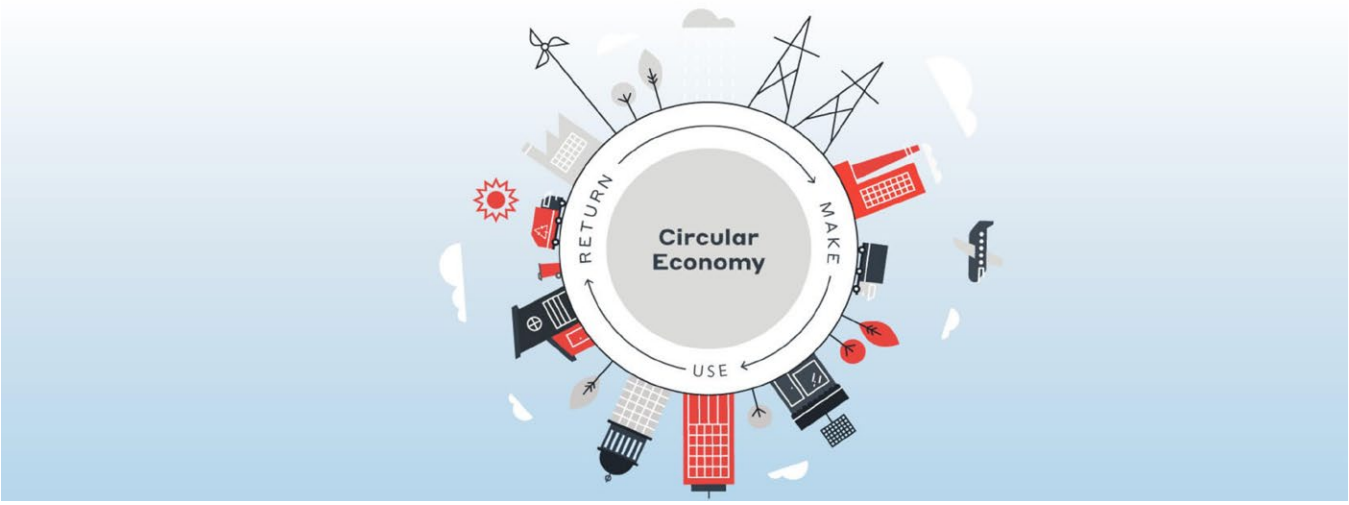
Applying Circular Economy Principles to Aviation

Scaling up sustainable practices to achieve net zero



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Tim Danson

Technical Director, Sustainability & Climate Change, Advisory Services United Kingdom

Intense pressure on business sectors to set and meet clear targets for sustainable outcomes requires shifting away from traditional approaches to a synergised and systemic framework.

This change embraces movement towards the circular economy, which asks society to look past the take-make-use-dispose approach to consumption to find a much less wasteful and damaging way forward. The circular economy concept offers a systems solution framework that calls for transformation-leading behaviour to keep materials in high-value use as long as possible (including the elimination of waste) and support the regeneration of nature.

Applying the principles of the circular economy can lead to more effective and longer-term achievement of sustainable practices as industries, including aviation, seek to reduce their climate impact. This is particularly important in sectors that have committed to achieving net zero, but where—often—actions lag behind stated ambition.

In aviation, demand for new and advanced buildings, infrastructure, services, products, technology and territory, for both landside and airside activities, remains unyielding and is correlated directly with the expanding and

diversifying expectations, needs and capabilities of modern society: safe and speedy global travel, access to mobile data and intelligent systems, and convenient, well-connected and digitally enabled places to work, rest and play.

Yet, at this time, we are also faced with the all-encompassing imperative to protect and nurture our global environment, the full breadth and depth of the communities we serve, and the economic systems from which we profit. ESG [Environmental, Social and Governance] factors and UN SDGs [Sustainable Development Goals] are not only providing a common base of understanding for sustainable decision-making around the world, they are instrumental in guiding organizations to move forward in a consistent, measurable and responsible manner. But in almost all cases, deeper sector-specific guidance is needed for delivering sustainable outcomes, including net zero and the circular economy. As in other sectors—relative to the planning, design, procurement, construction and management of built environment assets, products and services—aviation is now constantly challenged to consider and balance a wide range of (and sometimes competing) lifetime sustainability factors. For example, is it realistic to meet the long-term requirements of airport operators, airlines and passengers whilst also achieving low-carbon and net-zero solutions, gains in biodiversity and natural capital, social and gender equality, and climate resilience?

It is this multifaceted objective that calls attention to the circular economy model—a significant, and, to-date, remarkably undervalued means to help more effectively address the all-encompassing imperative.

Overview of the Circular Economy

The principles of the circular economy have emerged over the last 50 years from a variety of sources: from biological, economic and energy theorists, to industrial and manufacturing models and policy instruments. However, perhaps the most widely accepted definition of the circular economy in a modern context is set down by the Ellen Macarthur Foundation.[1] The definition is based on the need to take action following three key principles:

- Minimise and eliminate waste and pollution
- Keep resources (whether materials, energy and or water) in use, and at their highest possible value
- Regenerate nature, and thereby preserve and enhance the Earth's natural capital.

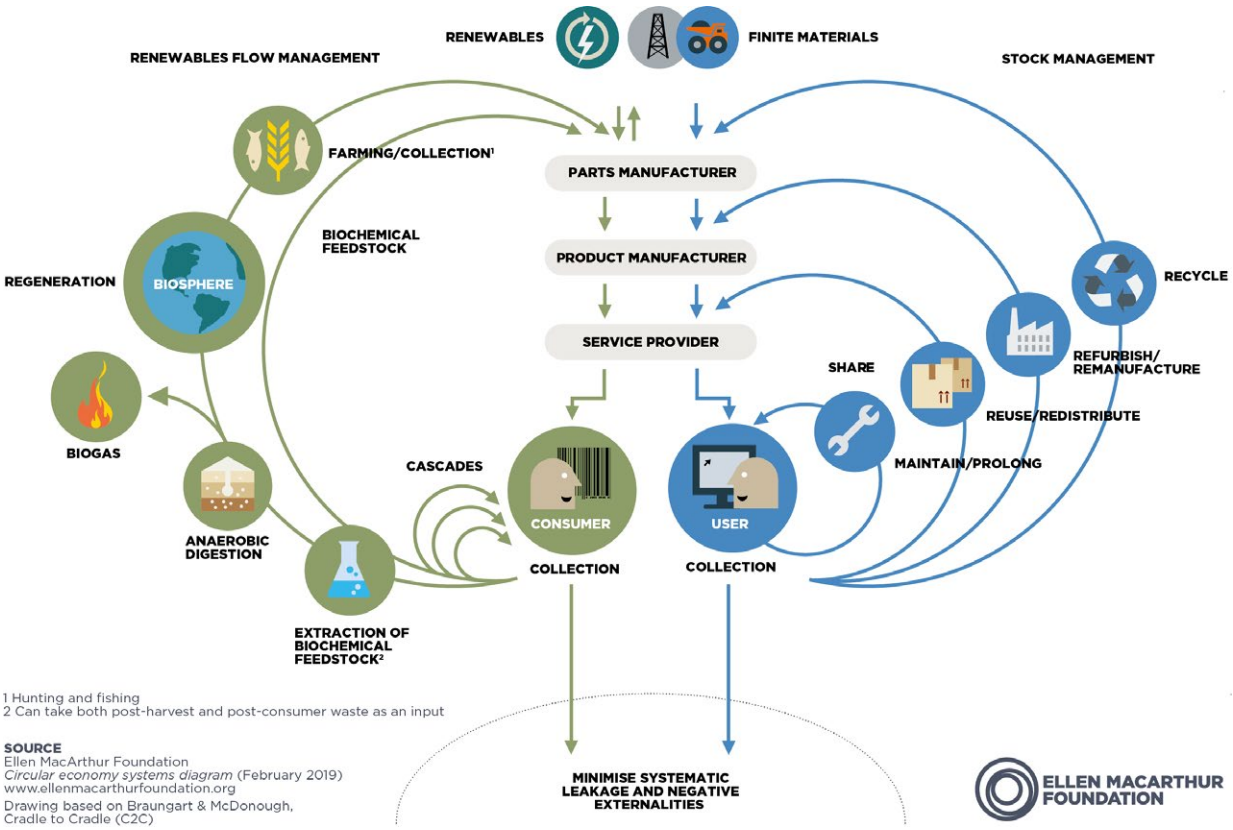

Figure 1 – Visualizing the continuous flow of materials in the circular economy

1 "Circular economy introduction," Ellen MacArthur Foundation.

The diagram demonstrates how wastage (or "leakage") should be prevented at every lifecycle stage of a resource, whether biological or technological in nature. (Biological resources are biodegradable and contain nutrients that should be returned to the Earth; technological resources are non-renewable materials that should be cycled through loops of reusing, repairing, remanufacturing or, where possible, recycling).

The Importance of the Circular Economy

Humans are consuming too many of the Earth's resources, too quickly.

In 2022, the Global Footprint Network calculated that humans extracted and used 75 percent more resources than the Earth can regenerate.[2] It also notes that this trend is not abating: the time in which it takes us to consume "one Earth's" resources gets earlier every year. Compounding this evidence, the United Nations has forecast that global resource consumption is expected to more than double by 2050.[3]

The Circularity Gap Report 2023[4] presents this information with the hard-hitting message that the world is currently only 7.2 percent circular (8.6 percent circular in 2022). In other words, we are consistently failing to achieve best value from over 90 percent of that which we consume.

The report also cites aviation as the fastest growing source of transport emissions in the global system and hence the growth of this sector in the last 30 years and its current reliance on fossil fuels, certainly plays a significant part.[5]

The importance of applying circular economy principles can also be expressed in the context of achieving net zero, a topic which continues to challenge the aviation sector. Whilst the decarbonisation of energy through, for example, the use of renewables for buildings, assets and services is expected to contribute to 55 percent of this goal, the way cement, plastics, steel, aluminium, and food is managed is the key to unlocking the remaining 45 percent. This startling fact is published in the 2021 report *Completing the Picture*, which also states that designing out waste, keeping materials in use, and regenerating farmland can reduce emissions by 9.3 billion tonnes. That is equivalent to eliminating current emissions from all forms of transport globally.[6] Of course, the net zero case just scratches the surface of the socio-environmental dimension: human health and biodiversity also stand to make considerable global gains from circular economy practices. For example, the European Parliament reports that waste prevention, eco-design and reuse could save EU companies €600 billion per annum and generate 580,000 jobs.[7]

Fostering a Culture of Circularity

With great upside potential to make the circular economy a reality, the question remains *how*. In essence, all industries need to establish the principles and standards that are relevant to their world, then work to apply those at scale. Within aviation, there are logistical, commercial and security complexities to such action, and the range of delivery partners is especially diverse, complicated and international, but these are by no means insurmountable.

Fostering a culture of circular action is a key step here. This can be achieved in many ways, such as the re-articulation of an existing action to better align with circular principles; a re-framing of plans and intent to account for circular metrics; or the piloting and scaling up of brand new approaches—for example, developing digital infrastructure that can manage material flows across multiple lifetimes of physical infrastructure.

The concept of "industrial symbiosis"[8] is also an important factor in achieving circularity, as practical outcomes are rarely accomplished in isolation: whenever circular principles are applied, it is essential to engage the full spectrum of value chain members, facilitators, partners and advisors that influence specified goals. Even getting to know our commercial neighbours can be an effective initial step to progressing circular economy solutions.

Whichever route to more circular outcomes is adopted, qualifying, quantifying and sharing the lessons from ventures–and having the confidence to do that openly and honestly—is an essential part of the process.

2 "Measure what you treasure," Global Footprint Network, Advancing the Science of Sustainability.

3 "With resource use expected to double by 2050, better natural resource use is essential for a pollution-free planet," UN environment programme.

4 The Circularity Gap Report 2023, CGRi.

5 World Aviation and the World Economy, Facts and Figures, International Civil Aviation Organization (ICAO); for additional information: Hannah Ritchie, "Climate change and flying: what share of global CO2 emissions come from aviation?" Our World in Data, October 22,2020.

6 "Completing the picture: How the circular economy tackles climate change," Ellen MacArthur Foundation.

7 "Towards a circular economy," European Commission.

8 Interoperable systems that are guided by data driven decisions for the flow of products / materials within and between organisations.

To deliver practical and meaningful action, we all need to substantially refocus our attention on the core elements of circularity. The following table describes some of the elements to consider in our daily work and lives as well as ways to advance the circular economy in aviation:

Refuse	• Is a particular technology, product or asset really needed? • Could the same function be implemented by using a radically different, more sustainable technology, product or asset (e.g. Sustainable Aviation Fuels, also referred to as SAFs[9])? SAFs are one of the most important parts of the aviation decarbonisation equation; their feedstock includes used cooking oil, plant oils, municipal waste, waste gases and agricultural residues.
Rethink	• Can better value or longevity be realised (e.g. by sharing resources)? • Is it possible to digitalise a previously physical technology or product so that there is less or no resource consumption required? (e.g. airspace modernisation programmes across the world).
Reduce	• Can manufacturing processes help to achieve leaner products that also have a longer, more flexible life, or offer lower running costs? • Is eco-design (using more natural or upcycled materials) a practical solution?—e.g. adopting Modern Methods of Construction (MMC)[10] or DfMA (Design for Manufacture and Assembly) principles; the prefabrication approach reduces material consumption, improves quality, reduces accidents on site and reduces transport emissions.
Reuse	• How can the design of, and physical access routes to, technologies and assets (in particular, steel for the aviation industry) allow them to be easily removed and reused in the future? • Do the designs foster deconstruction, de-mounting and adaptability, irrespective of future ownership? When decommissioning and demolishing buildings, identify and extract materials and products for re-use.
Repair	• Can products and assets be easily repaired and maintained? Higher quality products offer a longer overall life whilst also reducing the frequency of maintenance cycles. • How can leasing or hiring a technology, product or asset (by contract), rather than outright purchasing, be achieved? For example, the model of renting or leasing vehicles (rather than outright purchases) offers benefits that could be applied to other assets, e.g. furniture, lights, escalators and lifts.
Refurbish	• Is it possible to restore old or stockpiled products and assets to bring them up to date? • Can we design facilities for alternative future functions? Sustainable buildings are those that have a 2nd and 3rd use after their 1st life. This agility is essential as communities develop.[11]
Remanufacture	• Can parts be extracted from discarded technologies, products or assets, for use in a new product with the same function—e.g. use of end-of-first-life automotive batteries for aviation building power storage?
Repurpose	• Can parts from discarded technologies, products or assets be extracted for use in a different function?

Figure 2 – The table above is adapted from the European Union's Categorisation system for the circular economy: A sector-agnostic categorisation system for activities substantially contributing to the circular economy.

9 Giulio Corte, Auden Kaehler, David Williams, "Advancing Sustainable Aviation Fuel," WSP, June 9, 2020.

10 "Delivery using Modern Methods of Construction," WSP.

11 Tim Morrison, "Agility Underpins Future-Proof Airports," WSP, October 14, 2021.

Steps in Aviation

The industry mandate is to learn and refine how to advance contributions to circular outcomes over time. Here are just a few examples where aviation organizations are applying circular economy thinking and practices to business and projects:

- Heathrow Ltd focussing on redistribution of fixtures, furnishings and equipment during the decommissioning of Terminal 1 at Heathrow Airport in London. It has also designed the new terminal part of the expansion programme as a canopied space within which structures and buildings can be reorganised over time to respond to changing commercial, security and passenger needs whilst also avoiding traditional demolitions associated with refurbishments. Using a standardised Kit of Parts, these buildings can be dismantled and re-used multiple times in different configurations.
- Gatwick Airport in London investing in the conversion of waste into energy, turning in-flight food waste and other types of organic waste into biomass fuel to provide heating for the North Terminal.
- Gatwick Airport (laying surfacing materials only in high-use areas) and Indianapolis International Airport in the United States (moving towards the use of low-carbon pavement) are both challenging the traditional methods and materials that are used in their runways and taxiways.
- Amsterdam Airport Schiphol, Vancouver International Airport, Portland International Airport, and Queenstown Airport have all improved operational resource and waste management performance, in response to circular economy thinking.
- Rolls Royce is now leasing its jet engines to allow it to recover the rare earth metal "hafnium" in the turbine blades, rather than contributing to its ongoing primary extraction.[12]

The achievement of the circular economy is now widely recognised as critical to the achievement of a sustainable world across a wide range of environmental, social and economic topics.

Those who engage best and mature their businesses in response to this demand will find themselves at the forefront of the journey to sustainability, as well as reputationally and economically advantaged.

WSP can help guide you on your journey to circularity. Our specialists and engineers provide advice and consultation to organisations in a wide variety of sectors, from aviation, to buildings, to local government, to water management, to investment. We have a circular economy maturity matrix, a design challenges worksheet, and a self-assessment toolkit to help quantify and articulate your next steps to sustainable resource management.

Contact

Tim Danson

Technical Director,
Sustainability & Climate
Change, Advisory Services
United Kingdom

Tim.Danson@wsp.com

12 "Investment in recycling pays off," Aviation Benefits Beyond Borders.