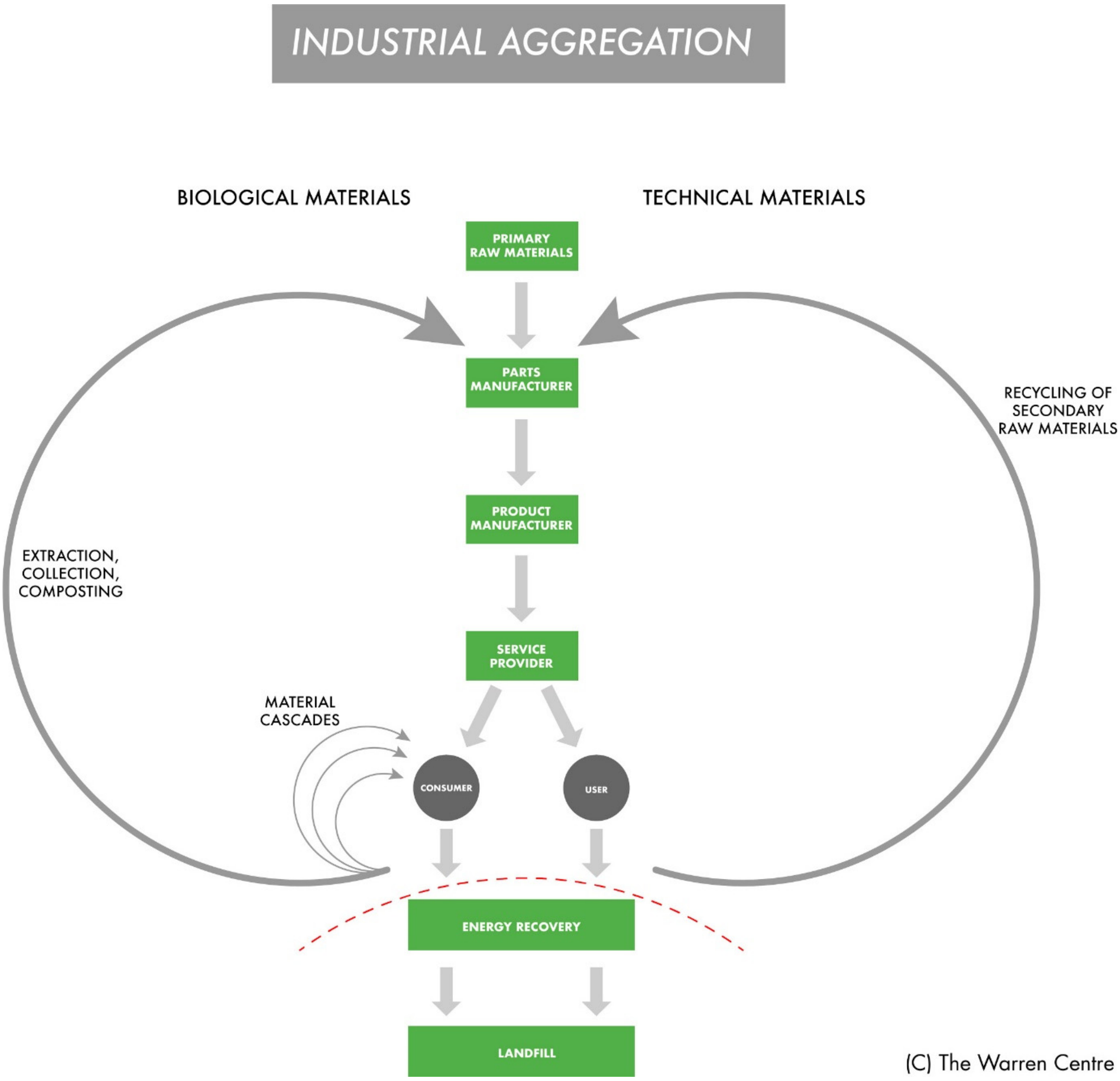
In a circular economy, manufacturers must design products considering their entire lifecycle and not just relinquish responsibility at the point of sale. This concept of 'cradle-to-cradle' means that designers should create longer lasting products, reuse parts and use less material. Product components must be able to be reused whether through 'upcycling', i.e. conversion into better quality or environmental value; or 'downcycling,' conversion into lesser quality. The creation of fully degradable or reusable products and materials requires further research and innovation, particularly in the areas of nanotechnology and biotechnology.

Ultimately, consumer demand will also drive the circular economy. With rising commodity prices, increasing environmental legislation, and potential green taxation, market price signals will push consumers to choose less waste-intensive products and services. There also exists a possibility for an overhaul of the way consumers experience goods and services, based not on ownership but on final needs. Where an ownership model encourages businesses to create more products to maximise profits, a final needs-based model considers the utility required and fulfils it through tangible products and intangible services.[5] The move to services and shared use is increasingly being seen in Australia with companies such as Uber and OBike.

This paper identifies current global trends towards a circular economy for industrial systems, products and consumers and examines the role of different stakeholders including government, industry and academia. The key legislative, technological and education barriers towards implementation are also considered.

5 Arnold Tukker, 'Product Services for a Resource-efficient and Circular Economy – A Review', *Journal of Cleaner Production*, volume 97, Elsevier, 7 Dec 2013

Global Trend 1:
INDUSTRY AGGREGATION AND AGGLOMERATION



(C) The Warren Centre

One of the cornerstone principles of the circular economy is the development processes where the waste streams from one industry become the material inputs for another and hence represent a marginal income stream. This already occurs at a small scale. Computer scraps, for example, contain more gold per unit weight than gold ore.[6] The process becomes more difficult at a larger scale, but the benefits are greater. With higher levels of waste stream aggregation and increasing economies of scale, the economic yield

[6] McKinsey & Company, 'The Circular Economy: Moving from Theory to Practice', McKinsey Centre for Business and Environment, Oct 2016

Computer Scraps
by Curtis Palmer / CC-BY 2.0

on secondary waste streams increases. Waste tyres, for example, are commonly recycled to recover scrap metal. By making tyres a part of a high-value industrial process and reusing the rubber, the value extracted can increase by up to twenty times.[7]

Using waste streams in high-value industrial processes requires two main conditions: economies of scale and economies of aggregation. The former is required because meaningful volumes and income flows are needed to justify investment in the required infrastructure. The latter is a matter of logistics as waste streams need to be physically co-located to ensure efficient transfer of waste and energy. Eco-industrial parks fulfil these requirements and are one of the main instruments of the circular economy. They are defined by the United States Environmental Protection Agency as:

> *"A community of manufacturing and service businesses seeking enhanced environmental and economic performance by collaborating in the management of environmental and reuse issues including energy, water, and materials. By working together the community of businesses seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only"*[8]

In South Africa, the Recycling and Economic Development Initiative of South Africa (REDISA) was established to process scrap tyres in a high-value material recovery process rather than incineration. Eighteen months after its establishment in 2012, collection rates increased from 3% to 70%.[9] The creation of this scheme has environmental benefits and provides further employment and industries. It is estimated that 10 full-time jobs are created for every 1000 tyres collected by REDISA.[10]

Perhaps the most resounding success story of an eco-industrial park is the Kalundborg eco-industrial park in Denmark. The project began in 1972 with Asnaes, currently Denmark's largest coal-fired power station. Kalundborg is now a collection of companies that rely on each other's waste outputs for their material inputs. For example, treated wastewater from an oil refinery is used as cooling water for the power station, and the oil refinery and a pharmaceuticals company use otherwise wasted steam from the power station. Cement and plasterboard manufacturers use 170,000 tonnes of fly-ash produced by Asnaes. Enzyme-rich pharmaceutical by-products become 1.5 million cubic metres of fertiliser used by local farmers. Furthermore, excess heat is used to warm homes in Kalundborg, removing the need for 3500

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[7] ibid

[8] United Nations Industrial Development Organisation, 'Economic Zones in the ASEAN – Industrial Parks, Special Economic Zones, Eco Industrial Parks, Innovation Districts as Strategies for Industrial Competitiveness', UNIDO Country Office in Vietnam, Aug 2015

[9] McKinsey & Company, 'The Circular Economy: Moving from Theory to Practice', McKinsey Centre for Business and Environment, Oct 2016

[10] ibid

Kalundborg Power Station
by Mr3641 / CC0

domestic heating systems.[11] Through this industrial symbiosis, not only is solid waste reduced, but it is estimated that CO_2 emissions are cut by 270,000 metric tonnes. A survey of executives of the participating companies estimate a total savings of $72 - 87 million per year.[12]

In China, concepts of the circular economy are now forming a large part of government planning and policy. The heavy industrial city of Dalian was used as a trial city with the municipality implementing strict waste management and energy efficiency regulations. From 2005 to 2010 energy efficiency per GDP and industrial value added was increased by 21% and 27% respectively.[13] In Tianjin, industrial symbiosis amongst steel manufacturers, chemical manufacturers, concrete companies and construction companies is coordinated like Kalundborg. China's Thirteenth Five Year Plan (2016-2020) looks wider and beyond trial cities. It includes a directive to "make coordinated plans for industrial layouts based on material flow and industrial linkage, encourage industrial parks to adopt a more circular operational flow, establish hybrid industry-agriculture circular economy demonstration zones, and promote the coupled growth of enterprises, industrial parks, and industries."[14]

[11] International Institute for Sustainable Development (2013), 'Kalundborg', International Institute for Sustainable Development, 2013, https://www.iisd.org/business/viewcasestudy.aspx?id=77

[12] Reuters, 'In Danish Trial of "Symbiosis," One Business' Waste is Another One's Gold', NBC News, 20 Dec 2015, https://www.nbcnews.com/business/energy/danish-trial-symbiosis-one-business-waste-anothers-gold-n482521

[13] Biwei Su, Almas Hashmati, Yong Geng, Xiaoman Yu, 'A Review of the Circular Economy in China: Moving from Rhetoric to Implementation', *Journal of Cleaner Production*, volume 42, Elsevier, 28 Nov 2012

[14] Central Committee of the Communist Party of China (2015), *The 13th Five Year Plan for Economic and Social Development of the People's Republic of China.*

Case Study 1: Carbonated Fly Ash in Australia

A major link in many eco-industrial parks and industrial aggregation scenarios is the use of fly-ash, a waste stream from burning coal, as an admixture for cement. This process is being used across the world from Kalundborg to Tianjin.

Recent research at the University of Sydney has examined the potential of using fly-ash for CO_2 sequestration and offsetting some of the emissions generated by the cement industry, accounting for 5-7% of global CO_2 produced.[15] This involves embedding the greenhouse gas emissions from coal into the fly-ash, a waste stream from the same process. This co-location of waste streams makes carbonated fly-ash an ideal circular economy approach. The research by Professor Ali Abbas studied scenarios for using carbonated fly-ash in Australia and the trade-off in compressive strength as more fly-ash is added to the cement. It was found that a cement blend with 10% carbonated fly-ash substantially retains its engineering capabilities. Based on 2013-14 emissions, the use of carbonated fly-ash could reduce Australia's carbon emissions by 0.43%.[16] Extrapolating this for the most recent 2015-16 emissions, this means a reduction of 0.78 million tonnes of CO_2.[17]

Similarly, research at Anna University in Chennai predicted a 2% reduction in emissions for an Indian context.[18] While not reducing carbon emissions as much as carbon capture or "clean" coal power stations, carbonated CFA is a much more feasible solution as part of wider decarbonisation in the short-medium term. This solution would work well with economic instruments such as carbon taxes or emissions trading schemes as economies transition from coal reliance to renewables. The green cement created by this process is currently being trialled in the construction of pavements in Sydney.

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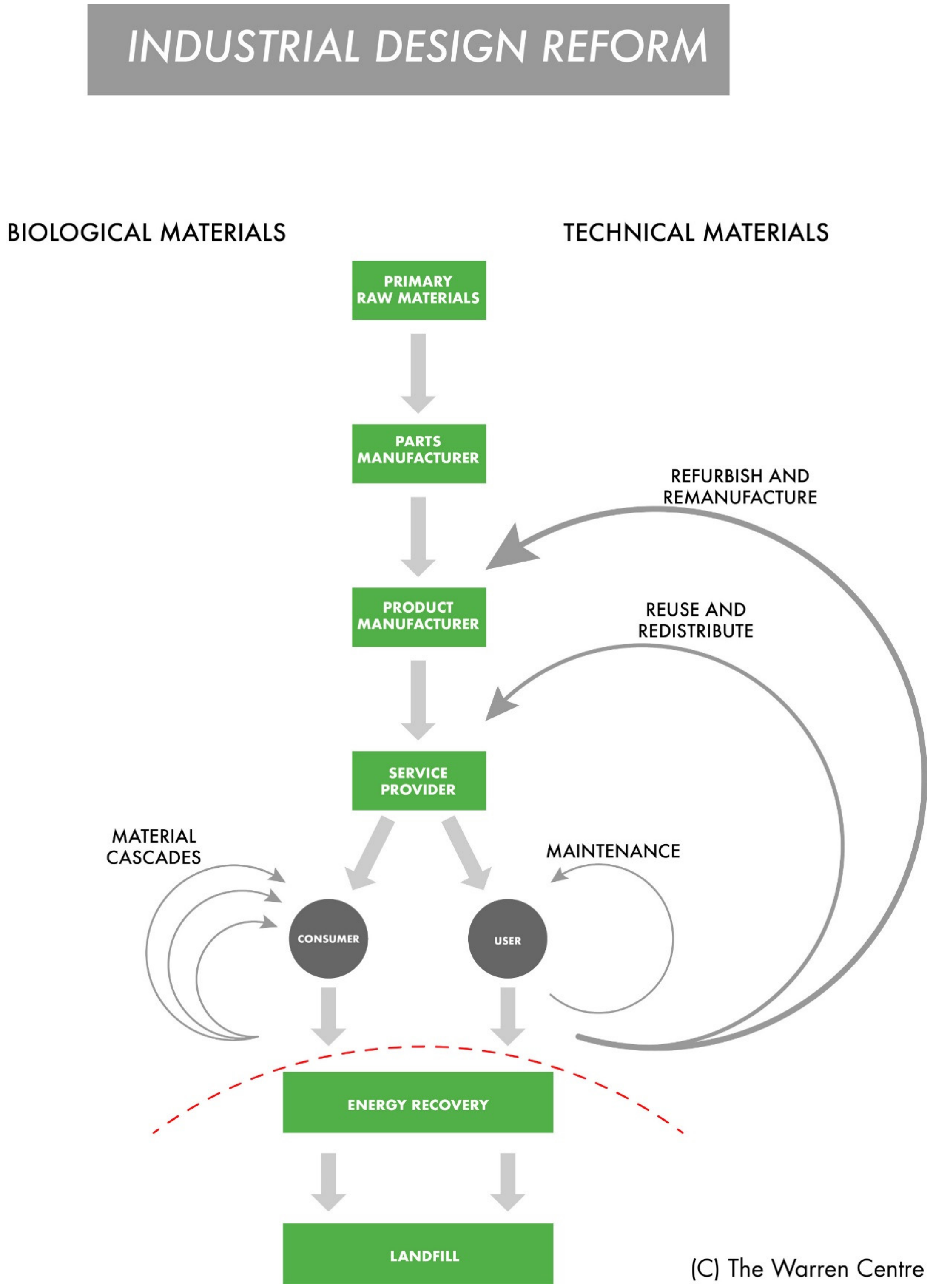
[15] WRI, 'Navigating the Numbers. Greenhouse Gas Data and International Climate Policy', World Resources Institute, Feb 2005

[16] Amirali Ebrahimi, Morteza Saffari, Dia Milani, Alejandro Montoya, Marjorie Valix, Ali Abbas, 'Sustainable Transformation of Fly Ash Industrial Waste into a Construction Cement Blend via CO_2 Carbonation', *Journal of Cleaner Production*, volume 156, Elsevier, 10 April 2017

[17] Australian Government Clean Energy Regulator (2017), 'Electricity Sector Emissions and Generation Data 2015-16', Australian Government Clean Energy Regulator, 19 April 2017, http://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/electricity-sector-emissions-and-generation-data/electricity-sector-emissions-and-generation-data-2015-16#Designated-generation-facility-data-201516

[18] Rushendra Revathy Tamilselvi Dananjayan, Palanivelu Kandasamy, Ramachandran Andimuthu, 'Direct Mineral Carbonation of Coal Fly Ash for CO_2 Sequestration', *Journal of Cleaner Production*, volume 112, Elsevier, 25 Jun 2015

Global Trend 2:
INDUSTRIAL DESIGN REFORM



Circular economy ideas can be applied to individual product design as well as industrial systems as a whole. This concept is known as cradle-to-cradle production where products themselves are designed to be recycled, reused or just use less material. Industrial designers should create products that are financially viable but also have minimal waste impact. In this way, man-made products simulate natural degradation processes like dead organic material providing nutrients for future generations of organisms. This design objective, known as biomimicry, is a further example of how the natural environment provides a template for waste processes.

However, moving to cradle-to-cradle production is not trivial and requires great change. Currently, industrial design is characterised by planned obsolescence and bespoke and unique parts that make replacement difficult. Extending product lives will mean a downturn in revenue for suppliers, but manufacturers might learn lessons from others industries like music, television or even private transport that are moving towards subscription-based services. Subscription provides a better business model to apply circular economy concepts. For a product designed with recycled materials to be financially viable, a steady supply of that recycled material is required. The kind of recycling infrastructure that would provide industrial volumes of secondary raw material are rare throughout the world and require significant technical development and supportive legislative advances. For benefits in the long run, circular economy concepts must be taught extensively informal industrial design courses.

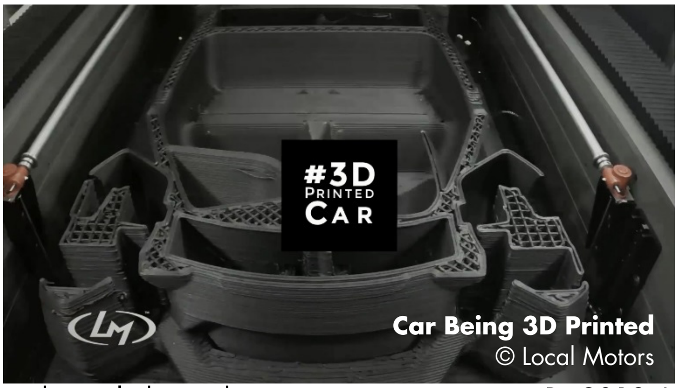
There are firms presently designing and manufacturing using the cradle-to-cradle method. Carpet maker Desso processes old carpet tiles to make yarns that go into new carpets.[19] Bituminous material from the tiles is also recycled. The firm aims to fully use cradle-to-cradle production by 2020 and is not relying on external sources for secondary raw materials. Automobile manufacturer Renault is creating a series of cars designed to permit 95% of their mass to be reused or recycled. Similarly, Caterpillar has been recycling its own industrial equipment, saving 59,000 tonnes of steel in 2010.[20]

Renault Captur Luxe with Eco2
By M 93 / CC-BY-SA 3.0

[19] Felix Preston, 'A Global Redesign? Shaping the Circular Economy', Chatham House (the Royal Institute of International Affairs), Mar 2012

[20] ibid

Case Study 2: Local Motors



Car Being 3D Printed
© Local Motors

Local Motors is a Phoenix-based automotive company applying circular economy concepts to disrupt and revolutionise their industry. The company uses 3D printing to create the bodies of their car models which can account for a large part of the car's mass. This means that a substantial fraction of the high cost capital equipment like press lines and robots are not necessary. Furthermore, at the end of life, the individual 3D printed plastic parts can be melted down and recycled to make create new components. By 2018, Local Motors expects to be able to create entire new cars from recycled parts.[21]

Using 3D printing also means the design of the cars can be easily customised for individual needs. Whereas traditional automotive manufacturing involves a production line with multiple units, Local Motors can create single run models with no further cost induced.[22] This reduces the oversupply of vehicles and subsequent end of year sales before the next model, a process which creates vast amounts of solid waste. Because of this, Local Motors' business model does not involve a central plant and various dealerships but rather small micro-production plants where these cars are produced according to specific needs. Local Motors is also pioneering an innovative model for a hybrid product-service system.

World's First 3D Printed Car
© Local Motors

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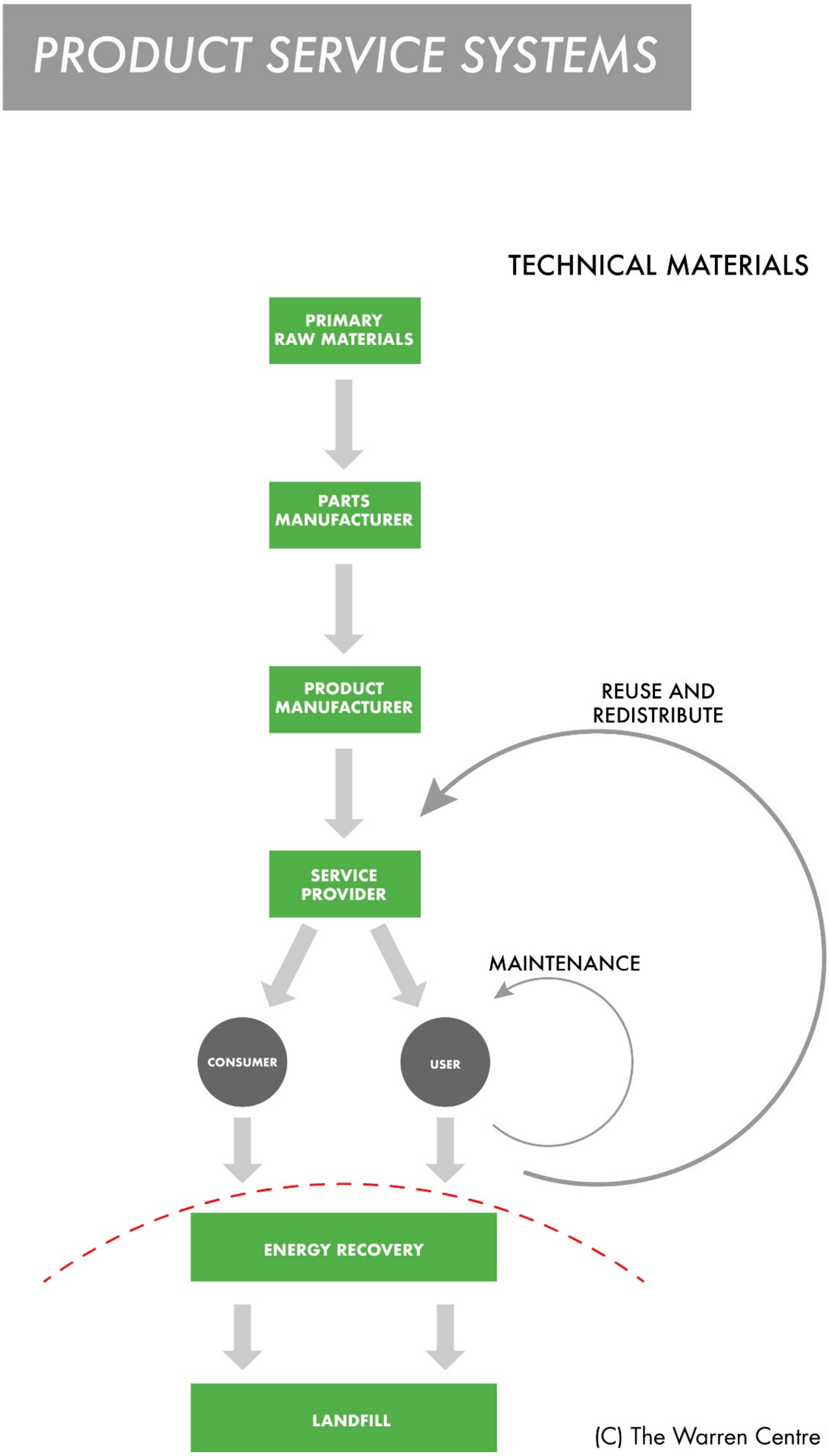
[21] John Hayes, 'Your Next Car Could be Custom Made for as Little as $12K – and be Recyclable', accessed at https://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/13578/Your-Next-Car-Could-be-Custom-Made-for-as-Little-as-12K-and-be-Recyclable.aspx, 02 Nov 2016

[22] Kristine Owram, 'How Local Motors hopes to disrupt the auto industry with a $53,000 3D-printed car', *Financial Post*, accessed at http://business.financialpost.com/transportation/how-local-motors-hopes-to-disrupt-the-auto-industry-with-a-53000-3d-printed-car, 19 Jan 2016

Global Trend 3:
PRODUCT SERVICE SYSTEMS




OBike
by EdwardX / CC-BY-SA 4.0

Consumer behaviour must also change if the linear economy is to be replaced by the circular economy. Without an apparent demand, firms will have no incentive to change their business models to recycle and use less input material. Increasingly business models for consumer products have been shifting from a product-based system to a product service system (PSS). A product-based system involves firms selling discrete goods to the consumer, incentivising manufacturers and marketers to create more products to sell to more buyers to make more profit. This has been the traditional business model for consumer products and has been entrenched by technological constraints, force of habit and the need for individuals to have control and ownership over objects. Alternatively, in a PSS, a firm does not sell a product but rather a fulfilment of a need, and the product is merely a conduit for satisfying consumer needs. This is seen in ridesharing services like GoGet or OBike, and even for shared office spaces. These business models prioritise access over ownership and take advantage of the idle capacity of these goods. Indeed, in the US, cars go unused on average for 23 hours per day.[23]

The ease with which products can be rented, shared and leased has undoubtedly been driven by advances in information and communications technology. By creating large networks of consumers with shared needs and utilities, the same level of service can be generated with fewer physical products. Incidentally, the apps and digital infrastructure which host these services eliminate paper waste as well. For firms to move to this kind of model, the World Economic Forum has identified four key actions to take. Firstly, businesses should understand better and improve their relationships with customers to clearly identify needs and possible revenue streams for PSS. Secondly, monetising idle capacity such as office sharing generates income and reduces waste. Thirdly, firms need greater control over the life cycle of their product by providing service contracts, for example, which allow better monitoring and planning. Finally, the revenue streams created through PSS need to be stabilised to ensure longevity and sustainability.[24]

PSS has great potential to vastly reduce material inputs in a variety of consumer industries, but there are drawbacks. Research has shown that leased products may not be treated with the same amount of care as owned products. Increasing wear and tear on these products means more repair costs for firms. In Australia, the irreverent dumping of OBikes in the Yarra River exemplifies this perfectly. Research into PSS and its role in the circular economy is becoming more prevalent, and the exact role and impact of PSS is yet to be determined.[25]

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[23] World Economic Forum, ‘Towards the Circular Economy: Accelerating the Scale-up Across Global Supply Chains’, World Economic Forum, Jan 2014

[24] Arnold Tukker, ‘Product Services for a Resource-efficient and Circular Economy – A Review’, *Journal of Cleaner Production*, volume 97, Elsevier, 7 Dec 2013

[25] ibid

Case Study 3: Suzhou New District

China's centralised top down approach to the circular economy has resulted in the development of eco-industrial parks to exchange and use waste streams. One of these is the Suzhou New District, which consists of 4000 different firms operating within 52 square kilometres, much larger than western counterparts like Kalundborg.[26] Established as one of the first national demonstration sites for eco-industrial parks, its success has come through the volume and variance of the different waste streams exchanged. For example, waste ammonia from chemical processes is used in the desulphurisation process for paper manufacturing.[27] While a completely closed loop is ideal, it is not always possible, and where gaps have been identified, processes are in place to plug them. This often involves partnerships with foreign firms like DOWA metal in Japan which supplies recycled copper and gold for circuit board manufacturing. The use of circular economy concepts in the Suzhou New District has led to significant waste and energy reductions. Between 2005 and 2010, the energy intensity dropped by 20% and was less than half the national average energy intensity of 1.24 tonnes of coal equivalent per 10,000 yuan of GDP. At the same time, organic pollutants in the water reduced by 47%, and sulphur dioxide pollution was reduced by 38%.[28] The success of the Suzhou New District demonstrates the power of the circular economy, particularly on a large scale. With China's resource use five times less efficient than the OECD and expected to produce one quarter of the world's solid waste by 2025,[29] these actions are more important than ever.

[26] John A. Mathews, Hao Tan, 'Circular Economy: Lessons from China', *Nature*, 23 Mar 2016

[27] Zongguo Wen, Xiaoyan Meng, 'Quantitative assessment of industrial symbiosis for the promotion of circular economy: a case study of the printed circuit boards industry in China's Suzhou New District', *Journal of Cleaner Production*, 1 Mar 2015

[28] John A. Mathews, Hao Tan, 'Circular Economy: Lessons from China', *Nature*, 23 Mar 2016

[29] Daniel Hoornweg, Perinaz Bhada-Tata, Chris Kennedy, 'Environment: waste production must peak this century', *Nature*, 30 Oct 2013

Future Challenges

Although transitions to a circular economy are happening in various places across the world, it is far from widespread. For circular economy concepts to be applied, there are several barriers which must be overcome. Legislative, technological and logistical issues pose future challenges for implementation, and a linear economy inertia must be overcome. As best practice is established in developed countries, frameworks are established to be transferred to developing countries.

LEGISLATION

Landfill in Perth, WA
by Ashley Felton / CC0

A major legislative issue holding back the implementation of circular economy concepts is the lack of proactive materials management regulation. Most regulatory frameworks are poorly defined and focus on 'waste management' rather than 'materials management'. For this reason, there is no incentive to recover secondary raw materials, and the price of production does not include negative externalities such as waste and pollution. Regulation to reduce waste should be specific and incentivise and manage based on the risk potential of different waste streams. This would allow the amount of waste going into landfill or incineration to be controlled more accurately and minimised. In countries like Sweden, where such regulation already exists, the percentage of waste in landfill is 0.7%.[30] New regulatory frameworks can ensure that waste streams are priced effectively, and standards are promoted for international and firm-to-firm cooperation. The transition to circular economy regulations should be accompanied by fiscal policy incentivising this change. As the regulatory framework is introduced, firms engaging with change should be less burdened by taxes. This may come through a waste tax or trading scheme for example.

The lack of commodity markets for secondary raw materials remains another barrier to the implementation of circular economy concepts worldwide. To move from small waste stream loops like eco-industrial parks to a global circular economy, there needs to be mediation and regulation of these materials. Such commodity markets have been established in the past but did not reach sizes to be economically viable.[31] With increasing awareness of the circular economy and technology allowing waste streams to be better understood and used, the creation of secondary raw materials commodity markets is more important now than ever. A well-regulated market would ensure quality standards and provide easily accessible data and information to firms willing to use waste streams as inputs. With a growing market and more certainty about pricing and regulation, secondary materials can become a much bigger part of industrial design. Furthermore, an international materials market would enable the circular economy at a global level.

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30 International Solid Waste Association, 'Circular Economy: Trends and Emerging Ideas', Sep 2012

31 World Economic Forum, 'Towards the Circular Economy: Accelerating the Scale-up Across Global Supply Chains', World Economic Forum, Jan 2014

LOGISTICS AND TECHNOLOGY

Logistics
by Ana Rahal / CC-BY-SA 4.0

Implementation of the circular economy on a large scale requires major logistical considerations. A product which is to be reused for parts at the end of its life may have upwards of 20 components, each with its own reuse loop. This can easily be recycled and reused on a small scale, however with so many consumer goods being made in Asia and sold in Europe and the USA, this becomes a much larger logistical endeavour. The World Economic Forum has identified four different types of supply chains and loops for products and materials.[32] Firstly, the linear model sees end-of-use products disposed where they are consumed. In the open cascade model, some materials and components of end-of-use products are brought into unregulated secondary markets mainly where they are consumed. A partially open loop involves end-of-life products being used and recycled at their place of consumption. This involves a linear component, e.g. initial manufacturing from raw materials and then a loop reusing the components at the place of consumption. Finally, a closed loop supply chain sees all materials and components returned to their original place of production to be reused. Clothing manufacturer H&M uses a closed loop supply chain by collecting old jeans and sending them back to Pakistan to be spun and converted into new jeans. Ideally, a closed loop system best fulfils the requirements of the circular economy, however it requires enormous logistical capabilities that might not always be efficient. Organising these loops at the correct scale (i.e. within a region, within a country, within a continent) will ensure that integrating waste streams as inputs becomes economically viable.

Recycling and reusing materials and components are not trivial tasks and require significant disassembly procedures. This is particularly true for many consumer products which use precious metals and plastic polymers. These raw materials are combined in complex ways, and end-of-use recovery requires just as much if not more complexity and technological capability. With hundreds of additives like pigments or flame retardants for the four main types of plastic polymers (polyethylene, polyethylene terephthalate, polypropylene, polyvinyl), the different combinations are becoming more numerous and more complex. There are several key issues for end-of-life disassembly that require significant technological advancements. Firstly, the efficiency of separation processes, both physical and chemical, needs to be improved vastly. Manufacturing a mobile phone requires $16 worth of raw precious metals, but upon disassembly only $3 can be recovered.[33] The scale at which this disassembly occurs also needs to be

32 Ellen Macarthur Foundation circular economy team

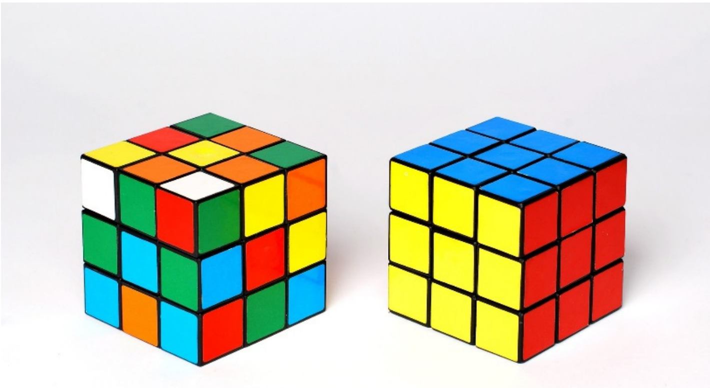
33 World Economic Forum, 'Towards the Circular Economy: Accelerating the Scale-up Across Global Supply Chains', World Economic Forum, Jan 2014

improved. Current methods may not be economically viable at their present size and reliability, however the R&D investment needed to upscale will only come with advancements elsewhere. Industrial reverse treatment also needs to ensure the purity of the secondary raw materials, particularly when one firm is using materials and components from another firm's products. Companies like Desso, which recycle yarns for their carpet tiles, are considering technology to remove glue and latex from end-of-life products more efficiently.[34] With the complex and various plastic polymers being used today, identifying and distinguishing the different materials is difficult. Unlike precious metals, the differences in these polymers occurs at a molecular level making large scale separation techniques, such as magnetic separation or melting point differentials, difficult. In the UK, Veolia is using infrared technology to distinguish among plastics, however much more innovation is required.

Accompanying a well-regulated secondary raw material commodity market, accurate data and information systems are needed for tracking waste flows and identifying raw materials. While the physical infrastructure for transporting materials and components is important, advanced information systems could allow global loops to be more efficient and productive. Real-time tracking of waste streams would provide the certainty of price and availability that using secondary raw materials has often lacked. This would promote the use of these waste streams and the economies of scale that come with this growth.

LINEAR ECONOMY INERTIA

Perhaps the largest barrier to implementing circular economy concepts is the linear economy inertia. The 'take-make-dispose' model which has defined modern industrial systems has become embedded in the global economy and society. Although the benefits of a circular economy may be clear, steering away from the norm will be difficult. This transition will require a combined effort from all stakeholders including consumers, producers and regulators and a correct alignment of incentives throughout the supply chain.



Solving the Puzzle
By Croisy and Pixabay / CC0

For consumers, an important part of overcoming this inertia is increased access to information. Consumers will often only consider the price of an item at the point of sale, opting for a cheaper option when a more expensive but longer lasting alternative may have a more economical net present value. Alternative models like PSS need to be put in direct competition with traditional models for consumers to evaluate themselves with better consumer information. Chatham House suggests a product labelling system which would allow consumers to choose products with more sustainable features and materials.[35]

For firms, this transition will prove even more difficult. The capital equipment and logistics systems used by these producers are ingrained to existing business models, and changing to circular economy concepts will require a massive overhaul. This includes the high-up front investment costs of upgrading machines, changing factories and creating new logistic systems. There is also risk of cannibalisation where these new circular economy products will eat into sales of other ones for no net gain. When printing company

34 Felix Preston, 'A Global Redesign? Shaping the Circular Economy', Chatham House (the Royal Institute of International Affairs), Mar 2012

35 ibid

Ricoh introduced their GreenLine recycled printers, a control plan ensured cannibalisation did not occur. While some circular economy concepts can be applied within a firm, industrial aggregation and agglomeration requires the cooperation of various producers. For these industrial ecosystems to form, all firms must be ready and willing at the same time. Furthermore, firms in the same industry that are competing against each other may not want to cooperate in this way.

RESEARCH AND EDUCATION IN DEVELOPING COUNTRIES

The way different economies deal with waste streams is vastly different across the world. Many Scandinavian countries have highly advanced systems which efficiently separate and reuse materials, but in developing countries, the take-make-dispose model is still deeply rooted. As the developed world moves towards a circular economy, it is important that lessons learnt and best practices are transferred to the developing nations. Although these waste streams may be more complex, developing countries present an opportunity to move directly to the circular economy, skipping intermediate steps that the developed world has undergone. This is already apparent in China's recognition of the circular economy in its recent Five Year Plans. Passing on these skills and best practices will not be easy but will be aided by the scaling up of transfer programs by international organisations like the International Solid Waste Association, the Chartered Institute of Waste Management and the Renewable Energy Association.[36]

Conclusion

The circular economy cannot be defined by a singular course of action. Rather, it is a multi-faceted approach to waste and materials management. As such, the different global trends and future challenges for the circular economy remain separate but intrinsically intertwined. At a large scale, industrial aggregation and agglomeration allows waste streams to be reused as inputs for further production. At a product level, goods are increasingly being designed to become a part of this system, employing materials that can be reused and recycled. Different purchasing models like product service systems allow consumers to engage with the circular economy as well. While some of these circular economy concepts are being applied across the world, there remain many legislative gaps and technological barriers to global implementation. In the short to medium term, the linear economy will remain prevalent.

The following actions have been identified as important steps towards the circular economy.

- Pricing of negative externalities through taxation and trading schemes
- Fiscal support for businesses transitioning to circular economy concepts
- Further research and development in materials science for more efficient identification and separation of plastics
- Using data and information systems to create databases of secondary raw materials
- Establishment of secondary raw materials commodity markets

[36] World Economic Forum, 'Towards the Circular Economy: Accelerating the Scale-up Across Global Supply Chains', World Economic Forum, Jan 2014