

# Interdisciplinary Circular Economy Workshop

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Arts & Humanities  
Research Council



# Innovate UK

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# 1. Background

## What is a circular economy?

A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.<sup>1</sup>

## What is the potential benefit to the UK economy and sustainable development in terms of impact and outcomes?

### UK economy

The transition towards a circular economy has the potential to drive growth and productivity in the UK. Accenture estimate that worldwide the circular economy will be worth \$4.5 trillion in the next 15 years, referring to it as the biggest revolution in the global economy in 250 years.<sup>2</sup> For the UK, the Next Manufacturing Revolution (NMR) report conservatively predicts a £10 billion profit increase, 4.5% greenhouse gas reduction and 300,000 jobs created from only partial implementation of circular economy approaches.<sup>3</sup>

### Sustainable Development

The 12<sup>th</sup> UN sustainable development goal<sup>4</sup> is to ensure sustainable consumption and production patterns. This goal includes the following targets:

- By 2030, achieve the sustainable management and efficient use of natural resources
- 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
- 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 minimize their adverse impacts on human health and the environment
- By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

### The UK research offering

Transition to a more circular economy presents a number of challenges which need input from the academic research community. Addressing these challenges effectively will require expertise from a wide range of disciplines and will utilise approaches which transcend disciplinary boundaries. Partnership with industry and other stakeholders including NGOs and regulators is also essential. Given the interdisciplinary nature of the area, any major Research Council intervention, such as a challenge-led programme, would need to involve multiple Research Councils working together or be part of a cross-council fund. Therefore in July 2016, RCUK held a workshop to bring together 32 experts covering the research areas of AHRC, NERC, EPSRC, ESRC and BBSRC, as well as industrialists and policy makers (see Annex B).

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<sup>1</sup> <http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy>

<sup>2</sup> Accenture, "Waste to Wealth: Creating Advantage in a Circular Economy," Palgrave Publishing

<sup>3</sup> Lavery, G., Evans, S., 2013. Next manufacturing Revolution - report on the opportunity for profit, jobs and environmental benefits from non-human resource productivity improvements

<sup>4</sup> <https://sustainabledevelopment.un.org/sdg12>

## 2. Circular Economy Workshop

### Aims of the Workshop

- To understand what research is needed to enable a circular economy to be achieved
- To determine where interdisciplinary and multi-disciplinary research can add most value
- To start defining the priorities for research (and innovation) activities based on UK strengths and capabilities, and user needs

Circular economy is a global challenge and RCUK is interested in UK focussed research questions (noting these have global context) and those that are relevant to low and middle income countries.

### Workshop outputs

Following introductory presentations from the Research Councils and the Ellen MacArthur Foundation to set the scene around the circular economy the day was split into two sessions:

- The variables of the circular economy - what variables need to be taken into consideration to move towards a circular economy?
- The Research Challenges - what are the key gaps in research that a cross-council call could address?

The workshop participants were split into four breakout groups for both sessions. The outcomes of sessions are summarised below and detailed notes from each of the breakout groups are provided in Annex A.

During Session One each of the groups identified the myriad of environmental, socio-economic, cultural, engineering, agricultural and bio-economy factors relevant to the circular economy. Examples include customer perception, finite availability of natural resources, leasing approaches, recycling technologies and embedding circular economy in free market economies. A common theme was the degree to which the variables change with scale (e.g. city-scale to national and international-scale) and location (e.g. low income countries v. high income countries; rural v. urban). Much of the discussion, however, focused on understanding the different perceptions and definitions of a circular economy, leading to broad agreement of the need for interdisciplinary and whole systems approaches to determine not only how to move towards a circular economy, but also what form of circular economy is desirable and/or realistic.

The second session focussed on identifying the priority research gaps. The key research challenges that emerged were:

- Understanding what a circular economy should look like, including determining how to develop a resilient circular economy and identifying what the benefits of a circular economy will be;
- Understanding how a circular economy can be achieved in different situations, e.g. at different scales, in different countries and in different industrial sectors; and
- Determining how to transition to a circular economy, including identifying key intervention points, developing metrics of success, and understanding how to embed circular economy principles in existing business models.

Each group emphasised the need for the research and models to factor in people in order to result in approaches and methodologies that can be applied to the real world. Case studies that explore the development of a circular economy in particular sectors and/or locations was seen as the most

appropriate way of tackling the research challenges, although the importance of linking the projects and integrating the outcomes where appropriate was also recognised.

The Research Councils are now considering how to address the research challenges identified during the workshop.

Please direct any questions to [manufacturing@epsrc.ac.uk](mailto:manufacturing@epsrc.ac.uk)

## Annex A - Individual Breakout Group Discussions

### Session 1 – The Variables of a Circular Economy



**Table 1**

Following the introductory presentations on the circular economy the group started by discussing in more detail what is meant by the circular economy. It was felt that more work need to be done to define the problem in order to solve it. Once we understand circularity, how do we measure success and how do we know when we have achieved circularity? It was suggested that modelling should be done on scenarios around a circular economy – what does a world with a circular economy look like? What would happen if we didn't go circular? The biological cycle was also considered and this was deemed a more complicated problem: biological systems evolve which changes the landscape that we are working with.

Further thinking about what a circular economy might look like, led the group to discuss the factors surrounding moving towards a circular economy. On what scale and timescale are we considering the transition? The shift from a supply chain>town>city>country>continent>global is a challenge and it would be difficult to map material and energy flow worldwide. It was recognised that transition to a circular economy would be different for low and middle income countries. The group therefore questioned where research should be focused in order to have the most significant impact.

When thinking about the transition to a circular economy the socio-economic boundaries and risks also need to be considered in order to give a fuller picture of the whole system. There were concerns around the socio-economic impact of transitioning to a circular economy in that, as the current model changes, this could lead to higher prices, which would have a bigger impact on lower social classes. There are also external factors to be considered when moving towards a circular economy for example governance and legislation.

A barrier to moving to a circular economy that the group discussed is behaviour and customer perception. It was felt that there would need to be a resource model that takes cultural, religious and behavioural aspects into consideration. A circular economy system would have to be designed to encourage acceptance and could include education and incentivisation for companies/individuals. However it was noted that corporates have the greatest influence on the supply chain and there is also the consideration that behaviour and culture varies around the world.

In the group there was support for moving towards a circular economy however it was felt that more work needs to be done to understand the unexpected consequences and the impact that the

transition would have across the whole system. There are currently gaps in the underpinning data needed to look at the whole system which would need to be filled in order to be able to understand the circular economy. The fragility of the economy and regions would need to be considered and the environmental impact should be assessed. To be able to work at a global level it was suggested that a global reporting system was required along with regulatory and legislative frameworks.

## **Table 2**

In discussing the variables of the circular economy it was felt to be critical to first clearly articulate the goal, priorities, and the 'why' of what was trying to be achieved; is the focus on reuse/recycling, reducing footprints, or maintaining/enhancing value? Additional clarity is needed around "how big is the circle"? Are we looking for a circular economy to function regionally, nationally, or internationally? The group also pointed out that the move from a linear economy to a circular one will be a journey, requiring a period of transition which will require managing.

The group noted the importance of resilience in an economy and this resilience may be a tension against complete circularity. How do you define and measure resilience and subsequently build it into a transition pathway? The point was raised that resilience may conflict with other resource drivers i.e. when 'waste' becomes a feedstock what happens to drivers to decrease that waste from other parts of the circular economy? Additionally, queries were raised around potential conflict between a circular economy and free markets. These issues, along with current (linear economy) asset holders and stakeholders could result in barriers to the transition. Assigning a proper 'value' to (environmental) externalities could help overcome some of these barriers and drive the implementation of the circular economy.

The groups saw the circular economy as an enabler of the Sustainable Development Goals (SDG), but debated if it would (or should) ever be a priority in situations where more fundamental needs are lacking (nutrition, clean water).

It was felt critical to ensure end of life considerations are taken during the design process, and the innovation in products, material flow, business models, and financing will be key to enabling the circular economy. However, demand management aspects should not be dismissed to reduce the need for virgin material/energy inflow.

The circular economy does not just involve 'things', but people also. A clear understanding of attitudes and behaviours to consumption and materials is important as these are a large source of uncertainty in planning any transition. It is uncertain what level of public understanding there is around the circular economy and the justification (and buy-in) to the need to transition. There is a large amount of misinformation and it will be important to identify who the public would consider an honest broker in communications around the circular economy,

A number of areas were identified for development, with technological advances being critical to enable to the circular economy. Some required technologies (i.e. separation) are lacking, as are appropriately skilled people. Data capture, sharing, and analysis will be important as different sectors of the economy become more reliant on each other for inputs or to take their 'wastes'.

Finally, the role of policy (both national and international) will be critical to the success of the circular economy. Geopolitical considerations will be important in creating a level playing field.

### Table 3

Design must be considered upfront and structured with the circular economy in mind. The question of how to assess the design of a system was considered, raising questions such as “who are designers and where do they come from?” and what do ICTs look like?

There is a lack of indicators and metrics for measuring the circular economy and these would be different over a range of scales e.g. company level vs country level. Complex supply chains and the global context were discussed and the economic implications of the circular economy considered. It was suggested that success in implementing the circular economy would be based on economic factors and whether it would be beneficial for profit.

Social factors such as people’s attitudes were considered: does everyone know what the circular economy is? Is there a will to change? It is important to understand what the consumer wants in terms of the functionality and quality of products based on a circular economy approach.

The idea of longevity and leasing was discussed, including how long products can be used for and what happens to them afterwards. People seem to want new stuff regularly – how do you address this? Finance is important to consider: there is a linear lock-in, and consideration needs to be given to how money flows through the economy. Attitudes need to be considered, behaviour and habits, i.e. whether people would be prepared to lease products instead of buy them. The need for efficient recovery mechanisms was also acknowledged.

The UK perspective won’t be the same as that for developing countries. External factors, including climate change, demographics and migration are factors which will impact on the implementation of a circular economy. It’s important to look at where circularity can flourish, consider cases where it has happened, and what those conditions were like. E.g., where there has been the default of economic system, unable to import etc. History can add an interesting perspective, in terms of re-use and recycling cultures in past times.

Other thoughts:

- Key principles of a circular economy were discussed such as open sourcing of IP.
- It was acknowledged that a new set of skills and thinking is needed. The definition of ‘waste’ should not be limited to waste of resources but to wasting time and skills as well.
- What role does democracy have within a circular economy?
- Role of data on resource flows was discussed, where there is currently a lack of completeness and consistency.
- Policy issues were discussed, e.g. local authorities plan for linear economies and this is required of them so they are uninterested in the circular economy.

### Table 4

Circular economy is not new and there are questions around why now is a good time to return to a circular economy. What can we learn from the past? Why did the economy become linear? A number of assumptions are made around the circular economy and these need to be challenged. There are models which work well, e.g. Xerox policy of leasing but, why is this not widely adopted? The [Courtauld Commitment](#) was similarly identified as a successful initiative: it is open and public, thereby facilitating sharing. We should avoid reinventing the wheel. We already have many tools at our disposal and we need to recognise these and make better use of them.



Questions that might be asked vary by scale and scope in terms of: time (fast and slow cycles; short and long term); local to global; urban to agriculture; micro- and macro-; sector; and system complexity. Many of these cycles are long-term, meaning impacts might be slow to realise. There is no single actor, which means a coordinated action for things to change and a need to empower the different players in the 'supply chain'. In other words, there is a need for 'systems thinking', with coordinated action across separate entities. The need to avoid unintended consequences was highlighted.

The group discussed cycling materials, where the key is understanding which intervention points will have the most impact. In terms of resource flows, it is knowing where the pinch points are. Economics is important. It is costly to move to a new model so the numbers have to add up. Price is the biggest driver for changing behaviour. This covers both competitor pressure and peer pressure. The UK is not short on innovation but converting these ideas into effective processes can be difficult. There are issues of scale-up. Current incentives can be quite 'piecemeal'. It is important to understand the 'tipping points' for change, whether this is for businesses or consumers. Consumer behaviour will have an impact, which might be buy-in or resistance to change (e.g. re-manufacture). Consumer motivations, demands, expectations and values will influence the effectiveness of change and the acceptance of new ideas or products. Major retailers have a role to play.

The right policy framework can be a positive driver for change in manufacturing or consumption. We need to take into account the global view, the role of other countries and their different perspective on the circular economy. For example, China is a significant consumer and a big player in materials. We should also consider the role of the emerging economies. Other areas which were touched on were: waste and manufacturing; BioVale (which promotes and develops the bioeconomy across Yorkshire and the Humber); simpler materials; materials advances, making them more complex to address particular problems; innovation and durability; re-design and repair; use and re-use; coping with disruption.

These are complex issues which can only be addressed with coordinated and collaborative input from across the full range of science, engineering, social science, arts and humanities disciplines.

## Session 2 – Research Challenges



**Table 1**

Following the morning’s discussions around the factors involved in transitioning towards a circular economy the group went on to think about what the research challenges are to address the issues raised. The group’s top three research challenges were: modelling, application, and product-based challenges. There was a common thread that would need to be considered in all research around people’s perception and behaviour around the circular economy and willingness to change.

- It was felt that there are gaps in knowledge that modelling work could help address for example: looking at the whole system, the capacity and scale of a circular economy. The modelling of the systems at various scales would also provide insight into the system limits, boundaries and impacts of a circular economy.
- Another area of research is around applications using case studies, for example a particular city or the agricultural cycle. Research to consider in the agricultural example could include biotechnology, climate change and environmental impact, people impact (e.g. tourism), public perception of recycling food.
- The third challenge that the group discussed was around product design, which could include looking at particular materials and what the best option in the circular system is e.g. reuse, recycle or repair? Strands of research under this topic could involve design, economics, life cycle analysis, consumer behaviour.

**Table 2**

While it proved difficult to prioritise research challenges a number of key questions were identified which could be built upon. It was noted that a key challenge will be bringing together disparate research/disciplines.

- What are the challenges/needs of retrofit (i.e. in the UK) vs setting up new systems (global and UK)? This question was particularly focused on infrastructure and the built environment, but also encapsulates the reconfiguring of whole systems and the need to ‘live within our means’.

- Identification of the appropriate scales; What do the desired 'circles' look like, how might they interlink and what are the resulting interdependencies and vulnerabilities?
- If a specific sector focus was desired that of particular UK relevance would be healthcare and the steel sectors.
- Alongside clearly articulating the goal, it will be important to understand what a circular economy looks like in that context. Alongside this is predicting and understanding the intended/unintended consequences (including the resulting resilience of the system).
- What benefits can a circular economy deliver (in the context of the SDGs)?

### Table 3

A collective understanding is needed of what the circular economy is, e.g. a concept or agreement; a one-size fits all framework. The definition of circular economy is important as it means different things to different cultures and locations.

How to transition to a circular economy was discussed, including what factors are needed to make this happen. Case studies would help us to understand what we are working towards and to build a narrative.

Metrics are needed –how will success look at a national, country, company level, both in the UK and in other country contexts, and how do these contribute to the Sustainable Development Goals? Systems-thinking is required, along with an understanding of how to measure something that is constantly evolving. 'Metrics' may not be the correct term, 'assessment' may be more appropriate, or an evaluation methodology that includes metrics.

How do you communicate the principles of a circular economy to enable stakeholders throughout the value chain to understand it? Consideration needs to be given to the whole supply chain to enable businesses to change. This is very interdisciplinary and a range of backgrounds are required to understand the challenges including, complexity scientists, social scientists, scientists with expertise in ecosystems services etc.

The objective of wellbeing, prosperity and sustainability requires thought. Research on Natural Capital is needed to demonstrate what is important in different contexts, particularly globally and across different countries. What are we trying to preserve for wellbeing/sustainability, and is this the same for different countries? This is the case across sectors e.g. ecosystems, water, food and transport

Other thoughts:

- Is everyone working to the same principles and is this necessary?
- Comparative studies with a linear economy and understanding the difference.
- Labelling systems for products. Need overriding system/framework for labelling good or bad.
- How to define what a circular product is.
- How to measure recycling.
- What would materials flows look like across different sectors in the UK, Europe and globally?
- Where are the opportunities for the UK to take advantage of opportunities that circular economy might provide?
- Manufacturing is a smaller amount of GDP than service in the UK. It is easier and cheaper to import. But circular economy can still be applied to the service sector.

#### **Table 4**

The topics which the group felt were of interest as cross-council research challenges:

- Learning from the past – why now? What worked and what didn't? How can we take past learning forward?
- Material flows – understanding the flows and the key intervention points
- Design implementation gap – challenge of scale-up; learning from other countries; inertia; consumer behaviour
- Tools (toolbox) for implementation – methodological, physical, skills - re-use; (re)development; roadmap of existing tools.
- Circular economy at different geographical scales – where does the UK stand? How can the UK move to a circular economy? How can it be a world-leader?
- Scenario analysis – what does a circular economy look like? To include large-scale modelling.
- 'Glue that unglues' – developing products that are easy to take apart and re-use.

Running through the themes there are areas such as:

- Challenging assumptions
- Big data
- Policy aspects and incentives
- Focus on sectors where there is scope for the biggest return.
- Implications for economic growth
- Better metrics – evidence for a circular economy
- Sustainability
- Closing gaps and minimising leakage
- Avoiding unintended consequences

## Annex B - Delegate list

| <b>Name</b>         | <b>Affiliation</b>                           |
|---------------------|--|
| Adisa Azapagic      | University of Manchester                     |
| Andrew Bloodworth   | BGS  |
| Andy Neely          | University of Cambridge                      |
| Anne Chick          | University of Lincoln                        |
| Ben Kidd            | ARUP   |
| Bernard Hon         | University of Liverpool                      |
| Catherine Joce      | KTN  |
| Cian O'Donovan      | University of Sussex                         |
| David Fitzsimons    | Oakdene Hollins                              |
| David Holtum        | EPSRC  |
| Fiona Charnley      | Cranfield University                         |
| Gary Leeke          | Cranfield University                         |
| Gev Eduljee         | SITA UK                                      |
| Helen Niblock       | EPSRC  |
| Henry King          | Unilever                                     |
| Ian Holman          | Cranfield University                         |
| Jacqui Glass        | Loughborough University                      |
| Jo Miller           | Ellen MacArthur Foundation                   |
| Joe Gallagher       | Aberystwyth University                       |
| Josie Warden        | RSA  |
| Julie Hill          | Green Alliance                               |
| Kate Scott          | University of Leeds                          |
| Kerry Kirwan        | University of Warwick                        |
| Michael Booth       | BBSRC  |
| Nick Cliffe         | Innovate UK                                  |
| Nina Sweet          | WRAP   |
| Patricia Thornley   | University of Manchester                     |
| Phillip Shapira     | University of Manchester                     |
| Raimund Bleischwitz | UCL  |
| Robyn Thomas        | NERC   |
| Rosie Hails         | Centre for Ecology & Hydrology, Wallingford, |
| Ruth Kelman         | NERC   |
| Simon McQueen-Mason | University of York                           |
| Sophie Martin       | ESRC   |
| Stephen Clune       | Lancaster University                         |
| Steve Evans         | University of Cambridge                      |
| Sue Carver          | AHRC   |
| Tim Cooper          | Nottingham Trent University                  |
| Tom Fisher          | Nottingham Trent University                  |
| Tom Knowland        | Leeds City Council                           |
| Yetunde Abdul       | BRE  |
| Zhongyun Fan        | Brunel University                            |