JOURNAL ARTICLE

How to globalize the circular economy

NATURE COMMENT Vol 565, pp. 153-155 (2019)

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Set up an international platform to share data and experiences, and coordinate industrial policies and trade to conserve resources and energy, urge Yong Geng, Joseph Sarkis and Raimund Bleischwitz.

Keywords Environment, Circular Economy, Global Governance

Publication 9 January 2019
DOI: 10.1038/d41586-019-00017-z
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Globalize the circular economy

An international platform should be set up to share data and experiences and co-ordinate industrial policies and trade to conserve resources and energy, urge Yong Geng, Joseph Sarkis and Raimund Bleischwitz

Industry must rethink its approach to resources. Manufacturing is profligate --- it takes a tonne of metal, silicon and plastic to produce a laptop weighing a few kilos. Waste is an afterthought --- 8 million tonnes of plastic are dumped into the oceans each day. Greenhouse gas emissions are out of control --- cement production alone generates 1.5 billion tonnes of CO_2, equivalent to emissions of over 325 million cars, each year[2]. Water is squandered --- on average it takes 1,250 litres of water to grow one kilogram of rice in China**.**

Global demand for resources is expected to double by 2050 (ref UNEP). If producers continue to simply manufacture, use and dispose, they could expend more than half of the CO_2 that can safely be emitted until 2050 without making the planet 2° C hotter. Unimpeded resource extraction and use puts greater pressure on multiple sensitive planetary boundaries such as exhausting rare minerals and injuring biological diversity.

Clearly, resources need to be managed more sustainably.

Yet, only 6% of materials are recycled. That is surprisingly little given potential savings. Reprocessing aluminium takes half as much energy as extracting the metal from ore. Products made from reworked plastics are 80% cheaper[3], if costs of collecting, sorting and processing plastic waste can be driven down. Supplies of scarce resources, like rare metals such as Lanthanum and Yttrium, can be protected. The costs of disposal are avoided and new revenue streams open up from materials that would otherwise be discarded. Increasing circular economy practices in China could save businesses and households CNY 32 trillion (USD 5.1 trillion) in 2030 or about 15% of the nation's GDP[4].

A handful of nations are taking steps. China and South Korea have operated circular economy principles --- linking supply chains of companies to reuse or recycle common materials --- in industrial parks for 20 years; China has certified over 50 such parks. The EU and Japan have legislated on eco-design, made producers more responsible for the after-use of their

products and boosted markets for secondary materials. In the US, some states and companies have set up networks for sharing and recycling resources[5]. Brazil and India have informal recycling systems.

But the sum of all these efforts remains tiny. Projects operate in isolation and have not shifted the behemoths of global industry.

We call for a global initiative to advance the circular economy. It should be led by the United Nations and involve the G20 and World Economic Forum, industry and citizen-oriented organizations. It should gather data, trigger learning, draw lessons and share experiences on how businesses and people use and recycle resources. Policies, missions and incentives should be developed to spread circular economy practices worldwide.

Reduce, reuse and recycle

The circular economy operates on 4 levels. Products need to be designed to be recyclable and reusable, based on green supply chains and clean manufacturing methods. Companies need novel business models to create value. Groups of companies and customers that exploit a particular resource need to be linked. Policies are needed to facilitate markets.

Sustainable materials, especially biomaterials, are key**.** For instance, biomass may be used as a chemical feedstock for products or packaging, or burned or turned into fuels for transport, heat and electricity[6]. Plastics should be recyclable; polymer production worldwide releases 400 million tonnes of greenhouse gases a year[1]. Chinese circular economy industrial parks saved 14 million tonnes of greenhouse gases in 2016 by recycling plastics, equivalent to removing over three million automobiles from the road.[7]

New markets and business models emerge. For instance, a copper smelting plant might recycle old wires and components as well as producing metal from minerals. Vehicle manufacturers might take back cars and upgrade their parts so that they run for longer. When a car reaches the end of its useful life it would be dismantled and its metals and plastics used to make other products worldwide. Less material is scrapped; fewer raw materials are needed. Customers access various mobility services rather than purchase cars.

China, Japan and South Korea have national 'top down' strategies for enabling the circular economy. In 2008 China approved its circular economy promotion law to 'reduce, reuse and recycle' municipal waste and industrial by-products. The government has invested billions of RMB in demonstration projects and tax incentives and has issued permits to allow industry to pursue previously-prohibited activities like selling grey water.

Brazil, India and the US take a bottom-up approach. For example, Rede Asta, a network of more than 60 co-operative women's groups across ten Brazilian states, has created an online platform to support artisans who recover materials from corporate and urban waste.

The EU is ambitiously doing a bit of both. It has adopted binding targets on re-use and recycling for municipal waste to 65%, recycling 75% of packaging waste, a limitation of the landfilling of municipal waste down to 10% by 2030. The EU is committed to have all plastics packaging reusable by 2030**.** It has established a platform to tackle food losses and waste and another platform on financing the circular economy. More specific regulatory action addresses electrical and electronic waste, end-of-life vehicles, and batteries and accumulators. It is also supporting regional innovations through its cohesion policy funds and the innovation programme H2020, such as networks of companies that recycle clothing. For instance, the capital of Slovenia, Ljubljana, reduced the amount of waste sent to landfill by 59 % and now generates 41 % less waste per capita than the European average. In a 2018 Eurobarometer survey, 41% of SMEs and 53% of large companies report decreasing production costs thanks to measures of a circular economy and resource efficiency, while 25% (27%) are designing products that are easier to maintain, repair or reuse.

Most of these circular economy initiatives have been proved successful, in terms of saving materials, waste, energy and emissions. In Kawasaki, Japan, reuse of by-products from industrial and municipal wastes to make cement has reduced greenhouse gas emissions by about 41,300 tons/year (a 15% reduction) since 2009 and saves 272,000 tons of virgin materials annually[8]. One typical Chinese industrial park located in Liuzhou, in Guangxi province, has reductions of over 2 million tons of CO_2 emissions/year by reduction of energy usage and circulating materials[9].

Yet circular economy networks remain limited in the areas, industries and timeframes they cover.

Limitations

There is no international policy effort to integrate circular economy approaches. Yet the circular economy would contribute to many of the UN's Sustainable Development Goals, including on water, energy, economic growth and climate change[10].

Some industries are starting to monitor global materials flows. For example, the aluminium sector has a global model of aluminum material flows. This model informs the industry on broad sources to help manage international flows. The cement sustainability initiative has a goal to support circular economy policies, by using its products and waste for energy production. This industry, in 2011, shown that 24 companies in the cement sustainability initiative, who are located in 100 countries, have made significant inroads. For example, on average they have substituted 13% of primary fuels with waste-derived fuels and reduced greenhouse gas emissions by 17 million tonnes per year through circular economy practices. There are thousands of small and medium size cement producers worldwide, which can still benefit from these practices that drive down operational costs by >15% and allow for investments into clinker substitution, industrialization of cement use, and prepare market development of eco-cement.

Yet accurate, traceable and secure data about the flows and stocks of materials, and the costs and efficiencies of industrial processes, are widely lacking. This makes it hard to make projections and policies and limits awareness of the benefits of the circular economy. For example, some eco-industrial parks and regions report annually on waste and recycling. But many do not. Long-term global data on resource trade of products groups and anthropogenic stocks in the built environment and in capital goods and their various footprints do not exist. Yet such an inventory would enable emerging economies and others to learn from successful countries and benefit from access to secondary resources.

Circular economy concepts are more often celebrated than critically assessed. Many assumptions are made and real-world factors left out of economic models. For example, business transaction costs are assumed to be low, or zero. The impacts on industries or countries that would lose out are not assessed. For example, original materials producers and extraction industries, many located in developing countries, may lose substantial revenues.

Projecting future market prices for raw materials and secondary resources is challenging. And policies can have unintended consequences. For example, incentivizing plastic recycling may lead to production of more plastics due to the “circular economy rebound” effect, which stipulates that additional plastic is needed as waste plastic degrades in quality from additional recycling and lower prices attract more demand.

Researchers need to collaborate more --- with industry and non-profit organisations, as well as across socio-economic, engineering and science disciplines**.** The International Institute of Environmental Studies (IIES), which includes 20 universities and research institutes around the world, has set the circular economy as a priority area and supports collaborative PhD programmes. But many other multilateral research organizations, like Future Earth, have no programmes on the circular economy. Even organizations devoted to it, such as the UK-based Ellen Macarthur Foundation, are limited in their geographic scope.

Community engagement is crucial. Consumers are the ultimate recipients of the product; they can drive producers to make changes and may co-design solutions. Yet data are short on household and municipal consumption and recycling. Germany’s transition to renewable energy in the 2000s was triggered through small-scale ownership models with citizens as backbones of funding, demand, and political pressure. The government constituted a legal priority for utilities to obtain green electricity at a fixed remuneration rate, and asked citizens to connect their solar panel installations to the grid, altogether boosting the market. A number of federal and regional programmes have been supporting smart energy housing with better insulation, energy-efficient appliances, and a range of alternative energies dependend on geographies (PV, wind, biomass, cogeneration, etc.). Estimated employment effects of plus 500,000 include installations and core industries of machinery and metal use.

Yet encouraging citizens to re-use materials may backfire. Informal recycling networks are common in developing countries **<an example**]. But scavenging waste removes it from more efficient processing by formal networks --- materials become scarce and costs rise.

Circular economy principles would aid organizations hedge against commodity price volatility and rebalance flows of goods, scrap and used products. Currently, uneven trade balances result in empty trucks and shipping containers. These containers should be filled with separated waste materials such as cardboard, wood and metals, which are returned to the producers and could refill value chains**.**

China and other developing countries with significant low-cost labor manufacturing, currently bare the brunt of wastes generated from manufacturing for products consumed elsewhere. A fairness issue arises since these producer countries have to manage waste and emissions generated from their production. The burden of local CE networks could be eased if the waste and materials were part of globally managed CE networks; although the waste generated from production could be effectively reused in local systems. Balancing local and global CE efforts through materials and product stewardship agreements and value chain management can make for a fairer waste and CE burden distribution. This would also lead to new business models on leasing of products or main components (e.g. batteries) and access to services based on accountability and supply chain due diligence. Plurilateral agreements involving China, Japan, the EU and the UK, and Canada could actually pave the way for fair trade in a circular economy.

Global trade in waste is a good place to start. For example, China and Thailand have recently, in 2018, banned imports of all waste. So that waste is being sent to less regulated countries where dumped plastics and electronics contaminate soil and water and cause health issues. An international covenant as well as take-back approaches and policies are needed for metals-based industries.

What next

A global strategy for the circular economy must include the following.

First, a global database should be developed to capture trends and links between resource uses. This could be run by international organisations such as UNEP and the World Economic Forum, with support from national agencies. Such a database should include indicators on material, water and energy flows as well as stocks in the built environment, relevant production costs and market trends. Gaps can be filled via cases studies and modelling. Supportive nations such as China, Japan, Germany and the UK should provide initial funding, supplemented by industry. A moderate fee might be levied on commodity transactions in stock exchanges, comparable to the one that France has introduced.

Second, a global platform should be established for sharing knowledge and learning about the circular economy. The Global Green Growth Knowledge Platform is a good model; it was

formed by South Korea, the World Bank, UNEP and the OECD. This knowledge platform is composed of a global community of knowledge experts and organizations committed to collaboratively generating, managing and sharing green growth knowledge and data. Although CE principles are part of this network, it is only one of dozens of topics related to sustainability and the sustainable development goals (SDGs), and role of industry as well as regions should become stronger. Focusing effort to further develop and expand such networks through greater CE-based research evidence and case studies of *global* CE initiatives is needed. Funding could come from international organizations, private bodies that would benefit from this information, and eventually businesses who offer services.

Third, international alliances need to be developed for large-scale experimentation. These should focus on governance and financial innovations that underpin transformations in pioneering cities and sectors -- especially water, energy, food, mobility and construction (and the 'nexus' thereof). Barriers, such as overcoming politically sensitive issues as to which industries and regions to resource or target, need to be identified and solutions developed. Regions that are reliant on exporting primary materials need attention and financial help from others to transform; Chile, Canada and the Scandinavian region may pioneer eco-innovation for resource-rich countries.

Fourth, standards for performance measurement, reporting, accounting and for future products need to be developed and harmonized. Key performance indicators need to be developed and assessed. These can be derived through ISO, the international standards organization. The environmental and corporate social responsibility systems offer examples. Assessing gaps towards future sustainability strategies need to be part of such an agenda.

Fifth, means of enforcement, dispute settlement and sanctions at an international scale should be developed. Voluntary regulatory and reporting initiatives will be a start. 'Naming and shaming' by citizens, the media and NGOs would leverage reputational risks to get international CE activities adopted and enforced. In the long-run, an international agreement on sustainable resource management could emerge via such globally coordinated bottom-up approaches that support international reporting, decision-making on eligible extraction sites, favourable trade patterns and economic incentives.

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Acknowledgement: This study is funded by Natural Science Foundation of China (71325006,71810107001, 71690241).

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GRAPHICS: to discuss

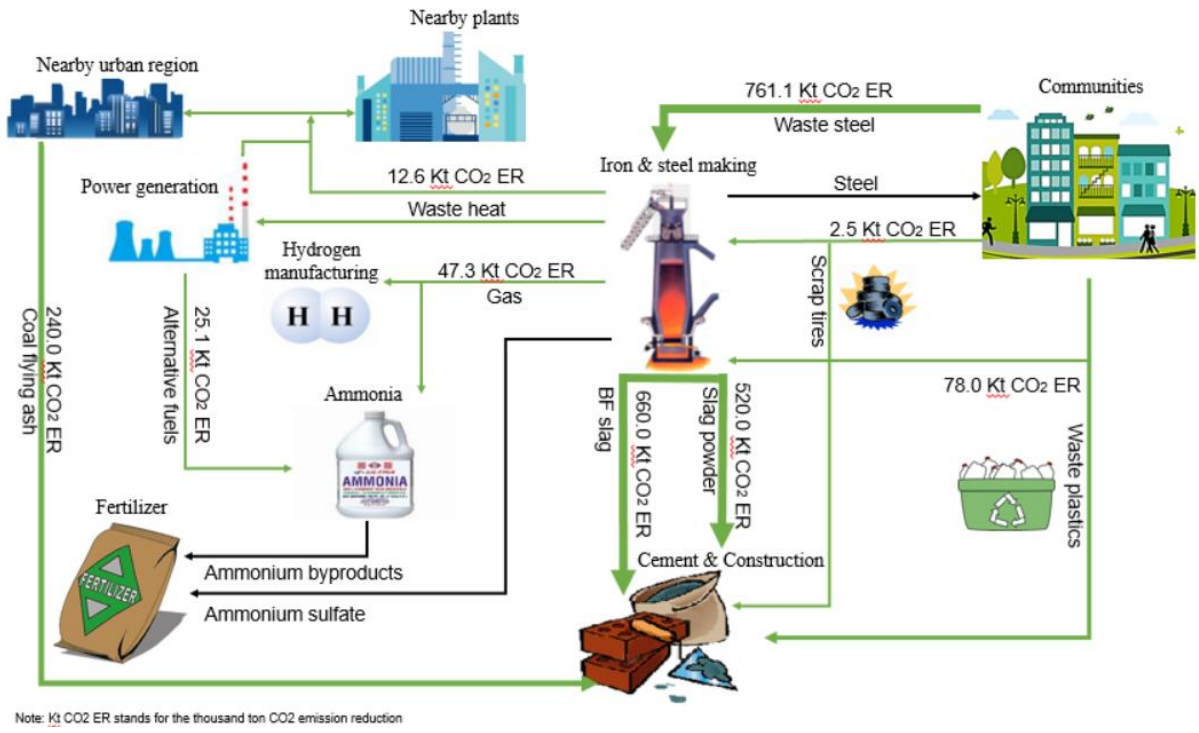

Figure 1: Urban Industrial Symbiosis example for Liuzhou, China identifying opportunities for carbon emissions reductions. Green arrows represent emission reductions due to industrial symbiotic relationships.