VIRTUOUS CIRCLE

How the circular economy can create jobs and save lives in low and middle-income countries

50 Institute of Development Studies

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How the circular economy can create jobs and save lives in low and middle-income countries

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Tearfund is a Christian relief and development agency building a global network of local churches to help eradicate poverty.

BUSINESSES THAT WORK ON THE BASIS OF CIRCULAR PRINCIPLES ARE AMONGST THE FASTEST GROWING IN THE ECONOMY

Dr Martin R Stuchtey, McKinsey Center for Business and Environment[1]

THIS SHIFT TO CIRCULAR ECONOMIC ACTIVITY COULD HELP ADDRESS THE GLOBAL JOB GAP OF 600 MILLION

Dominic Waughray, Senior Director, World Economic Forum[2]

'GROW NOW, CLEAN UP LATER' REALLY DOESN'T WORK

Muthukumara Mani, Senior Environmental Economist at the World Bank[3]

1 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

2 Ellen MacArthur Foundation (2014) *Towards the circular economy, volume 3*. Report prepared in collaboration with the World Economic Forum and McKinsey and Company.

3 *Financial Times* (2013) 'Environmental damage costs India $80bn a year', published 17 July 2013, accessed 6 May 2016.

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EXECUTIVE SUMMARY

This short paper – primarily for development policy-makers and practitioners – highlights a significant opportunity to accelerate progress towards the Sustainable Development Goals.

Case studies from Brazil, Ghana, Kenya and India demonstrate how supporting (and removing obstacles to) circular economy business models can provide a triple win:

- increasing productivity and economic growth
- improving the quality and quantity of employment
- saving lives, by reducing environmental impacts such as water pollution, air pollution and climate change (approximately 9 million people die of diseases linked to mismanagement of waste and pollutants each year)

The concept of the circular economy is almost entirely absent from the development discourse at present. And yet, the circular economy holds out the promise of an alternative growth model that reduces the tension between lifting people out of poverty and protecting the planet, dramatically increasing the scope for meeting the SDGs.

In high-income countries, many parts of the private sector are already embracing the circular economy. Consultancy firm McKinsey estimates that greater resource efficiency could save European manufacturers US$ 630 billion a year[4] and leading brands have already incorporated the concept into their business models.[5] This enthusiasm illustrates the role of the circular economy in supporting economic growth: with commodity prices still above their 1985–2004 average in real terms[6] (despite the current slump), and now on a long-term upward trend, resource efficiency offers a way to shield growth from these rising costs.

At the same time, academics suggest that the circular economy will increase employment. A recent meta-analysis of 65 papers in this area concluded that 'existing studies point to positive employment effects occurring in the case that a circular economy is implemented'.[7] If we are to meet the SDGs, low and middle-income countries need these additional jobs: a quarter of those in extreme poverty are either unemployed or working in low-quality, dangerous employment,[8] with the poorest often already involved in informal (and hazardous) waste collection and recycling.

In Brazil, Tearfund partner Diaconia has adapted anaerobic bio-digester technology so that small-scale farmers can use it to convert animal waste into cooking gas and a nutrient-rich fertiliser, increasing their incomes and preventing emissions of methane (a powerful greenhouse gas). Eleanor Bentall/Tearfund

4 World Economic Forum (2014) *Towards the circular economy, volume 4: accelerating the scale-up across global supply chains*. Report prepared in collaboration with McKinsey and Ellen MacArthur Foundation.

5 Including many leading brands such as Caterpillar, Maersk, H&M and Rolls Royce. See references in main paper for more details.

6 World Bank (2016) *Global economic prospects 2016*, p28

7 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

8 The remaining three quarters are either not of working age, economically inactive (for example, looking after children) or in formal employment. International Labour Organisation (2016) *World employment social outlook 2016*.

The Kumasi industrial cluster in Ghana is a major automotive re-manufacturing and repair cluster in West Africa. It is a prominent example of the scale and economic benefits of circular business models in developing countries, with the extent of activity surpassing anything found in Europe: 200,000 workers are employed (up from 40,000 in the early 1980s) in more than 12,000 businesses.[12] 'Kumasi: Suame Magazine's Artisans Unveil Ghana-Made Car at Manhyia Palace', OMGGhana.com

Furthermore, under 'development as usual', low and middle-income countries face a growing waste mountain and increases in pollution, with associated insanitary conditions, disease and cost for local government. Approximately 9 million people die of diseases linked to mismanagement of waste and pollutants each year: six times as many as die from AIDS-related illnesses, and 20 times more than die from malaria.[9] The circular economy would reduce the waste and pollution that drives these health impacts.

In fact, the circular economy could become an alternative economic model, where growth derives from increase in knowledge and productivity, rather than greater resource use. Even a modest move in this direction would have dramatic benefits – reducing, for example, the risk of resource-related conflicts, which the UN suggests 'may well come to define global peace and security in the 21st century'.[10]

The circular economy offers a genuine triple win. Writing about Europe, McKinsey concludes that 'the circular economy could produce better GDP and employment outcomes… and would decouple economic growth from resource use'.[11] Indeed, they estimate that the shift to a circular economy could halve European carbon emissions by 2030.

The same triple win is potentially available in low and middle-income countries. The experience of both practitioners at Tearfund and researchers from the Institute of Development Studies – working with communities and academics around the globe – suggests that circular models do indeed offer significant benefits for those living in poverty. However, the concept is almost entirely absent from development discourse and practice at present.

WHAT IS THE CIRCULAR ECONOMY?

Currently, we have a primarily linear economy. We make a product – for example, a toaster or a mobile phone – we use it and, when it breaks or there's a better model available, we throw it away. At this point, all of the resources (energy, metals, water) used to make that phone are lost. In Europe, an average of 95 per cent of a product's material and energy value is wasted in this way.[13]

A circular economy would address these issues, by eliminating waste and inefficiency at each stage of the product life cycle, from reducing the amount of time cars and machinery sit idle, to increasing the scope for repairability or modular re-manufacturing of used components. This broad definition of the circular economy includes practices such as the sharing economy and performance economy. It is concerned with an often-overlooked element of productivity: resource efficiency.

The concept has its roots in bio-mimicry. In the natural world, there is no waste: instead, when an organism reaches the end of its life, it provides nutrients for another part of the system. Industrial symbiosis is one example of this principle, whereby waste or by-products from one industrial process become inputs for another. The UK's recent National Industrial Symbiosis Programme generated £1.1 billion in cost reductions for the participating companies (largely SMEs) over recent years.[14]

9 UNEP (2015) *Pollution is the largest cause of death in the world*, UNEP SDG fact sheet, available at www.gahp.net/new/wp-content/uploads/2015/03/UNEP_SDG_FactSheet_March13_2015.pdf; Malaria mortality figures from www.who.int/gho/malaria/epidemic/deaths/en

10 The EU-UN Partnership of Land, Natural Resources and Conflict Prevention: www.un.org/en/land-natural-resources-conflict

11 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

12 Schmitz H (2015) 'Africa's biggest recycling hub?' IDS Blog, available at www.ids.ac.uk/opinion/africa-s-biggest-recycling-hub

13 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

14 www.international-synergies.com/projects/national-industrial-symbiosis-programme

Sanergy installs high-quality, low-cost toilets in the slums of Nairobi, Kenya. The project results in a cleaner, safer urban environment and the waste is used to produce high-value agricultural inputs and renewable energy. To date, over 700 toilets serve more than 30,000 users each day, and Sanergy has created more than 800 jobs in the communities where they work.[17] Sanergy

Unfortunately, many low and middle-income countries may currently be becoming *less* resource efficient, as a traditional culture of repair and re-use is eroded and they opt into the dominant linear supply chains, infrastructure and institutions of the global economy.[15] This is particularly concerning given how much current academic and business interest is focused on enabling high-income countries to remodel their supply chains and institutions, making them *more* resource efficient. Furthermore, recent research from EPEA Brazil, the University of Santa Catarina and Tearfund suggests that in certain sectors, low and middle-income countries could potentially leapfrog straight to circular systems and institutions.[16] In practice, this means creating an enabling environment that allows existing examples of circularity in low and middle-income countries to be formalised and scaled up. At present, these practices face a number of obstacles, including mis-pricing of externalities, lack of access to finance, information failures, government failures and coordination problems.

We make ten recommendations for policy-makers

In all countries, encourage greater resource efficiency by:

1 Reforming tax systems so that they do a better job of discouraging undesirable activities (such as pollution or waste) and encouraging desirable activities (such as establishing circular business models). Environmental taxation raises 10 per cent of tax revenue in the Netherlands and 19 per cent in Tanzania, but the OECD average is just 2 per cent.[18]

2 Setting targets for waste reduction and resource efficiency, to drive progress throughout the public and private spheres.

In low and middle-income countries, take advantage of the big missed opportunities in waste collection, repair/remanufacture and organic waste:

3 Public waste management policy should involve those already working in the waste picking and informal recycling sector, supporting them to formalise in order to access social protection, improve incomes and working conditions, increase recycling rates and reduce costs for government.

4 Governments should support nascent remanufacturing and repair industries through public procurement, and by working with representatives of micro- and small-/medium-size enterprises in these sectors to ensure that appropriate services (electricity, connectivity etc) are provided, in order to create jobs and reduce waste.

15 Schandl H et al (2015) *Indicators for a resource efficient and green Asia and the Pacific*, UNEP and SWITCH-Asia. See also Foxon TJ (2002) *Technological and institutional 'lock-in' as a barrier to sustainable innovation*, ICCEPT Working Paper, November, Imperial College Centre for Energy Policy and Technology.

16 Fernandes A (2016) *Closing the loop: the benefits of the circular economy for developing countries and emerging economies*, Tearfund

17 Information provided by Sanergy. See also Tan K and Griffiths B (forthcoming) *Fighting poverty with enterprise*, 2nd edition, Transformational Business Network. Further information available at www.saner.gy

18 Figures from OECD stat, alongside Vollebergh H (2015) *Green tax reform: energy tax challenges for the Netherlands*; The Netherlands and GIZ (2014) *Environmental fiscal reform – case studies*, GIZ: Bonn, Germany

SWITCH-Asia's ACIDLOOP project focuses on technology transfer from Europe and capacity building in the Indian metal-finishing industry, a booming sector responsible for significant levels of water use and pollution. Reported results include up to a 45 per cent reduction in fresh water use in the south India project component[19] and potential energy and material savings of more than 20 per cent.
ACIDLOOP, www.switch-asia.eu/projects/acidloop

5 Governments should revise existing policies that inhibit circular business models for organic waste unnecessarily (such as free landfill collection or some unnecessary restrictions on treatment of human waste). Circular models for organic waste promote wider provision of sanitation to poor communities and reduce carbon emissions.

In high-income countries, do more to support the transition in low and middle-income countries:

6 EU regulations and design standards should take a tougher line on toxic materials, insist that businesses provide information about how to repair products, and incentivise durability and reparability. (The EU's product standards set a benchmark for standards the world over and many of Europe's products also ultimately end up in low and middle-income countries.)

7 Development finance institutions should devote more resources to resource efficiency projects. Circular investments can offer excellent social and environmental returns, and several have already received funds from DFID's development finance institution, CDC, among others.

8 The UK government should introduce a circular economy theme as part of the cross-governmental (Global) Prosperity Fund. More generally, the UK's forthcoming plan for implementation of the SDGs[20] (at home and abroad) should include circular economy principles and practices.

9 Governments should work with business to support the transition to a circular economy in low and middle-income countries by, for example, facilitating technology sharing between European and developing country operations.

10 There is a pressing need for more research, to (i) comprehensively establish the 'size of the prize' from the transition to a circular economy in low and middle-income countries; and (ii) construct a full typology of reforms that support this transition, through comparative studies of circular practices and interventions around the globe.

The circular economy offers an unparalleled opportunity. It's good for the economy, good for society and good for the planet. Supporting the transition would save lives and create employment, accelerating progress towards the Sustainable Development Goals.

19 Balakrishnan et al (2016) ACIDLOOP: detailed project brochure, The Energy and Resource Institute and SWITCH-Asia Programme

20 See the International Development Select Committee's recommendations for a plan in this area, set out here: www.publications.parliament.uk/pa/cm201617/cmselect/cmintdev/103/10310.htm#_idTextAnchor087

INTRODUCTION

The circular economy concept has been making waves in the business community for the last five years. It's easy to see why: McKinsey estimates that the concept would allow European manufacturers to save $630 billion a year through increased resource efficiency.[21] Leading brands such as Caterpillar[22], Maersk[23], H&M[24] and Rolls Royce[25] are already incorporating the concept into their business models. In a world characterised by a long-term upwards trend in resource prices and volatility, the circular economy offers a way to prevent global growth from stalling in the face of these economic headwinds.

At the same time, policy-makers see the circular economy as part of the solution to both unemployment and environmental degradation.[26] By dramatically increasing the efficiency with which we use resources, the circular economy offers a win-win: decreasing our footprint on the planet and increasing productivity at the same time. Consultancy firm McKinsey suggests that 'the circular economy could produce better GDP and employment outcomes… and would decouple economic growth from resource use'.[27] Indeed, it estimates that the shift to a circular economy could halve European carbon emissions by 2030.

These findings suggest that the concept could also offer significant benefits to low and middle-income countries. However, the concept is almost entirely absent from the development discourse at present. What if these nations could leapfrog straight to circular systems? Might this help increase growth and employment and/or reduce carbon emissions and other environmental problems? And what about the impact on poverty?

CREATING THE RIGHT ENABLING ENVIRONMENT FOR CIRCULAR INDUSTRIES HAS THE POTENTIAL TO CREATE JOBS, IMPROVE SOCIAL OUTCOMES FOR THE POOREST AND REDUCE POLLUTION

This short paper summarises our existing knowledge about the circular economy in low and middle-income countries. Case studies from Brazil, Ghana, Kenya and India demonstrate how creating the right enabling environment for circular industries has the potential to create jobs, improve social outcomes for the poorest and reduce pollution (related to both poor health and climate change), compared with business as usual. Indeed, the shift to a circular economy is key to achieving several of the Sustainable Development Goals (SDGs).[28]

Drawing on these case studies and other research, we make recommendations for a greater focus on the circular economy in low and middle-income countries. These recommendations are relevant to donor governments, developing country governments, business, academia and the third sector.

21 World Economic Forum (2014) *Towards the circular economy, volume 4: accelerating the scale-up across global supply chains*. Report prepared in collaboration with McKinsey and Ellen MacArthur Foundation

22 Caterpilllar, 'Remanufacturing for the 21st century'. Presentation made at World Trade Organisation: slides available here: www.wto.org/english/forums_e/public_forum12_e/session40snodgress_e.pdf

23 See www.maersk.com/en/hardware/triple-e/the-hard-facts/cradle-to-cradle

24 Kennett S (2014) 'H&M, other clothing manufacturers launch a circular economy trend', available at: www.greenbiz.com/blog/2014/07/28/hm-other-clothing-companies-launch-circular-economy-trend

25 See www.rolls-royce.com/media/press-releases/yr-2012/121030-the-hour.aspx

26 European Commission (2015) *Closing the loop: an EU action plan for the circular economy*, available at http://ec.europa.eu/environment/circular-economy/index_en.htm

27 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

28 Schroeder P, Anggraeni K and Weber U (currently under review) 'Circular economy contributions to the post-2015 development agenda', *Journal of Industrial Ecology*, Special issue: Exploring the circular economy

1 WHAT IS A CIRCULAR ECONOMY?

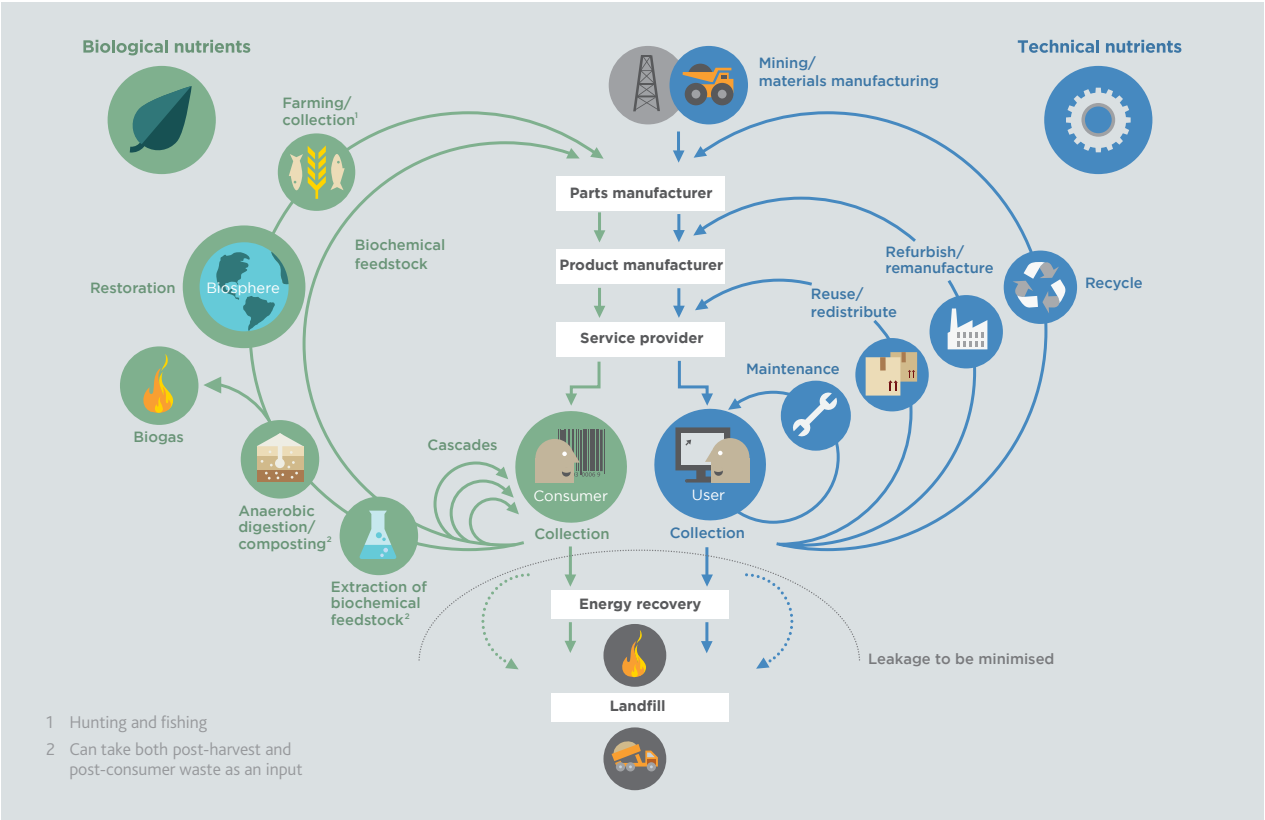
Currently, we have a primarily linear economy. We make a product – for example, a toaster or a mobile phone – we use it and, when it breaks or there's a better model available, we throw it away. At this point, all of the resources (energy, metals, water) used to make that phone are lost. In Europe, an average of 95 per cent of a product's material and energy value is wasted in this way.[29]

THE CIRCULAR ECONOMY CONCERNS AN OFTEN-OVERLOOKED ELEMENT OF PRODUCTIVITY: RESOURCE EFFICIENCY

A circular economy would address these issues, by maximising the efficiency with which resources are used at each stage of the product life cycle. This is partly about what happens to a product at the end of its life, but it is also about eliminating waste and inefficiency throughout the production and consumption chain, from reducing the amount of time cars and machinery sit idle, to increasing the scope for repairability or modular re-manufacturing of used components.[30] As such, the circular economy concerns an often-overlooked element of productivity: resource efficiency.

The concept has its roots in biomimicry. In the natural world, there is no waste: instead, when an organism reaches the end of its life, it provides nutrients for another part of the system.

Figure 1 Closed loops in a circular economy



Source: Ellen MacArthur Foundation (2013) – drawn by the Ellen MacArthur Foundation Circular Economy Team

29 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

30 We use a broad definition of the circular economy (following McKinsey and the Ellen MacArthur Foundation), including resource-efficient practices such as the sharing economy and performance economy, which themselves support the overall circularity concept.

New business models facilitate this shift. For example, the 'performance economy' describes a world where the manufacturer of a product remains responsible for ensuring that it delivers the service it is designed to perform for the duration of its expected life. In this vein, Rolls Royce's 'power by the hour' service provides passenger jet engines on a fixed-cost per flying hour basis, so that the customer only pays for engines that are performing well.[31]

Another example is industrial symbiosis, whereby companies collaborate so that the waste or by-product of one industrial process becomes a resource for another. In the UK, the National Industrial Symbiosis Programme (NISP) was actively engaged with 15,000 companies between 2005 and 2013, generating £1 billion in sales and £1.1 billion in cost reductions (in England alone) for the participating companies, which were largely SMEs.[32] The programme is currently being trialled overseas, with the support of the Foreign and Commonwealth Office.

This circular system is, by its very nature, more resource efficient than the current linear system: it preserves the energy and resources already invested ('embedded') in a product, simultaneously reducing the economy's environmental footprint and providing opportunities for business.

The Ellen MacArthur Foundation has developed a typology of interventions that support the transition to a circular economy, presented in Figure 2.

Figure 2 The ReSOLVE framework: six action areas for businesses and countries wanting to move towards the circular economy

Source: McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

31 See www.rolls-royce.com/media/press-releases/yr-2012/121030-the-hour.aspx

32 www.international-synergies.com/projects/national-industrial-symbiosis-programme

2 THE CIRCULAR ECONOMY AND ECONOMIC GROWTH

By eliminating waste, the circular economy is inherently good for productivity. For example, based on an analysis of three sectors (transport, food and the built environment), McKinsey estimates that pursuing a circular economy would increase European GDP by seven per cent by 2030, compared with business as usual.[33]

Above and beyond this effect, however, there is also reason to believe that resource efficiency will be *particularly* important in supporting global prosperity over coming years. In 2012, governments around the world (including the UK) released resource security strategies, in response to concerns that reduced availability of some raw materials might reduce economic growth. Indeed, almost a third of profit warnings issued by FTSE 350 companies in 2011 were related to rising resource prices, and 80 per cent of manufacturing firm CEOs saw materials shortages as a key risk to their business.[34] Despite a reduction in commodity prices since 2011, prices remain higher than their 1985–2004 average in real terms[35] and many economists and global institutions still suggest that commodity prices are now on a long-term upward trend.[36] Prices have also become more volatile.[37]

WITHOUT IMPROVEMENTS IN RESOURCE EFFICIENCY, VOLATILE AND RISING COMMODITY PRICES WILL INEVITABLY EXERT A DRAG ON GLOBAL GROWTH PROSPECTS

These trends represent a real threat to economic growth based on the business-as-usual, linear model over the medium term. Without improvements in resource efficiency, volatile and rising commodity prices will inevitably exert a drag on global growth prospects. In low and middle-income countries, this is a clear cause for concern with regard to meeting the poverty-related SDGs. Despite this, there is a worrying lack of research on the role that the transition to a circular economy could play at the macro-level in low and middle-income countries.

The circular economy holds out the promise of an alternative model for growth, where increased prosperity results from improvements in productivity and knowledge, rather than greater resource use. This is something we consider in detail in Section 5.

3 THE CIRCULAR ECONOMY AND EMPLOYMENT

JOBS CREATED IN REMANUFACTURING, REPAIR AND HIGH-TECH RECYCLING ARE LIKELY TO BE SKILLED ROLES

A recent meta-analysis of 65 academic studies in this area concluded that 'while more research is needed, existing studies point to the positive employment effects occurring in the case that a circular economy is implemented'.[38] Green Alliance and Wrap[39] explain that 'this is because, whilst [circular business] activities tend to be efficient in their use of natural resources, they can be relatively intensive in their use of labour, compared with the activities they replace'. Furthermore, jobs created in remanufacturing, repair and high-tech recycling are likely to be skilled roles.

33 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

34 BIS and Defra (2012) *Resource Security Action Plan*, UK Government

35 World Bank (2016) *Global economic prospects 2016*, p28

36 Jacks D (2013) 'From boom to bust: a typology of real commodity prices in the long-run', NBER Working Paper Number 18874. See also 'Rocks for the long run', 12 June 2013, *The Economist*, available at www.economist.com/blogs/freeexchange/2013/06/commodity-prices; and Kulish M and Rees D (2015) 'Implications of higher and more volatile commodity prices', Reserve Bank of Australia.

37 Morgan J and Edwards I (2015) *Managing resources for a resilient economy: lessons from the financial sector*, Green Alliance

38 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.

39 Morgan J and Mitchell P (2015) *Employment and the circular economy*, Green Alliance and WRAP, available at www.green-alliance.org.uk/resources/Employment%20and%20the%20circular%20economy.pdf

Already, an estimated 3.4 million people are employed in circular economy jobs such as repair, waste, recycling, and the rental and leasing sectors across the EU. One estimate suggests that the further expansion of the circular economy could create 3 million extra jobs and reduce unemployment by 520,000 across the EU member states by 2030.[40] In their analysis, Green Alliance and Wrap (2015)[41] find that the transformation to a circular economy could create 517,000 new skilled jobs in the UK by 2030.

In low and middle-income countries, existing circular activities such as waste picking, repair and even remanufacturing already provide jobs for significant sections of the workforce, albeit often in the informal sector, where they lack access to legal protections and social security coverage. For example, informal waste collection alone occupies two per cent of the population in some areas.[42] However, these jobs are often characterised by exposure to insanitary conditions, hazardous substances and poor working environments. In this context, circular economy interventions can improve both the quality as well as the quantity of employment (see Case Study D).

Again, further research is needed to establish the total impact of the circular economy on employment in low and middle-income countries, although micro-studies have demonstrated the circular economy's job-creating and job-improving potential through a wide array of case studies (see case studies A, B, C and D).

4 THE CIRCULAR ECONOMY AND RESOURCE CONFLICTS

According to the UN, 'The challenges associated with preventing, managing and resolving natural resource-induced conflicts may well come to define global peace and security in the 21st century.'[43] The aggravating role of water scarcity in creating the conditions for the Syrian civil war has been widely debated,[44] and the potential for scarcity to act as a threat-multiplier in a number of other contexts has also been noted.[45] Fragile states are often seen as most at risk.[46]

The systemic shift to a circular economy has the potential to make a significant contribuation to mitigating the risk of resource-related conflict, by reducing stress on key resources such as freshwater and land, and also reducing the impact of climate change. These benefits follow from the beneficial effect of the circular economy on the environment.

THE SYSTEMIC SHIFT TO A CIRCULAR ECONOMY HAS THE POTENTIAL TO MAKE A SIGNIFICANT CONTRIBUTION TO MITIGATING THE RISK OF RESOURCE-RELATED CONFLICT

40 WRAP (2015) *Economic growth potential of more circular economies*: www.wrap.org.uk/content/circular-economy-study-identifies-3-million-jobs-across-europe

41 Morgan J and Mitchell P (2015) *Employment and the circular economy*, Green Alliance and WRAP, available at www.green-alliance.org.uk/resources/Employment%20and%20the%20circular%20economy.pdf

42 Gunsilius E, Spies S, García-Cortés S, Medina M, Dias S, Scheinberg A, Sabry W, Abdel-Hady N, dos Santos A and Ruiz S (2011) *Recovering resources, creating opportunities: integrating the informal sector into solid waste management*, GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development, available here www.giz.de/de/downloads/giz2011-en-recycling-partnerships-informal-sector-final-report.pdf

43 The EU-UN Partnership of Land, Natural Resources and Conflict Prevention; see www.un.org/en/land-natural-resources-conflict

44 See, for example, Kelly C et al (2015) 'Climate change in the fertile crescent and implications of the recent Syrian drought', *Proceedings of the National Academy of Sciences* 112 (11)

45 Evans A (2010) 'Resource scarcity, climate change and the risk of violent conflict', *World Development Report 2011* Background Paper, New York University Centre on International Cooperation. Also, see www.unep.org/disastersandconflicts/Portals/155/disastersandconflicts/docs/UNEP_car_mission_Report_August_2009_draft_rev_1.pdf

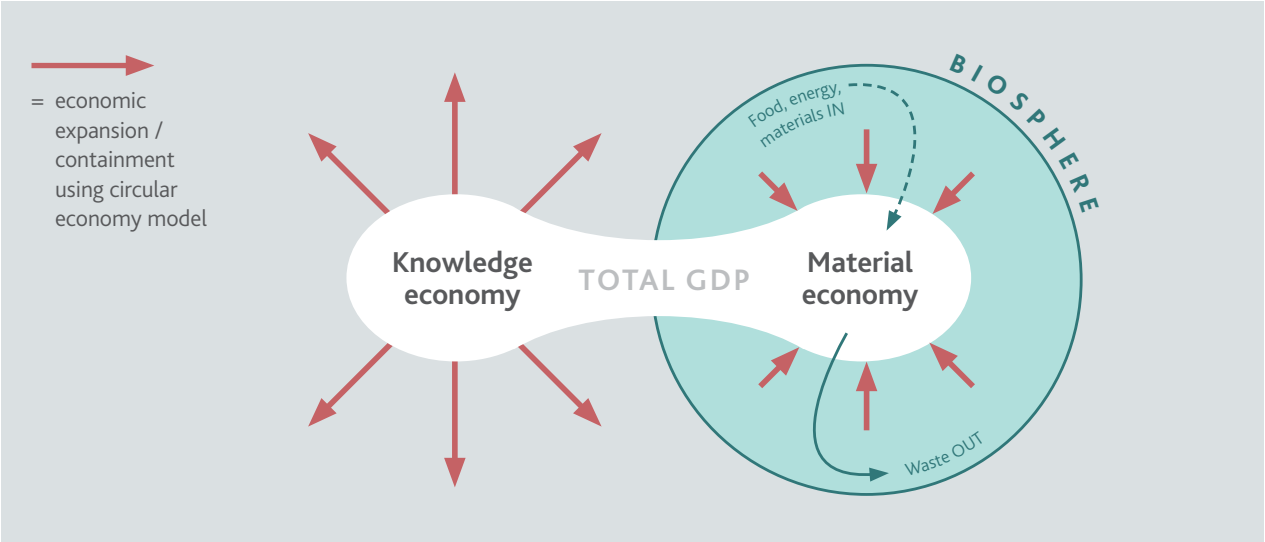
46 Ibid

5 THE CIRCULAR ECONOMY AND THE ENVIRONMENT

The circular economy provides an alternative approach to interactions between the economy and environment. According to this worldview, the economy must work with biological processes and not against them, emulating the circular models of nature, because the material economy sits within the natural world and is dependent on it.

The key concept here is best explained by Figure 3. On the right is the material economy: this involves stuff – physical things that are manufactured, built or harvested. This part of the economy sits within the earth's ecosystems. It involves extracting material from these systems (such as metals or food) and putting material back (such as carbon emissions and waste). On the left is the 'knowledge economy'. Most of a product's (and hence the economy's) value comes from the knowledge that allows raw materials to be transformed into something useful.

Figure 3 Resources + Knowledge = GDP



Based on a diagram produced originally by Hepburn C and Bowen A (2013) 'Prosperity with growth: economic growth, climate change and environmental limits' in Fouquet R (ed) *Handbook of energy and climate change*, Edward Elgar

The circular economy concentrates on containing the size of the material economy, by increasing resource efficiency and constantly re-using and recycling materials. Under this paradigm, future economic growth is driven by the expansion of the knowledge economy.

This holds out the promise of decoupling economic growth from environmental impacts (as McKinsey has noted[47]). However, in practice, the level of decoupling that can be achieved depends on available technology and, crucially, our willingness to pursue circular systems through changes in policy and practice.

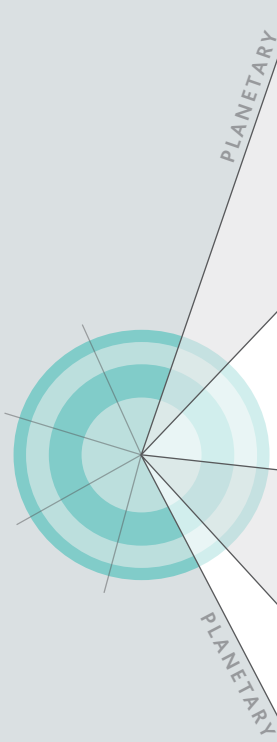
The circular economy worldview marks a shift away from the exploitative attitudes to nature that have characterised modern economic thought. In fact, it is arguably a worldview more similar to that underlying some developing country perspectives on the environment,[48] as well as the view presented in many of the world's great faiths. Tearfund's report, *The restorative economy*, explains, for example, how the jubilee principles found in the Jewish and Christian scriptures are designed to ensure that the economy works 'with, rather than against, creation'.[49]

47 McKinsey (2015) *Growth within: a circular economy vision for a competitive Europe*. Report commissioned by Ellen MacArthur Foundation.
48 For example Schultz P (2002) 'Environmental behaviours and attitudes across cultures', *Online Readings in Psychology and Culture*, 8(1)
49 Evans A and Gower R (2015) *The restorative economy: our unfinished millennium jubilee*, Tearfund, p29

At a more detailed level, the Stockholm Resilience Centre's (SRC's) Planetary Boundaries[50] provides a helpful framework for categorising the specific environmental benefits that a circular economy would bring. The SRC identifies nine global processes and systems that ensure planet earth is a hospitable place for humanity, relating to climate change, biosphere integrity (species and biodiversity) loss, land system change, freshwater use, biogeochemical flows (phosphorous and nitrogen), ocean acidification, atmospheric aerosol loading, ozone depletion and chemical pollution/release of novel entities (such as radioactive material).

The shift to a circular economy has the potential to make a positive difference in several of these areas: Figure 4 describes the impact on six of the most relevant.

Figure 4 How the circular economy would help us live within the earth's limits



	Potential circular economy impact
(i) Climate change	By preserving the energy embedded in manufactured products, significant reductions in greenhouse gas emissions can be made. McKinsey estimates that implementing the circular economy across the food, built environment and transport sectors in Europe could reduce emissions by 81 per cent by 2050. To give a specific example, according to evidence submitted to the World Trade Organisation by Caterpillar, its remanufactured piston heads save 60 per cent of the emissions associated with manufacturing from scratch.[51] Similarly, the European Environment Agency finds that more ambitious targets for recycling and reducing landfill could lead to a reduction in European emissions of between 424 and 617 million tonnes of carbon dioxide equivalent by 2035[52] (roughly equal to the UK's entire emissions).
(ii) Freshwater use	The production of a typical mobile phone takes six bathtubs of water (more than 1,000 litres).[53] This embedded water is lost when the phone goes to landfill, but can be preserved through repair or reusing components. The same is true of other manufactured products. This is particularly important where the embedded water is sourced from regions where scarcity is a problem. (1.2 billion people already live in water basins where use exceeds sustainable limits.[54])
(iii) Chemical pollution *and* **(iv) Atmospheric aerosol loading**	In the same way that the circular economy preserves embedded water, it can reduce the need to emit pollutants. Pollution is embedded in manufactured products, and prolonging their life or remanufacturing their components removes the need for emissions associated with new products. This reduces overall chemical and aerosol pollution associated with industrial processes.
(v) Land use change *and* **(vi) Biosphere integrity**	The circular economy would reduce demand for natural resources, helping to limit land use change and habitat destruction driven by the extraction of these resources from the earth. For example, preserving and re-using metal and paper reduces the need for mining and logging, thus preserving biosphere integrity.

It is important to note that, while some of these benefits will arise purely through business pursuing the commercial opportunities that the circular economy offers, the environmental dividend can only be fully attained through government ensuring that the cost of pollution and other environmental externalities are fully incorporated into business and consumption decisions (for example, through tax policy). This creates the right enabling environment for a shift to the circular economy. In the Brazilian context for example, Fernandes argues that the role for government includes 'ensuring that the environmental externalities of linear supply chains are factored into companies' costs (for example, by charging for the environmental costs of landfills or making manufacturers responsible for end-of-life products)'.[55] In many cases, tax systems currently discourage circular approaches, and reversing this is a necessary first step.

50 Rockstrom J et al. (2009) 'A safe operating space for humanity', *Nature* Volume 461(24). See also www.stockholmresilience.org/research/planetary-boundaries.html

51 Caterpilllar, 'Remanufacturing for the 21st century'. Presentation made at World Trade Organisation, slides available here: www.wto.org/english/forums_e/public_forum12_e/session40snodgress_e.pdf

52 European Environment Agency (2016) *Circular economy in Europe – developing the knowledge base*, EEA Report No 2/2016, Copenhagen

53 Yoshikawa M (2008) 'Urban miners look for precious metals in cell phones', Reuters. See also http://voices.nationalgeographic.com/2015/04/09/daily-life-takes-how-much-water

54 Evans A and Gower R (2015) *The restorative economy: our unfinished millennium jubilee*, Tearfund

55 Fernandes A (2016) *Closing the loop: the benefits of the circular economy for developing countries and emerging economies*, Tearfund

6 THE CIRCULAR ECONOMY AND LOW AND MIDDLE-INCOME COUNTRIES

Recent academic and business interest in the circular economy has focused on how high-income countries can become more resource efficient. However, low and middle-income countries may currently be in the process of becoming *less* resource efficient, as a traditional culture of repair and re-use is eroded and they opt into the dominant linear supply chains, infrastructure and institutions of the global economy.[56]

This represents a significant problem for five reasons.

Firstly, reductions in resource efficiency undermine efforts to eliminate poverty. They lower productivity across developing economies, and also make these countries more susceptible to the drag on growth presented by volatile and rising resource costs.

Secondly, as the linear economy grows, low and middle-income countries tend to face a growing waste mountain with associated insanitary conditions, disease, water pollution and cost for local government. According to the World Health Organisation, approximately 9 million people die of diseases linked to mismanagement of waste and pollutants each year (that's six times as many as die from AIDS-related illnesses, and 20 times more than die from malaria).[57]

Thirdly, a quarter of those in extreme poverty are either unemployed or working in low-quality, dangerous employment,[58] with the poorest often already involved in informal (and hazardous) waste collection and recycling. The circular economy offers a way to improve their working conditions and incomes, in addition to creating more high-quality jobs.

Fourthly, the shift to a circular economy would make a significant contribution to mitigating the risk of resource-related conflict, which is expected to be a major driver of fragility and even state failure in the 21st century.

UNLESS WE CAN DECOUPLE GROWTH FROM ENVIRONMENTAL IMPACTS, HUMANITY FACES AN ECOLOGICAL CRISIS, WITH PROFOUND IMPACTS FOR THE LIFE CHANCES OF POOR PEOPLE

Finally, the circular economy would preserve planet earth's life support systems. Growth in the traditional, linear economy causes environmental degradation including climate change, air pollution and water contamination. In India, for example, 23 per cent of childhood deaths can be attributed to polluted air, contaminated water or other environmental problems.[59] Unless we can decouple growth from environmental impacts, humanity faces an ecological crisis, with profound impacts for the life chances of poor people. As Muthukumara Mani, the World Bank's Senior Environmental Economist has observed, '"Grow now, clean up later" really doesn't work'.[60]

Supporting circular approaches in low and middle-income countries could thus start a virtuous circle, supporting growth and increasing employment, as well as reducing pollution and waste (with their associated health, environmental and financial costs). Recent research from EPEA Brazil, the University of Santa Catarina and Tearfund suggests low and middle-income countries could potentially leapfrog straight to circular systems and institutions, without following the traditional model of eliminating existing (often informal) circular systems and then reintroducing them down the line.[61]

56 Foxon, TJ (2002). Technological and institutional 'lock-in' as a barrier to sustainable innovation, *ICCEPT Working Paper*, November, Imperial College Centre for Energy Policy and Technology

57 UNEP (2015) *Pollution is the largest cause of death in the world*, UNEP SDG fact sheet, available at www.gahp.net/new/wp-content/uploads/2015/03/UNEP_SDG_FactSheet_March13_2015.pdf; malaria mortality figures from www.who.int/gho/malaria/epidemic/deaths/en

58 The remaining three quarters are either not of working age, economically inactive (for example, looking after children) or in formal employment. International Labour Organisation (2016) 'World Employment Social Outlook 2016', ILO, Geneva

59 World Bank (2013) 'India: Diagnostic Assessment of Select Environmental Challenges Volume 1', report Number 70004-IN; see also www.ft.com/cms/s/0/0a89f3a8-eeca-11e2-98dd-00144feabdc0.html#axzz44UclLWsv

60 www.ft.com/cms/s/0/0a89f3a8-eeca-11e2-98dd-00144feabdc0.html#axzz44UclLWsv

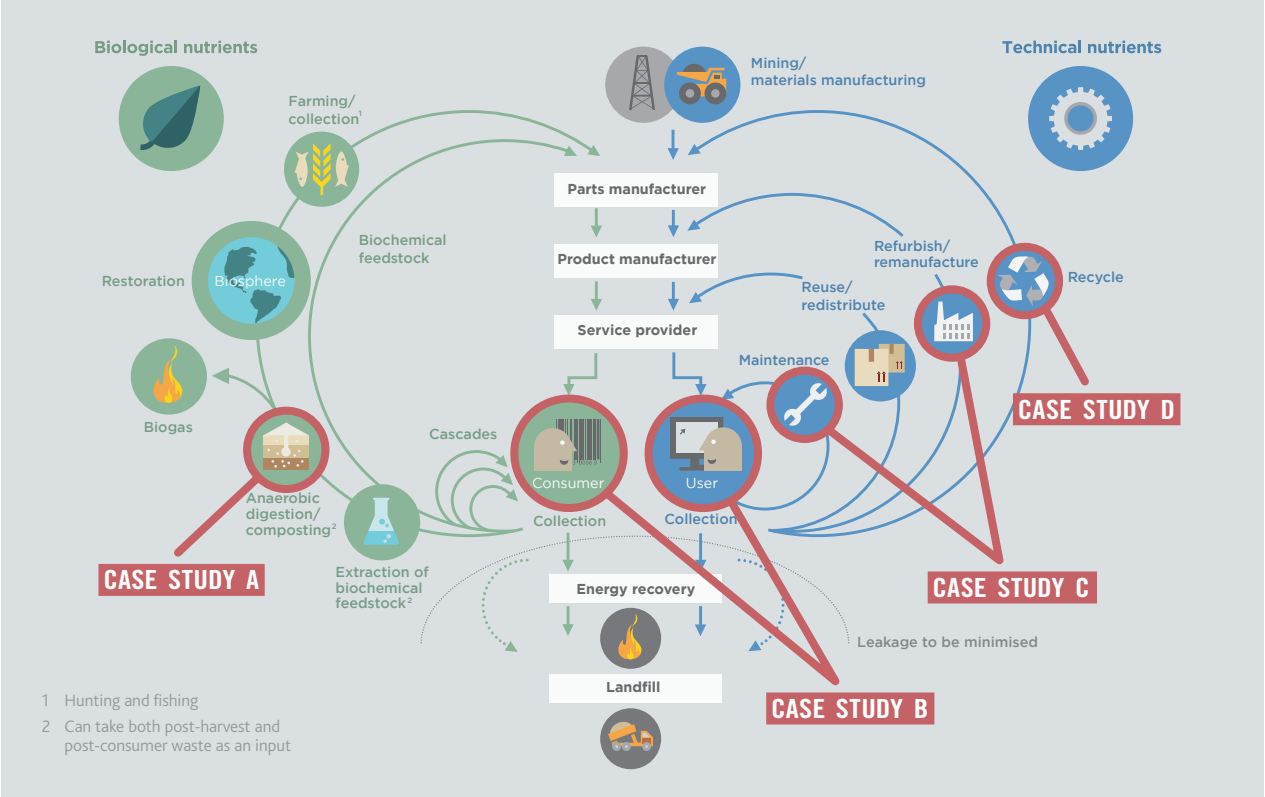
61 Fernandes A (2016) *Closing the loop: the benefits of the circular economy for developing countries and emerging economies*, Tearfund

In practice, leapfrogging means engaging with existing examples of circularity in low and middle-income countries, and creating an enabling environment that allows them to be formalised and upscaled. The case studies below explore this further. As these examples demonstrate, in many cases, creating an enabling environment for the circular economy could also provide opportunities for the poorest – those at the base of the economic pyramid.

7 CASE STUDIES OF THE CIRCULAR ECONOMY IN LOW AND MIDDLE-INCOME COUNTRIES

Figure 1 (page 8) presented a typology of closed loops in a circular economy. Here, we provide case studies illustrating four of these processes in developing country contexts, together with a fifth case study based on one area of the more comprehensive ReSOLVE framework (resource recovery and re-use in industrial processes), described in Figure 5.

Figure 5 Mapping case studies onto a typology of closed loops in the circular economy



Based on Ellen MacArthur Foundation (2013) – drawn by the Ellen MacArthur Foundation Circular Economy Team

CASE STUDY A

The missed opportunity of organic waste

The public health failings of the 19th century in the West resulted in (the now) high-income countries taking an approach to the treatment of waste driven exclusively by health and sanitation concerns, with no reference to the potential economic value of this waste.[62] Importing the same paradigm into low and middle-income countries has left many communities without adequate facilities and has also meant that the environmental impact of organic waste (via climate change, for example) is often overlooked.

Procomposto, Diaconia and Sanergy illustrate how harnessing the value that can be generated from organic waste can increase sanitation coverage, provide jobs, protect the climate and improve livelihoods for the poorest. The technology involved is proven and often very basic.

Procomposto[63] is an SME that provides waste collection and treatment services to major generators of organic waste in Brazilian cities, such as restaurants, apartment blocks and supermarkets. The collected waste goes through a composting process to generate fertiliser for organic farming. In Brazil, more than half of municipal waste is organic (94,000 tonnes a day) and currently 98 per cent of this is sent to landfills or open dumps, where a large proportion of it will break down to produce methane, a powerful greenhouse gas. By contrast, Procomposto's approach reintroduces CO_2 to the soil.

One of the major obstacles to scaling up this type of activity in Brazil is that in many locations the municipality will collect landfill waste from businesses for free, creating no incentive to separate organic waste or use Procomposto's collection service.

TO DATE OVER 700 TOILETS SERVE MORE THAN 30,000 USERS EACH DAY, AND SANERGY HAS CREATED MORE THAN 800 JOBS IN THE COMMUNITIES WHERE THEY WORK

Sanergy (a social enterprise) takes a value-chain approach to the provision of hygienic sanitation in urban slums and initially received funding from a number of impact investors (including DFID's CDC). Sanergy installs high-quality, low-cost toilets in the slums of Nairobi, which are managed by a local franchise owner. Sanergy safely and professionally removes the waste from each toilet on a regular basis. It then processes the waste into high-quality agricultural inputs and renewable energy. Toilets are either installed in schools, residential compounds, or public locations (the latter on a pay-per-use basis). The project results in a cleaner, safer urban environment and to date over 700 toilets serve more than 30,000 users each day, and Sanergy has created more than 800 jobs in the communities where they work.[64]

Diaconia is an NGO and Tearfund partner working in rural north-east Brazil. It has adapted anaerobic bio-digester technology so that small-scale farmers can use it to convert animal manure into cooking gas and a nutrient-rich fertiliser. This enables the families involved to economise on their purchase of cooking gas, and also increase agricultural production. At the same time, by capturing and burning the methane produced by the manure (which converts it into CO_2), the process potentially decreases the emission of associated greenhouse gases.[65]

In all three cases, circular economy approaches are producing environmental, social and economic benefits. However, these examples also highlight areas where more could be done to create a supportive enabling environment: for Procomposto, municipality policy on collection of waste is a major concern; well directed impact investment was crucial to Sanergy; and the NGO Diaconia directly facilitated the provision of low-tech anaerobic digesters to poor farmers.

62 Gunsilius E, Spies S, García-Cortés S, Medina M, Dias S, Scheinberg A, Sabry W, Abdel-Hady N, dos Santos A and Ruiz S (2011) *Recovering resources, creating opportunities: integrating the informal sector into solid waste management*, GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development, available here www.giz.de/de/downloads/giz2011-en-recycling-partnerships-informal-sector-final-report.pdf

63 For more details on this case study, see Fernandes A (2016) *Closing the loop: the benefits of the circular economy for developing countries and emerging economies*, Tearfund

64 Information provided by Sanergy. See also Tan K and Griffiths B (forthcoming) *Fighting poverty with enterprise*, 2nd edition, Transformational Business Network. Further information available at www.saner.gy

65 Fernandes A (2016) *Closing the loop: the benefits of the circular economy for developing countries and emerging economies*, Tearfund

CASE STUDY B

Involving waste pickers in reverse logistics

Waste pickers in Brazil (and many other emerging markets) make up a significant part of the poorest segment of the population in urban areas. The activity is often hazardous and poorly remunerated, and in some countries the government persecutes workers. However, when supported to organise into recycling cooperatives, these individuals can leave informal employment, access social protection, enjoy better working conditions and increase their incomes, while increasing recycling rates. The Brazilian government has a proactive programme encouraging this as part of wider efforts to formalise marginalised sections of the economy.[66]

The Recyclers Association Jaraguaense Valley Itapocu (or ARJVI) was started in 2012 by a small group of waste pickers, to help improve their working conditions. The association now enables about 100 people – or 20 families – to earn an average monthly income of $1,300. The association receives recyclable waste from the local municipality and also purchases waste from other smaller groups of waste pickers in the region. Members sort and classify the waste, before bundling it for sale to recyclables-processing companies. In the process, they reduce the amount of waste sent to landfill.

The relationship with the local municipality is key to their business model, but variations in the amount of waste received via this route have caused significant volatility for members. Today, more than half of their revenue comes from the sorting and sale of waste purchased from other waste pickers. Brazil's new National Policy on Solid Waste explicitly mentions the need to include waste pickers in public waste management,[67] but implementation of this policy lies with local municipalities, and there can be significant capacity constraints at this level, which can hinder effective implementation.

The Vira–Lata cooperative was founded in 1998 and plays a unique role in two private sector supply chains. The cooperative facilitates the collection of steel car parts from the Porto Seguro insurance company's network of car repair workshops, and sorts and sells this material to Gerdau, a steel components manufacturer. In the glass supply chain, the cooperative collects glass bottles from Diageo retailers and sells them to glass recyclers such as Owens-Illinois. Both arrangements ensure lower costs than if the companies had managed the reverse logistics system by themselves. Moreover, by enabling the reverse flow of materials between waste generators and recyclers, the door-to-door collection and sorting services provided by the cooperative have helped to prevent used beer bottles and car parts ending up on the counterfeit beer or components markets.[68]

WASTE PICKER ASSOCIATIONS OR COOPERATIVES ARE RESPONSIBLE FOR A THIRD OF ALL THE RECYCLABLE WASTE COLLECTED, AND ALSO OPERATE MORE THAN HALF OF THE SORTING FACILITIES CURRENTLY IN OPERATION IN BRAZIL

In Brazil, waste picker associations or cooperatives are responsible for a third of all the recyclable waste collected, and also operate more than half of the sorting facilities currently in operation. In general, they recycle a much higher proportion of their waste than private sector or municipality waste services.[69] However, despite their importance in the recycling system, there is clear potential for improvement. At present, only ten per cent of waste pickers are organised into associations or cooperatives, and even among these organisations, a significant number (perhaps half) lack the expertise to maintain contracts with the government or larger private sector enterprises.[70] The new Solid Waste National Policy and associated measures should result in significant improvements, *if* it is implemented effectively at municipality level.

66 UNEP (2015) *Global waste management outlook*; Pochman M (2015) *Policies for the formalization of micro and small enterprises in Brazil*; sourced from the ILO's Brazil office

67 Fernandes A (2016) *Closing the loop: the benefits of the circular economy for developing countries and emerging economies*, Tearfund

68 Ibid

69 Ibid

70 Ibid

CASE STUDY C

Micro-enterprise clusters in repair and remanufacture in Ghana

One prominent example of the potential scale and economic benefits of re-manufacturing and repair activities in low and middle-income countries is the Suame/Kumasi industrial cluster in Ghana. The manner and extent of repair and remanufacture achieved in this cluster of micro-enterprises and SMEs, located at the periphery of the international automotive industry, is beyond anything found in Europe. It has been in operation for more than 30 years and involves huge numbers of people: today 200,000 workers are employed (up from 40,000 in the early 1980s) in more than 12,000 businesses.[71]

Four factors helped drive the development of the cluster. Firstly, the unavailability of imported materials and spare parts in the late 1970s resulted in an increasing need to recycle and repair equipment – for example, cars, lorries and small buses were repaired in local workshops, which developed innovative ways of prolonging the lifetime of vehicles. Over time, producers and traders became highly specialised in particular operations or products.

THIS CLUSTER OF MICRO-ENTERPRISES AND SMES IS BEYOND ANYTHING FOUND IN EUROPE: 200,000 WORKERS ARE EMPLOYED IN MORE THAN 12,000 BUSINESSES

Secondly, government procurement played an important role. In the early 1980s, the government of Ghana launched a major national initiative to repair all state-owned vehicles, particularly those being used for transporting agricultural commodities such as cocoa and other food crops from the countryside to urban areas.[72] This work was delivered via the Suame cluster. This demonstrates how policy initiatives promoting circular economy practices in specific industry sectors such as automotive and machinery can also support the growth of other sectors, in this case the agriculture sector.

Thirdly, the ability of small enterprises at Suame to organise through formal and informal associations in order to solve collective problems and advocate with the government played a role. According to a recent World Bank publication, 'as far back as the 1970s approximately 98 per cent of the proprietors of Suame enterprises belonged to the Magazine Mechanical Association'.[73]

Fourthly, local craftsmen of the Sumasi cluster are also increasingly involved in product innovation. For instance, in cooperation with European designers they created a new, archetypical African car: the SMATI Turtle 1. The car took its name from its characteristics: its slow but steady speed, its basic and strong mechanics, and its protective bodywork. This new vehicle is an example of the Suame cluster's make-do approach: re-using and transforming what is at hand into innovative objects and with new design features.[74]

The market for remanufactured and repaired vehicles and other products in Ghana is mainly domestic, and extends to export markets in other West African countries to a limited extent. Despite its success, the cluster still faces challenges, for instance lack of effective dissemination of R&D results to local firms and inadequate physical infrastructure. Furthermore, to enhance competitiveness, companies need to raise continuously the skill level of their workforce.[75] For instance, while the skills base of the cluster lies primarily in automotive mechanics, some workshops have begun acquiring skills in electronics, responding to the increasing amounts of electronically controlled parts in motor vehicles.

The cluster is only one prominent example of many clusters worldwide which employ these circular economy principles of repair, remanufacture and even innovative redesign.

71 Schmitz H (2015) 'Africa's biggest recycling hub?' IDS blog: www.ids.ac.uk/opinion/africa-s-biggest-recycling-hub

72 Zeng DZ (2008) *Knowledge, technology, and cluster-based growth in Africa*, World Bank Institute

73 Zeng (2008) Ibid, p22

74 www.designindaba.com/articles/creative-work/smati-turtle-1-road-african-made-car

75 Zeng (2008) Op. cit.

CASE STUDY D

Improving environmental outcomes, pay and conditions for informal e-waste recycling workers in Delhi and Bangalore

Waste Electrical and Electronic Equipment (WEEE, also referred to as e-waste) is one of the fastest-growing waste streams in the world and recycling activities take place mostly in low and middle-income countries, especially China and India but also increasingly in African countries.[76] Much of the recycling takes place in informal settings, in unofficial dumpsites and landfills, or slum districts.

The process can cause significant health and environmental risks to workers and inhabitants of surrounding areas. E-waste contains hazardous substances including heavy metals such as lead and mercury, as well as endocrine-disrupting substances such as brominated flame retardants. In India, more than 95 per cent of the e-waste is treated and processed by untrained workers who carry out dangerous procedures without personal protective equipment and are highly exposed to these toxic substances.[77]

The SWITCH-Asia Programme's WEEE Recycling Project aimed to improve living and working standards in India's urban centres and to support the implementation of the National Environmental Policy which includes involving the informal sector in e-waste management. The project aimed to reduce the pollution arising from e-waste recycling undertaken in the informal sector in four urban areas (Bangalore, Delhi, Kolkata and Pune) by encouraging environmentally sound recycling through a collective effort of all the relevant stakeholders in the value chain. Technologically feasible and socially acceptable solutions for the proper channelling and regulation of e-waste flows were implemented.[78]

The project demonstrated there is an urgent need to provide closer linkages between the informal and formal sectors. For example, the last steps in the e-waste recycling chain for extracting precious metals and other valuable raw materials are the most critical from an environmental and safety perspective, and therefore should be carried out in regulated formal sector environments with appropriate facilities.

Despite these efforts and the project's initial successes, it is clear that reforms earlier in the product life cycle will be required to fully overcome the problems and barriers to environmentally sound and non-hazardous recycling. Critically, these efforts must also include new designs of electronic equipment to allow for easy disassembly and recycling of metals, alongside awareness-raising among users of electrical and electronic equipment regarding the need for safe disposal. The design standards set in high-income countries are key in this regard, an issue we return to in Section 4.

This case study on India's e-waste recycling challenges is not an isolated case but illustrates the wider issues and global challenges associated with waste electronic equipment.

CASE STUDY E

Introducing acid recovery and re-use practices in India's metal-finishing SMEs

The SWITCH-Asia Programme's ACIDLOOP Project[79] promoted circular practices, in particular acid recovery and re-use, recycling practices and other related technologies in the Indian metal-finishing industry, a booming sector in the Indian economy responsible for significant pollution of water resources. Between February 2012 and January 2016, the project supported 106 small and medium-sized metal-finishing companies across India to become more resource efficient in their production processes. Many waste-minimisation options in the metal-finishing industry, including process recovery and re-use, represent significant opportunities which require relatively low investments.

76 www.pcworld.com/article/2878492/west-africa-turns-into-dumping-ground-for-ewaste.html

77 Annamalai J (2015) 'Occupational health hazards related to informal recycling of E-waste in India: an overview', *Indian Journal of Occupational and Environmental Medicine* 2015 Jan-Apr; 19(1) pp61–65

78 www.switch-asia.eu/projects/weee-recycle

79 www.switch-asia.eu/projects/acidloop

MANY WASTE-MINIMISATION OPTIONS IN THE METAL-FINISHING INDUSTRY REPRESENT SIGNIFICANT OPPORTUNITIES WHICH REQUIRE RELATIVELY LOW INVESTMENTS

ACIDLOOP addressed resource consumption across all steps of the metal-finishing process.[80,81] The use of acids and other chemicals during the metal-finishing process has the potential to cause severe environmental damage if released into the environment or treated inappropriately. For example, used acids and rinsing waters contain heavy metals and, if not properly treated before discharge, they contaminate both surface water and groundwater. At the same time, acid, water and liquid waste are significant cost factors for metal-finishing SMEs. Untreated discharge therefore leads to the loss of valuable resources.

The project applied a combined horizontal and vertical scaling-up approach involving metal-finishing clusters across a wide region in the locations of Chandigarh, Pune, Aurangabad, Ahmedabad, Vadodara, Rajkot, Chennai, Bangalore and Hosur. Reported results include up to a 45 per cent reduction of fresh water use in the South India project component by introducing appropriate rinsing technologies.[82] Furthermore, both the energy and material consumption across all companies could be reduced by more than 20 per cent.

Cost-saving circular practices could be introduced in many industrial sectors in low and middle-income economies, in particular in SMEs, through technology transfer and capacity-building initiatives such as this one.

Lessons from the case studies

The case studies in this paper have been chosen to illustrate the huge opportunities that the circular economy concept offers to low and middle-income countries. Far from being unique situations, these examples shed light on common barriers and identify elements of best practice. They show what could be possible across the global South.

However, they are not comprehensive: the ReSOLVE framework illustrates that there are many more areas where circular interventions could be made.

Lessons can be drawn from the case studies for five key segments of the circular economy:

- **Organic waste**: This is a huge missed opportunity from an environmental, employment and health perspective. The technology required is proven and often simple to implement. However, scaling up initiatives in this area requires a shift in mindset – seeing organic waste as a potential resource as well as a potential cause of disease. Furthermore, existing government policy can sometimes inhibit business models built around capturing the value of organic waste, and access to start-up funding can also be an issue.
- **Waste collection and sorting**: It's clear that waste pickers typically occupy an important position in existing waste management systems, which helps prevent large build-ups of waste. Where private companies and municipalities seek to integrate them into formal systems there are clear win-wins – increasing recycling rates, lowering government and business costs, and improving livelihoods. However, these groups often require support to organise and formalise as associations or cooperatives. The role of local government is absolutely key in this process, but there are often significant capacity gaps at this level. This is one of the few areas of the circular economy where there is a growing evidence base for policy.[83]

80 Metal-finishing is the process of surface modification with the aim of improving appearance and durability of the product. Metal-finishing processes include electroplating, which is the application of dissolved metal ions through an electric current as a coating to the surface of an object. In the process of the coating application, the metal-finishing sector also performs tasks such as surface cleaning, surface treatment, rinsing and drying of metal parts.

81 Sundaravadivel M, Vigneswaran S and Visvanathan C (2006) *Waste minimization in metal finishing industries*. Retrieved on 24 April 2016 from www.eolss.net/sample-chapters/c07/e2-14-02-05.pdf

82 Balakrishnan et al (2016) ACIDLOOP: detailed project brochure, The Energy and Resource Institute and SWITCH-Asia Programme

83 See, for example, Gunsilius E, Spies S, García-Cortés S, Medina M, Dias S, Scheinberg A, Sabry W, Abdel-Hady N, dos Santos A and Ruiz S (2011) *Recovering resources, creating opportunities: integrating the informal sector into solid waste management*, GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development, available here: www.giz.de/de/downloads/giz2011-en-recycling-partnerships-informal-sector-final-report.pdf

- **E-waste recycling and occupational health**: Much needs to be done to improve the situation of e-waste recycling workers in low and middle-income countries. While capacity building on the ground is helpful, there is a clear need for upstream reforms to restrict the use of hazardous chemicals and alter product design standards to make disassembly and resource-recovery easier and safer. There is some limited literature in this area.[84]
- **Repair and remanufacturing** enterprises can develop into large clusters, which become the backbone of industry in some developing country economies. The role of government – through procurement and also providing basic services such as electricity – is key. Helping small and micro-enterprises to organise together to lobby government can be a key part of this process.
- **Recovery and re-use of resources in industrial processes:** Technology transfer coupled with capacity building is important to facilitate the uptake of circular economy processes among SMEs in low and middle-income countries. These often reduce business costs and improve environmental outcomes at the same time.

If we map these five areas in a 'making markets work for poor people' framework (with the addition of an extra category related to product design problems), we find the following obstacles to progress:

Table 1 Obstacles to the circular economy in low and middle-income countries

ELEMENT OF CIRCULAR ECONOMY	Organic waste	Resource recovery and re-use	Repair	Remanu-facture	Involving waste pickers in collection and sorting	Hazardous e-waste recycling
Mis-pricing of externalities and resources (pollution, water etc)	X	X	X	X	X	X
Lack of access to credit	X	X			X	X
Information failures (including access to intellectual property)		X	X		X	X
Coordination problems			X	X	X	X
Social norms	X	X	X		X	X
Government failure	X				X	X
Poor design incentives (planned obsolescence, hard to repair, toxic materials)			X	X		X

There is a pressing need for further research to explore these obstacles in more depth. In particular, further research could establish a comprehensive typology of circular economy practices in low and middle-income countries (building on the ReSOLVE framework) and a menu of interventions that address the obstacles to their expansion.

84 See, for example, Lines K and Garside B (2016) *Clean and inclusive? Recycling e-waste in China and India*, International Institute for Environment and Development; European Environment Bureau, *Hazardous substances* factsheet, available online makeresourcescount.eu/wp-content/uploads/2016/03/FS2_Hazardous-substance_08.pdf

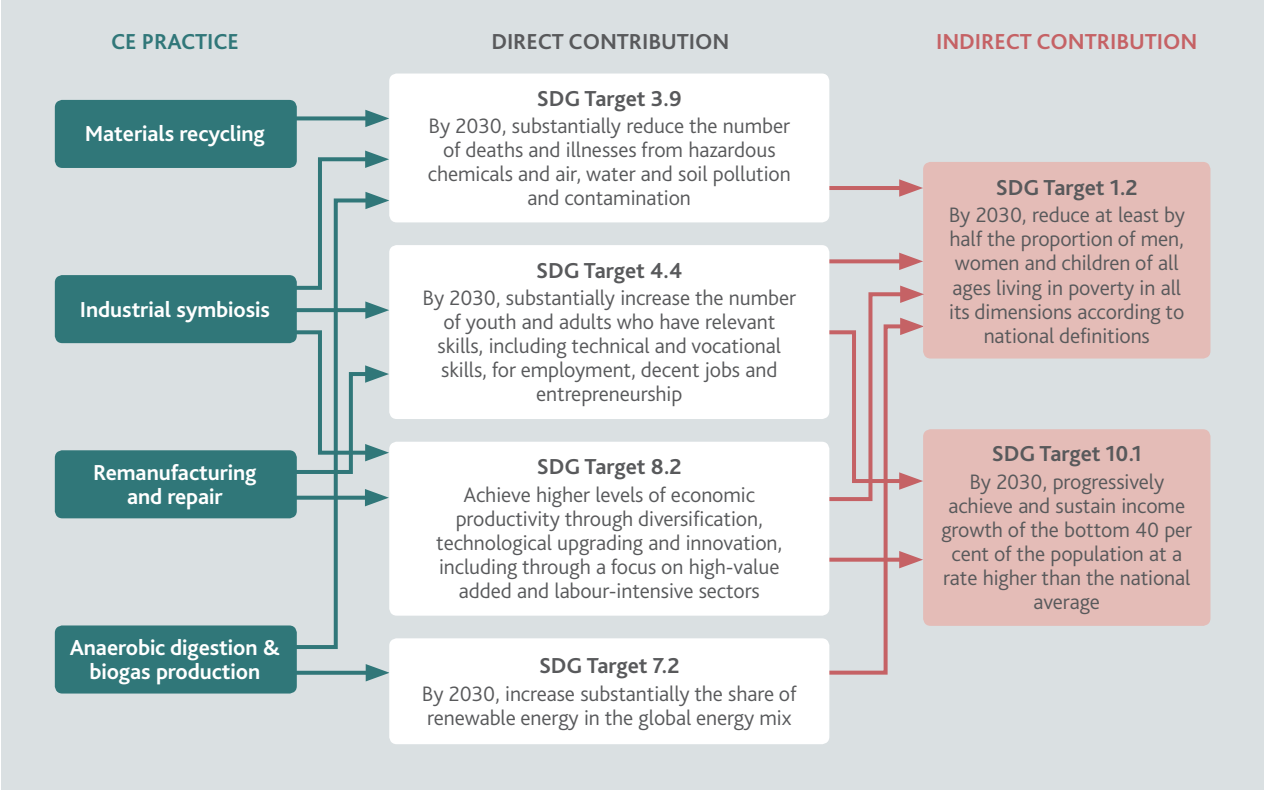
8 THE CIRCULAR ECONOMY AND THE SDGS

THE CIRCULAR ECONOMY UNDERPINS EFFORTS TO REDUCE MATERIAL POVERTY AND ALSO REDUCES THE TENSION BETWEEN GOALS RELATED TO GROWTH AND THOSE RELATED TO POLLUTION

Circular economy approaches are critical to achieving the SDGs. Firstly, the circular economy underpins efforts to reduce material poverty by shielding growth from the long-term upward trend in resource prices and volatility. Secondly, the circular economy also reduces the tension between goals related to growth and those related to pollution (and associated health impacts): by weakening the link between growth and environmental damage, the circular economy makes these goals much more compatible.

There are also clear, specific linkages to Goals 3 (health), 7 (clean energy) and 8 (work), the circular economy is central to Goal 12 (sustainable consumption and production), and Goals 9 (innovation and infrastructure) and 11 (cities) are also relevant.

Figure 6 Major elements of the circular economy and their linkages with selected SDG targets



There is a close link between the circular economy and 'good health and well-being' (Goal 3), particularly Target 3.9 which aims to 'substantially reduce by 2030 the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination'. E-waste recovery and recycling is a case in point: it significantly lowers the total life cycle impacts of electronic waste compared to other options such as incineration or landfilling, and reduces emissions to air, water and soil.[85] However, e-waste recyclers in low and middle-income countries are highly exposed to a wide range of toxins detrimental to human health, including heavy metals such as lead and mercury.

Regarding Goal 7 on affordable and clean energy, the circular economy can help to reduce overall energy needs and achieve higher rates of energy efficiency, for instance through recovery of waste heat of industrial processes or biogas production through anaerobic digestion.

85 Wäger PA, Hischier R and Eugster M (2011) 'Environmental impacts of the Swiss collection and recovery systems for Waste Electrical and Electronic Equipment (WEEE): a follow-up.' *Science of the Total Environment* 409 (2011) pp1746–1756

Goal 8 of the SDGs emphasises the promotion of decent work, full employment and sustainable economic growth. The circular economy is relevant, in particular for Target 8.2: 'Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.' It is also relevant to Target 8.3: 'Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalisation and growth of micro-, small and medium-sized enterprises, including through access to financial services.' As has been demonstrated by the case studies above, circular economy practices can contribute significantly to achieving these targets.

Circular economy approaches are also at the heart of Goal 12: 'Ensure sustainable consumption and production patterns.' This is a transversal goal which is connected to a wide range of other SDGs. The cross-cutting nature of sustainable consumption and production (SCP) is grounded in a life cycle approach and will ultimately need to be reflected in economic and environmental policies of developed and low and middle-income countries and future business models. Recognising the importance of this cross-cutting approach to policymaking for SCP, the United Nations Environment Programme (UNEP) coordinates the 10-Year Framework Programme on SCP, which was adopted prior to the SDGs during the Rio +20 Earth Summit. Specific targets of SDG 12 and the circular economy approaches needed to achieve the targets are outlined in Table 2 below.

Table 2 Circular economy (CE) approaches to achieve targets under SDG 12

Target	Description	CE approaches to implement and achieve targets
12.2	By 2030, achieve the sustainable management and efficient use of natural resources	**All below**
12.3	By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	• **Promotion of food-sharing systems** • **Urban composting and community farming initiatives** • **Reconnected nutrient loops** • **Valorisation of food-manufacturing waste** • **Food-sharing platforms and initiatives**
12.4	By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment	• **Chemicals recovery and re-use from industrial processes** • **Removal of toxins from recycling loops**
12.5	By 2030, substantially reduce waste generation through prevention, reduction, recycling and re-use	• **Extended product lifetimes and enhanced reparability** • **3R practices implemented at all levels of society and economy** • **Anaerobic digestion, composting and gasification technologies for organic waste**
12.6	Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	• **Green supply-chain management and reverse logistics** • **Enhanced corporate reporting on repairability and recyclability of products** • **Extended producer responsibility**
12.9	Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production	• **Inclusion of CE activities in development cooperation programmes** • **Provision of capacity building** • **Enabling technology transfer through involvement of private sector** • **Provision of green financing options**

Source: Schroeder P, Anggraeni K and Weber U (currently under review) 'Circular economy contributions to the post-2015 development agenda', *Journal of Industrial Ecology*, Special issue: Exploring the circular economy

9 THE EUROPEAN CIRCULAR ECONOMY PACKAGE AND IMPLICATIONS FOR LOW AND MIDDLE-INCOME COUNTRIES

As recently as December 2015, the European Commission released a set of proposals – the Circular Economy Package – with the aim of supporting European businesses to become more resource-efficient and move the economy towards a circular closed-loop system. The re-use of raw materials that are now disposed of as waste is one of the key principles of the package. It also aims to cover the full life cycle of products: from production and consumption to waste management and the market for secondary raw materials. To achieve this transition, the package is supported financially by the European Structural and Investment Funds (ESIF), which includes €5.5 billion for waste management.[86] In March 2016, a new regulation to boost the use of organic and waste-based fertilisers in the EU was also presented. Today only five per cent of the EU's bio-waste is recycled, but more bio-waste recycling could replace up to 30 per cent of non-organic fertilisers. (Currently, the EU imports about 6 million tonnes of phosphates a year.[87]) In addition, the EU Circular Economy Package addresses future product requirements under the Ecodesign directive. It includes an Ecodesign work plan from 2015 to 2017 and a request to European standardisation organisations to develop standards on material efficiency for setting future Ecodesign requirements on durability, reparability and recyclability of products.[88]

This package affects low and middle-income countries in two important ways. Firstly, future European product standards affect those countries that supply raw materials or manufacture products for the European market. In fact, as the biggest single market in the world, EU design standards set a benchmark for standards the world over. On average, 80 per cent of a product's environmental footprint is determined at the design stage,[89] and improvements in this area could help reduce environmental impacts in source countries.

Secondly, many of the products used in the European market eventually end up in low and middle-income countries (as Case study D illustrates). As a result, if we want to make something easier (and safer) to repair, re-use or remanufacture in Africa or South Asia, then we need to change European design and product requirements. For example, future developments of European circular economy policies could include strengthening EU requirements for products to make them last longer and ensure that they are easier and less hazardous to disassemble and re-assemble, as well as compelling manufacturers to publish information to aid product repair.

Cooperation on some of these issues with supply chain partners of European businesses has already been initiated. In particular, SMEs in low and middle-income countries require support to implement Ecodesign principles and enhance the quality of product components supplied to European markets. Circular economy principles and approaches have therefore been included in some of the EU's external development cooperation programmes, the most prominent example of which are the SWITCH Programmes, which encompass the SWITCH-Asia Programme, SWITCH-Mediterranean and, most recently, the SWITCH Africa Green Programme.

86 http://europa.eu/rapid/press-release_IP-16-827_en.htm

87 Ibid

88 European Commission (2015) 'Closing the loop: an EU action plan for the circular economy', available at http://ec.europa.eu/environment/circular-economy/index_en.htm

89 *How Ecodesign can help the environment by making products smarter*. European Commission: http://ec.europa.eu/DocsRoom/documents/5187/attachments/1/translations/en/renditions/native

10 CONCLUSIONS AND RECOMMENDATIONS

The potential prize is large. If low and middle-income countries can leapfrog towards a circular system, they will avoid the waste mountain (and associated diseases and pollution) that typically accompanies growth in the linear economy. According to the World Health Organisation, approximately 9 million people die of diseases linked to mismanagement of waste and pollutants each year. (That's six times as many as die from HIV-related conditions, and 20 times more than die from malaria.)[90]

IF LOW AND MIDDLE-INCOME COUNTRIES CAN LEAPFROG TOWARDS A CIRCULAR SYSTEM THEY WILL AVOID THE WASTE MOUNTAIN (AND ASSOCIATED DISEASES AND POLLUTION) THAT TYPICALLY ACCOMPANIES GROWTH IN THE LINEAR ECONOMY

At the same time, low and middle-income countries will be able to reap huge environmental benefits. In Brazil, half of collected waste is organic (94,000 tonnes a day), most of which breaks down in landfill to produce methane, a greenhouse gas almost 100 times as powerful as carbon dioxide.[91] The circular economy would prevent this.

And low and middle-income countries will be able to create more jobs, particularly for those at the base of the economic pyramid. For example, the Suame remanufacturing cluster in Ghana employs 200,000 people spread across 12,000 enterprises.

At the macro-level, enabling the transition to a circular economy would shield economic growth from the headwinds of a long-term upward trend in resource prices and increased price volatility. And crucially the circular economy would weaken the link between economic growth and environmental degradation, helping keep intact planet earth's life support systems (several of which are currently under threat).

How can this transition be supported? It requires an enabling environment that allows existing circular practices to scale up, and new ones to emerge. In this regard, we make ten recommendations for policy makers:

In all countries, encourage greater resource efficiency by:

1. Reforming tax systems so that they do a better job of discouraging undesirable activities (such as pollution or waste) and encourage desirable activities (such as establishing circular business models). Environmental taxation raises ten per cent of tax revenue in the Netherlands and 19 per cent in Tanzania, but the OECD average is just two per cent.[92]
2. Set targets for waste reduction and resource efficiency, to drive progress throughout the public and private spheres.

In low and middle-income countries, take advantage of the big missed opportunities in waste collection, repair/remanufacture and organic waste:

3. Public waste management policy should involve those already working in the waste picking and informal recycling sector, supporting them to formalise in order to access social protection, improve incomes and working conditions, increase recycling rates and reduce costs for government.
4. Governments should support nascent remanufacturing and repair industries through public procurement, and by working with representatives of micro- and small/medium-size enterprises in these

90 UNEP (2015) *Pollution is the largest cause of death in the world*, UNEP SDG fact sheet, available at www.gahp.net/new/wp-content/uploads/2015/03/UNEP_SDG_FactSheet_March13_2015.pdf Malaria mortality figures from www.who.int/gho/malaria/epidemic/deaths/en

91 Methane traps almost 100 times more heat than carbon dioxide over a five year period, but also dissipates from the atmosphere more quickly, taking about ten years. Given the urgency of addressing climate change, methane's heat retention properties trump its short-lived nature.

92 Figures from OECD stat, alongside Vollebergh H (2015) *Green tax reform: energy tax challenges for the Netherlands*; The Netherlands and GIZ (2014) *Environmental fiscal reform – case studies*, GIZ: Bonn, Germany

sectors to ensure that appropriate services (electricity, connectivity etc) are provided, in order to create jobs and reduce waste.

5 Governments should revise existing policies that inhibit unnecessarily circular business models for organic waste (such as free landfill collection or some unnecessary restrictions on treatment of human waste). Circular models for organic waste spur wider provision of sanitation to poor communities and reduce carbon emissions.

In high-income countries, do more to support the transition in low and middle-income countries:

6 EU regulations and design standards should take a tougher line on toxic materials, insist that businesses provide information about how to repair products, and incentivise durability and reparability. The EU's product standards set a benchmark for standards the world over and many of these products also end up ultimately in low and middle-income countries. Changes in EU law are thus key to making products in Africa and Asia easier (and safer) to repair and remanufacture.

7 Development finance institutions should devote more resources to this sector. Circular investments can offer excellent social and environmental returns, and several have received funds from DFID's development finance institution, CDC, among others.

8 The UK government should introduce a circular economy theme as part of the cross-governmental (Global) Prosperity Fund. More generally, the UK's forthcoming plan for implementation of the SDGs[93] (at home and abroad) should include circular economy principles and practices.

9 Governments should work with multinational businesses to support the transition to a circular economy in low and middle-income countries by, for example, facilitating technology sharing between European and developing country operations.

10 There is a pressing need for more research, to (i) comprehensively establish the 'size of the prize' from the transition to a circular economy in low and middle-income countries; and (ii) construct a full typology of reforms that support this transition, through comparative studies of circular practices and interventions around the globe.

THE CIRCULAR ECONOMY OFFERS AN UNPARALLELED OPPORTUNITY. IT'S GOOD FOR THE ECONOMY, GOOD FOR SOCIETY AND GOOD FOR THE PLANET. SUPPORTING THE TRANSITION WOULD SAVE LIVES AND CREATE EMPLOYMENT, ACCELERATING PROGRESS TOWARDS THE SDGS.

93 See the International Development Select Committee's recommendations for a plan in this area, set out here: www.publications.parliament.uk/pa/cm201617/cmselect/cmintdev/103/10310.htm#_idTextAnchor087

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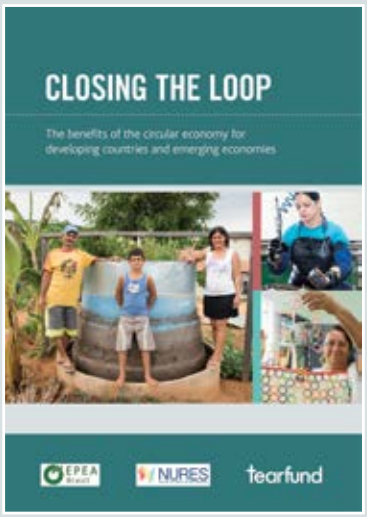
FURTHER READING

Visit **www.tearfund.org/circular** to download *Closing the loop*, Tearfund's research report on the circular economy.



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