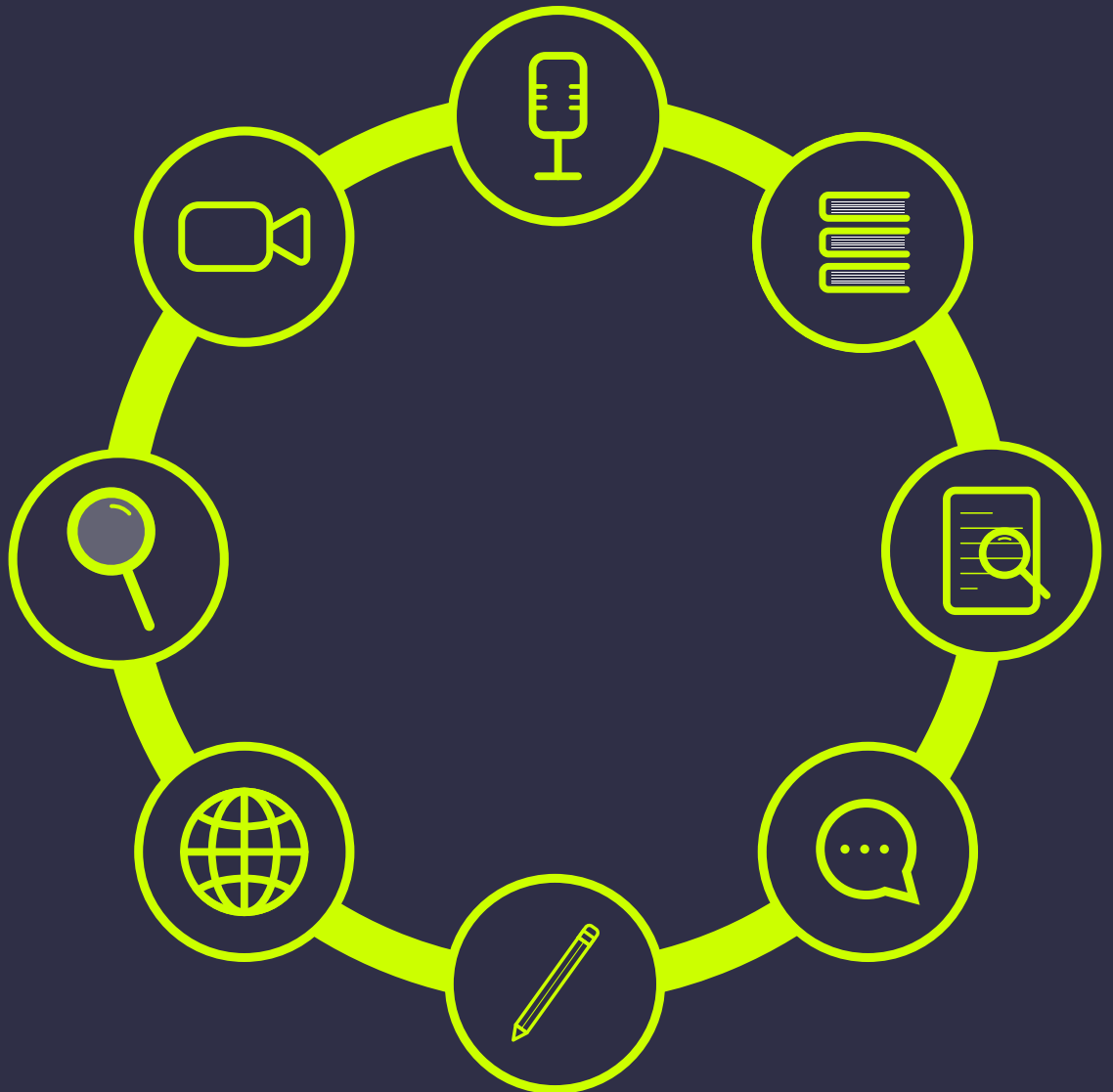


Higher education resources



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Introduction

The Ellen MacArthur Foundation was launched in 2010 to accelerate the transition to a circular economy. Since its creation, the charity has emerged as a global thought leader, establishing the circular economy on the agenda of decision makers across business, government, and academia.

Since establishing the Foundation's Higher Education Programme in 2012, the concept of a circular economy within universities has grown into a field with rapidly increasing momentum. Together with its network – including many of the world's leading universities, such as Berkeley, Exeter, University College London (UCL), and TU Delft – the Foundation has shaped the thinking and mind shift necessary to support the transition to a circular economy. The past ten years have seen the Foundation working with universities to advance the transition to a circular economy in this sector.

We have achieved a number of significant milestones, such as:

- establishing the first global network for higher education institutions focusing on circular economy
- co-producing a number of circular economy programmes, courses, and learning materials, such as TU Delft's MOOC, University of Exeter's Masterclasses, and a University of Bradford MBA
- providing high level feedback on higher education course development
- engaging with thousands of postgraduates and young professionals through our From linear to circular programme to introduce them to the topic

We have also enabled numerous universities and businesses to work together to resolve circular economy challenges to support the systemic transition from linear to circular.

The Foundation emphasises interdisciplinary, project-based and participatory approaches, encompassing both formal education and informal learning. With a focus on online platforms, the Foundation provides insights and resources to support learning about the circular economy, and the systems thinking required to accelerate a transition.

We are therefore uniquely positioned to drive and inform the growing momentum from the higher education sector to integrate the circular economy into learning across all fields of study.

Who is this document for?

The Foundation's aim is to accelerate the transition to a circular economy. One of the key mechanisms for doing this is to empower educators at all levels. This document provides guidance, resources, insights, and relevant links to support higher education institutions that are looking to develop circular economy teaching and learning capacity.

The purpose of this document is to support academics in creating new course material for teaching the principles related to the circular economy. It is not intended to be prescriptive for curriculum design, but rather as a starting point for those looking to introduce and include circular economy into any discipline and curriculum. Whilst this document is primarily for university academic staff developing new curricula, policymakers, senior managers and support staff who want to know more about the circular economy may also find it helpful.

The document focuses specifically on teaching and learning in higher education institutions, however, teaching and learning do not happen in isolation from other activities in a higher education campus environment, and so this document also gives insight into how students' learning can be enriched through a campus-wide approach to the circular economy.



**How can I
improve my own
knowledge first?**



This resource assumes a fundamental understanding of the circular economy, however, if you are new to the topic, there are a range of other resources that can be used to build your knowledge before you embark on integrating circular economy principles into your teaching.

These include:



Train the Trainer

The resource has been designed to deliver an introduction to the circular economy without prior context for those new to the concept, whilst also delivering value to those more familiar with the concept. The Train the Trainer circular economy resource offers plug-and-play, highly interactive workshop content, enabling you to deepen your understanding of circular economy and the fundamental principles of the framework.



The Foundation's Learning Hub

The Learning Hub offers a series of curated learning experiences. Expand your understanding of the circular economy and learn how the concept can be applied to different parts of the economy.



Circular Economy Masterclass Introductory Course

This six-week online course from the University of Exeter is aimed at organisations and individuals who are familiar with the principles of circular economy, and who are keen to extend their knowledge and put their ideas into action, in order to create and deliver commercial benefits. Universities that are Foundation members will have access to places on this course.



TU Delft MOOC – Circular Economy: An Introduction

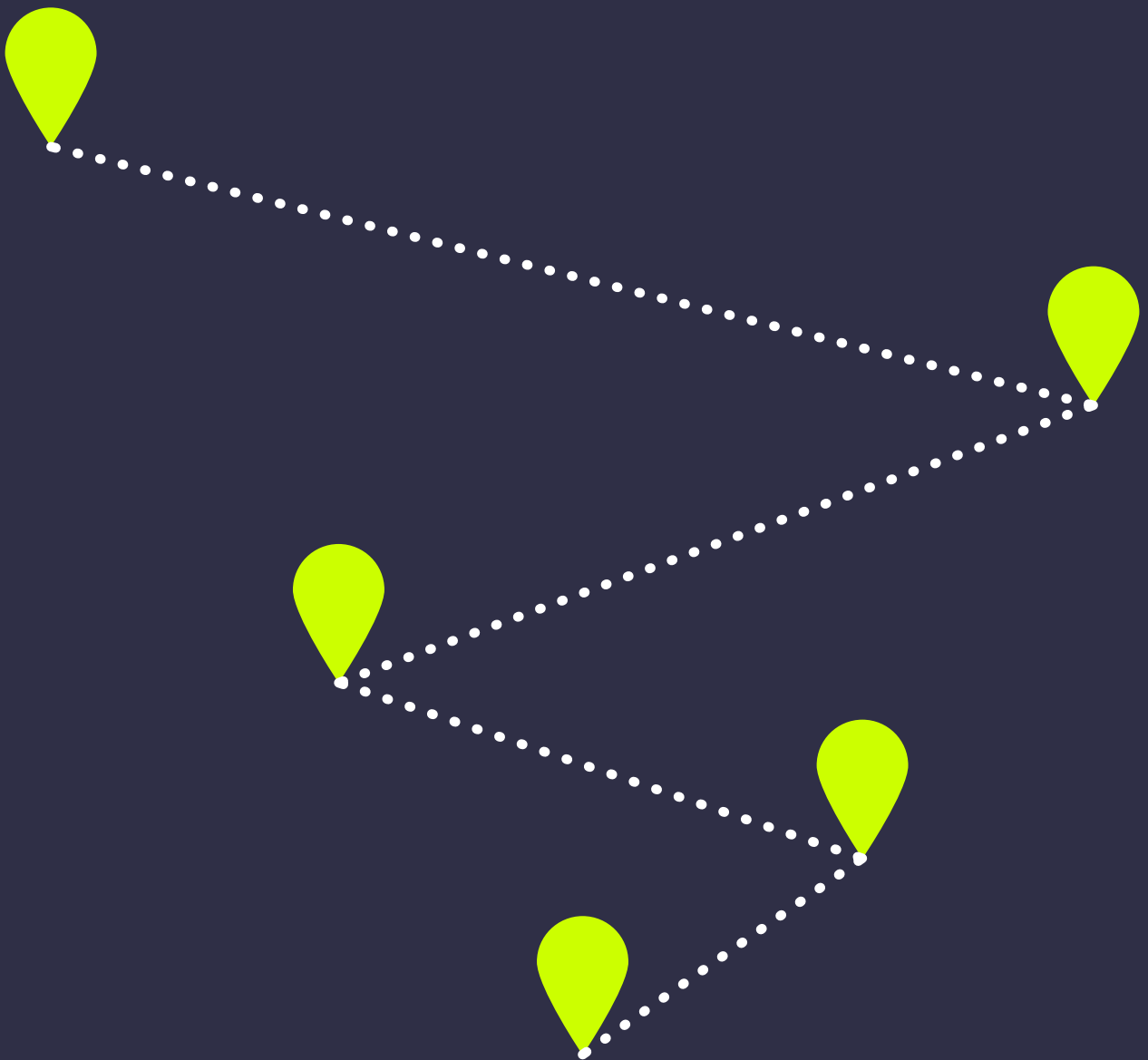
During this free, online seven-week course, you will learn to re-think the economic system you're experiencing every day, and act upon it. The course is led by TU Delft, co-created with the Foundation and the Leiden-Delft-Erasmus Centre for Sustainability.



Circular.now MOOC – circularnow.fi/

The Circular Economy.now module is suitable for teachers in all fields, as it does not require any special knowledge about the circular economy. You can incorporate the perspectives and topics of your own field in the course through your contact teaching and project assignments. The platform also includes a section for teachers, where you can find more detailed instructions and a course plan.

Why should the **circular economy** be a part of your students' learning journey?



There is widespread recognition and understanding that the current economic model is unsustainable in the long-term. The circular economy offers an alternative model that designs out waste and pollution, keeps products and materials in use, and regenerates natural systems. Many pillars of industry are moving their operations to become more circular and for graduates to remain competitive in the jobs market, a fundamental knowledge of the circular economy and how to apply it in different settings is becoming increasingly important. Circular economy is appearing in job titles or as a specific capability within roles and responsibilities across many industries and therefore is a key framework graduates need to understand and with which they need to engage.

There is also a growing interest from students as many circular economy, student-led initiatives are getting off the ground. The rise of initiatives such as the [Circular Economy Club \(CEC\)](#), the [Post Landfill Action Network \(PLAN\)](#), The National Union of Students (NUS)'s [Green Impact](#) or individual university projects like Imperial's [Food Co-op](#) all demonstrate student interest in the circular economy.

By understanding the principles of a circular economy, namely ∞ designing out waste and pollution, ♻️ keeping products and materials in use, and ♻️ regenerating natural systems, the next generation of students will be have the necessary skills and insights to create and access career opportunities leading to transformational change within organisations. The next generation will be able to collectively reconstruct and redesign the global economy to one that works in the long-term.

What this might mean in practice:

- Learners will develop insight into real world systems which are typically non-linear, complex, and dynamic. Learners will need to apply a systems thinking lens: they will: learn what being a feedback-rich system means; identify positive and balancing feedback; learn about homeostasis and homeorhesis; understand effectiveness and scale; learn about diversity and its role in creativity and resilience; learn about capital stocks and related flows. This is not a circular economy per se, but the core 'framework for thinking'. Systems thinking is a fundamental part of understanding the circular economy and should form part of any teaching. There is further information on [systems thinking](#) on our Learning Hub;
- Students will gain insight into the root concepts and schools of thought that underpin the circular economy model. These include: industrial symbiosis/ecology, regenerative design, biomimicry, cradle-to-cradle, and more;

- Learners will gain insight into how a circular economy might be understood, including the roles of businesses, governments, and citizens. This will enable learners to apply a complex, living systems' framework across a multitude of disciplines and to understand how and where value is created in these new systems;
- Learners will develop their understanding of the importance of an inter-disciplinary and multi-stakeholder approach in moving to a circular economy;
- Learners will become knowledgeable about the circular economy and its application using a multitude of learning approaches, including participatory as an example of feedback-rich learning; and
- Learners will be offered participatory aspects to research-led teaching, using your campus as a living laboratory. Making links between teaching and research can lead to enhanced student experience as well as offering insight into the practical application of circular economy theory.

Higher education institutions are key stakeholders in the global economic system and are the source of the next generation of business leaders, designers, scientists, educators, and engineers – amongst many other disciplines – all of which collectively make up an economy. Engaging students through teaching and learning, university and higher education institutions have the power to shift mindsets and scale the transition towards a more circular economy.

Where should
circular economy
go in the
curriculum?



The term 'circular economy' was first coined by Walter Stahel in the 1970s, but it has only come to prominence much more recently. The circular economy as an idea and concept is an amalgamation of a number of other schools of thought including:

- Walter Stahel's The Performance Economy
- William McDonough and Michael Braungart's Cradle to Cradle
- Janine Benyus' Biomimicry
- Industrial ecology
- Regenerative design
- Gunter Pauli's The Blue Economy
- Systems thinking

Begin to explore the *schools of thought* in more detail on our website.

There is a growing bank of academic literature on the topic. Using 'Google Scholar' and searching for articles with 'circular economy' in the title, the number of articles published annually since 2017 has increased by 70–90% per year, from 925 articles published in 2017 to 3,860 by the end of 2019. This trend is continuing through 2020.

Historically, the realm of the circular economy in higher education has been predominantly held by design, business management, and engineering courses. However, there has been a noticeable shift towards the circular economy becoming a more multidisciplinary subject area – from management to architecture, engineering to fashion design, business to consumer behaviour and psychology. This is a good sign, as the circular economy is, by nature, both a multidisciplinary and an interdisciplinary concept and therefore should be present in all fields of study.

We suggest that what is most needed is support that enables **all** learners to develop a clear sense of the narrative and principles behind the circular economy to support a shift in mindset and enable learners to apply their circular economy knowledge to a wide range of industry and business settings. This is also true for research, as having a knowledge of the circular economy can aid in the effective exploitation of research outputs in supporting the development of a circular economy. This has implications for not only the content that is being taught but also the methodologies underpinning how this new content is taught and learned. Essentially, all students should be taught the same basic model, together with different applications, and then learn the relevance of circular economy within their field of study or work.

Language and framing of circular economy



The Foundation describes a circular economy as one that is regenerative and restorative by design. In a circular economy, economic activity builds and rebuilds overall system health, whilst the importance of going back to the beginning and designing fundamentally differently is emphasised. The concept recognises the importance of the economy needing to work effectively at all scales – for big and small businesses, for organisations and individuals, globally and locally.

It is based on three principles:



Design out waste and pollution

What if waste and pollution were never created in the first place? Waste and pollution are not accidents, but the consequences of decisions made at the design stage, where most of the environmental impacts are determined. By changing our mindset to view waste as a design flaw and harnessing new materials and technologies, we can ensure that waste and pollution are not created in the first place.



Keep products and materials in use

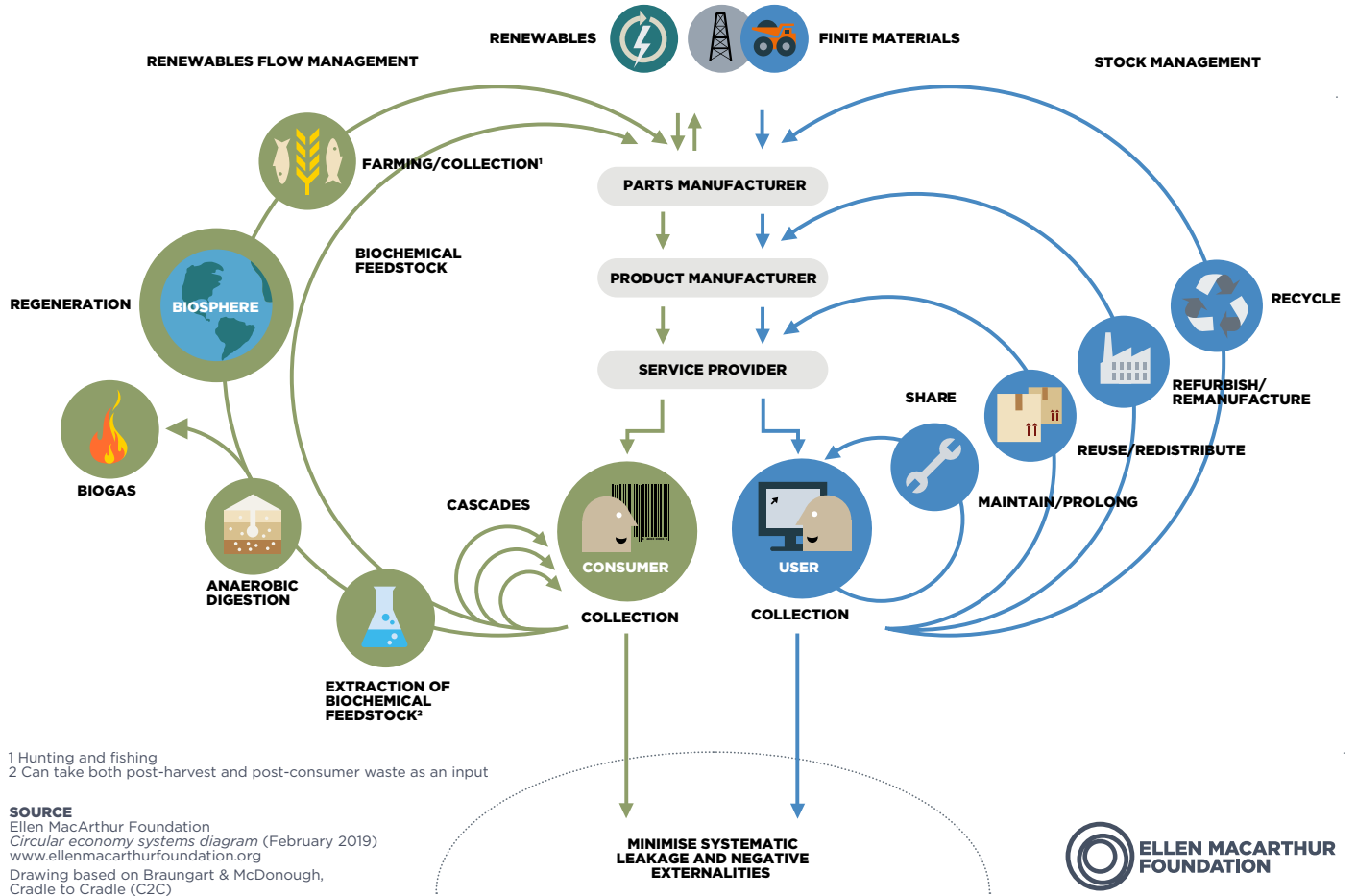
What if we could build an economy that uses things, rather than uses them up? We can't keep wasting resources. Products and materials must be kept in the economy. We can design some products and components so they can be reused, repaired, and remanufactured. And we can design the systems that keep these products and components in circulation.



Regenerate natural systems

What if we could not only protect but actively improve the environment? In nature, there is no concept of waste. Everything is food for something else – a leaf that falls from a tree feeds the forest. We can take inspiration from living systems by designing healthy outputs that add value to the biosphere rather than degrade it. With a regenerative mindset, we can aim to do good rather than just be 'less bad'.

Butterfly diagram



The diagram highlights a number of value creation opportunities including:

- distinguishing between biological and technical flows of materials to allow biodegradable materials to be separated, reused effectively and returned as nutrients to the soil when appropriate
- as shown on the technical side of the diagram, gaining greater value from innovating through the inner loops, where a higher percentage of the original embedded value in terms of labour and energy is retained
- designing products to be more durable, easier to repair, and upgradeable so they can stay in circulation and cycle through different loops for longer

Want to know more about the 'butterfly diagram'? Watch this [video](#) with our founder Ellen MacArthur.

Want to understand more about some of the words and phrases that we do and don't use, and why? We discuss a variety of terms and language in this [video](#).

As well as the bank of academic research, there is a growing bank of economic analyses showcasing the economic argument for implementing a circular economy. In 2012, the Foundation published the first in a series of reports highlighting the economic opportunity of moving to a circular economy. Not only are there multiple articles published by leading financial players, but as more companies move to a more circular model, this proves the economic model works in practice. More and more companies have corporate social responsibility campaigns that align with circular economy, which brings huge opportunities. There is a wave of ambitious targets (e.g. reduction, recycling, reuse) that companies are signing up to, sometimes without direct routes to achieving them. Having graduates skilled in circular economy will enable industries to achieve their targets and help reframe these ambitions to be circular.

Misconceptions

how to deal with
these and how we
differentiate them



As the circular economy is built upon multiple schools of thought, it can often become quite a clouded and contested concept. To help achieve some clarity, here are a few of the common misconceptions of what a circular economy truly is:

Misconception 1: It's all about making better use of waste

In a circular economy, waste is eliminated through better design, rather than developing novel ways to utilise waste that has already been created. It puts the emphasis on upstream innovation, rather than better waste management – although this is needed as well. There is a clear distinction between designing from waste and designing out waste.

Misconception 2: It's only about recycling more

The focus of a circular economy is on maintaining products, components, and materials at their highest possible value for the longest possible time through reuse, repair, refurbishment, and remanufacturing strategies. Recycling is part of the circular economy, but it represents the outermost loop on the 'butterfly diagram', often referred to as the 'loop of last resort', when other options for products and materials are no longer available.

Misconception 3: It's all about efficiency

Traditional sustainability efforts have focused on efficiency tactics – reducing the amount of material and energy used in production processes, and aiming to lower environmental impacts. A strategy focused on reducing the negative impacts of our activities – or making them more efficient – can only go so far. A circular economy is about creating a new system, rather than tweaking the wasteful linear system in place today.

Misconception 4: It's a new word for sustainability

The circular economy describes a fundamentally different vision for the industrial economy in direct opposition to the incumbent take-make-waste model. It focuses on industry-led transformation and systems level change – drawing inspiration from nature – rather than individual action or guilt. It is about designing differently from the outset, rather than mitigating and reducing the impacts of something that has already been created, and is focused on doing more good, rather than less bad.

This distinction is particularly important given that many courses with 'sustainable' in the title adopt the term 'circular economy' within their syllabus, but fail to reflect the principles and framework outlined in the earlier sections of this document.

Misconception 5: Waste-to-energy is part of a circular economy

In many countries, incineration – the burning of waste like plastics to produce energy – is viewed as a valuable pathway. Setting aside questions about toxicity in burning waste and resulting air pollution, this solution isn't viewed as part of a well-designed system. For example, in the case of plastics, taking an energy source (oil), turning it into an important material using more energy, which is then used for a very short period of time, only to then use more energy to turn it back into another form of energy, is not an example of a high value process. There's also increasing evidence that waste-to-energy plants can lock cities, regions, and even countries into needing a steady flow of waste to make these plants economically viable – essentially creating a demand for it rather than designing out waste altogether.

To find more clarity on the misconceptions, here is an [article](#) and also a [video](#).

Resources to support course development

What is the circular economy?

This is an engaging introduction to the circular economy on the Foundation's *Learning Hub*. The link includes a podcast, videos, and infographics which will enable you to discover the key principles behind the circular economy.

Circular economy systems diagram (butterfly diagram) video

Watch Ellen MacArthur explain the circular economy systems diagram, more commonly known as the 'butterfly diagram', one of the core elements of circular economy.

Explore the circular economy podcast series

Hear from Ellen MacArthur herself, as well as experts from the circular economy field, as they discuss the new way to design, make, and use things in this commute-friendly podcast series.

Case studies

The journey to incorporate circular economy content into curricula will be a different story for each academic, their university/institution, and area of expertise. Our case study library offers many concrete examples of the circular economy in action and illustrates the variety of solutions from which students may draw inspiration. Most case studies provided by the Foundation can be applied to multiple topic and disciplinary areas and are labelled with tags in the case study library, so you can explore by sector, topic or key words.

Live online events

The Foundation hosts regular interactive broadcasts and webinars throughout the year showcasing innovation, discussing big ideas, and sharing disruptive stories as part of our goal to inspire action and innovation towards a circular economy.

The circular economy video series

Meet the people bringing the circular economy to life in this short video collection – from innovative entrepreneurs to circular economy leads in global companies.

System reset

Filmed as part of the Foundation's *Disruptive Innovation Festival* (DIF), this video offers a window into a world where we can imagine an economic system built on abundance rather than scarcity. Taking advantage of the latest digital tools, computational power, material science and biomimicry, this new system could have the power to transform how we live and work.

The learning hub

The Foundation's new platform is designed to guide you through online, interactive deep dives of topics from circular design, to food, to cities and much more, featuring case studies and expert knowledge.

The current learning paths on the learning hub that are likely to be most appropriate to support course development are:

What is the circular economy?

Learn about the three principles that are the foundation of the circular economy concept and some of the benefits of shifting away from the current, linear economy.

Systems and the circular economy

In this learning path, you can explore how and why systems and systems thinking are so integral to the circular economy concept.

The circular economy in detail

Dive into the details of the concept of the circular economy to understand its history, its nuances, and the benefits it offers to business, society, and the environment.

Food and the circular economy

Learn about the true costs of the current food system and the catalytic role cities can play in creating a healthy, resilient system based on natural processes.

Fashion and the circular economy

Explore the vision for a fashion industry that is built on the principles of the circular economy and the opportunities that exist to shift the current industry towards this vision.

Cities and the circular economy

Learn how applying the principles of a circular economy to urban systems, such as buildings, mobility, products, food, and services can create thriving cities.

The circular design guide

Co-designed and created together with our Design Partner IDEO, this guide offers a wide variety of resources, methods, and workshops to help you to design, and to teach design, for a circular economy.

Circular strategy design workshop

Use the downloadable tools, such as facilitator notes, printable worksheets, and challenge cards from this design workshop to apply circular design to your teaching.

Glossary (link to be added)

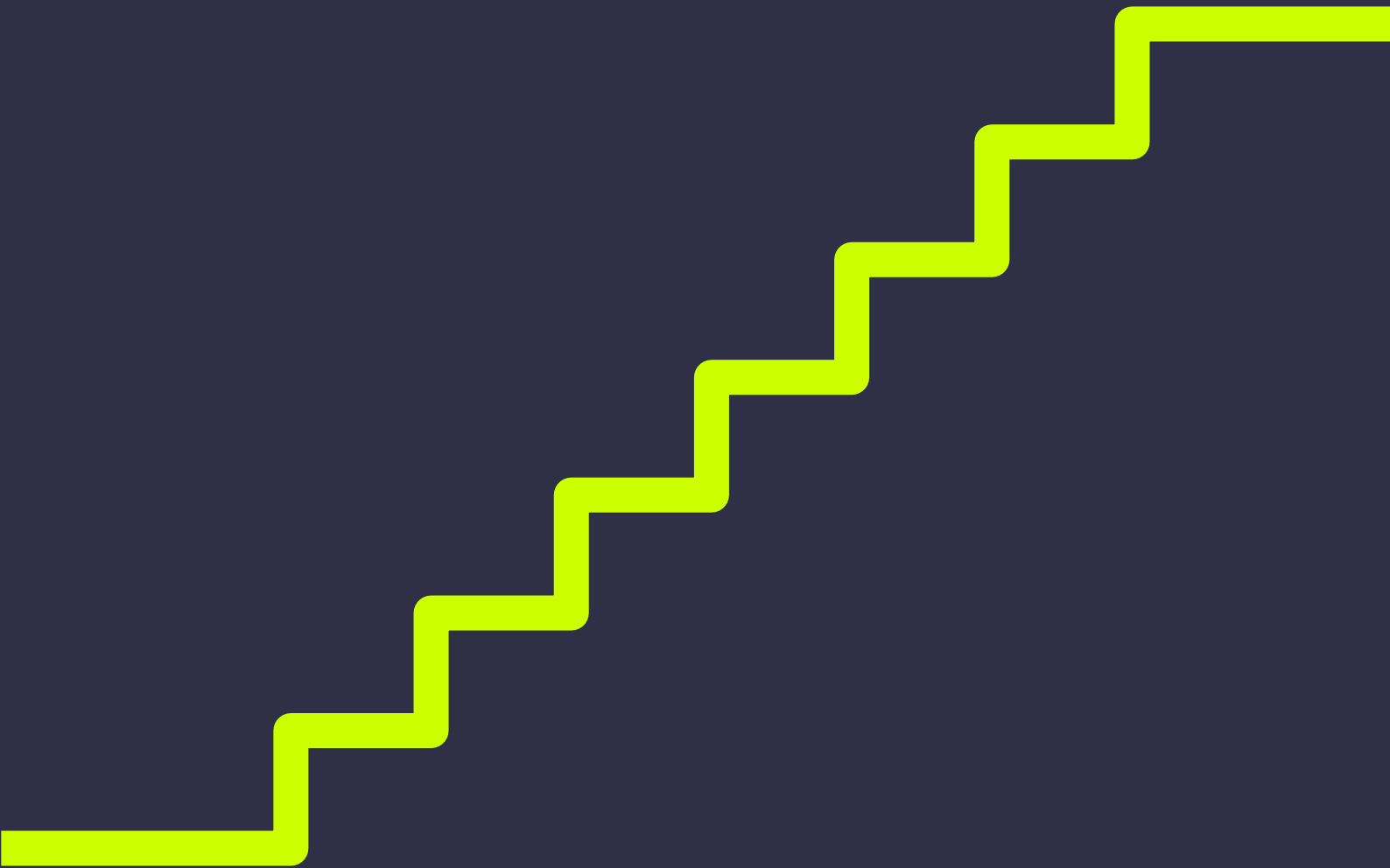
Practical learning activities

The Foundation has produced a number of workshop activities to support student learning. These ten curated activities will help students embed understanding of the fundamental principles that underpin the circular economy. If you have activities you use that you feel could add to this resource, please do let us know.

ellenmacarthurfoundation.org/our-work/activities/universities/higher-education-resources



**Challenges to
implementing
circular economy
in your curriculum
and how to
overcome them**



The circular economy course examples outlined in the ‘examples of the circular economy in curricula’ section show how some frontrunners have progressively incorporated circular economy education into their curricula in the last few years. The rising needs of circular economy education and the shortage of expertise has resulted in some challenges presented by pioneering educators. This section is aiming to outline a few common challenges that may be encountered during the journey when it comes to design and delivery of circular economy courses, getting relevant stakeholders on board, and promoting the novel curriculum within the organisations. Hopefully, the solutions presented in addressing the challenges will support you in your own journey.

Challenge 1: The shortage of expertise for course design

From the first *Circular Action Plan* adopted by the European Commission in 2015 to the new *European Green Deal* in 2020, there is a growing consensus that circular economy skills and knowledge are needed in different areas of public administration and in business – in chemistry, legislation, business activities, behavioural sciences, construction, and food production. The list is limitless – after all, it covers all areas of human activity. Education needs to react to changes in the world – and this includes circular economy education.

As society moves towards a circular economy, we will constantly confront greater challenges that education will have to address. This brings the greatest challenge facing the development of teaching – a shortage of expertise when it comes to the skills in and knowledge of circular economy issues.

However, the circular economy shouldn't only be taught in the traditional textbook, teacher-up-front style. The circular economy is a framework and it inspires young people and shapes their worldview. Introducing both the strengths and challenges of the circular economy concept could enable students to critically reflect upon circular economy and how to apply it. Confucius said “I hear and I forget. I see and I remember. I do and I understand.”

It is ideal to develop experiences, content, and tools that have a learner-centred focus. We should always start by asking how we might best produce a learning experience that increases the learner's understanding of the circular economy, develops their capability to apply that newly acquired understanding in their own context, and motivates them to contribute to and create circular solutions at scale. In order to do this, it is key that we grow the expertise required to develop new courses and creative learning opportunities.

A mixed approach to teaching circular economy is required. We have created a series of workshop activities to support student interaction to bring circular economy principles to life. There are of course many ways to engage learners in the principles of the circular economy and how to apply them in their context. Some case studies are set out below:

Case study 1:

Julian Kirchherr from **Utrecht University** (the Netherlands) has designed a well-received circular economy introductory course for undergraduates. The course design was based on the pedagogical principles of constructive alignment and problem-based learning as well as interactivity, non-dogmatism, and reciprocity. The design also allows for continuously incorporating students' feedback into a course.

Case study 2:

Shanghai Jiaotong University – The *Zhiyuan Programme* is intended for the most talented and ambitious students from different subjects at the university, and it is undertaken in addition to the regular course load within specific bachelor's programmes. As a multidisciplinary topic, circular economy is welcomed by lecturers. Student input from various disciplines throughout the course serves to strengthen the learning outcomes.

Case study 3:

A *Circular Cities Summer Workshop* conducted by **Columbia University** – Students take part in the five-day workshop that aims to give the students an opportunity to dive into the mechanisms and tools that enable institutions, businesses, and governments to build circular cities. The course engages students using a comparative methodology, whereby the students conduct interviews, visit businesses, and city agencies focused on circularity in two major cities (London and New York). "This allows students to gain an in-depth understanding of the concept of circular cities and develop insights into current gaps in implementation and possibilities for future application."

Challenge 2: How do you get the buy-in of relevant stakeholders and decision makers?

From what we have identified to date, circular economy can be perceived as a subject or module at university and not often part of the core content of multiple subjects. Additionally, the allocation of resources can constrain efforts to integrate an idea like the circular economy across multiple courses and the time taken to design and create new programmes and courses is often slow. As circular economy needs an interdisciplinary approach, this makes cross-curriculum development even harder.

Finland's move towards a circular economy has been advanced by a growing awareness of the requirement of a circular economy. In 2018, it was noted that, as a term, 'the circular economy' has become mainstream in Finland, and the possibilities it offers have become more broadly understood. With a growing common understanding of circular economy, in the spring of 2017, Sitra (Finland) launched three funding application processes to find people to implement new university minor subject packages, study packages for universities of applied sciences, and teaching packages for vocational schools. Educational institutions funded by Sitra has formed a consortium with other educational institutions, companies, and organisations.

But, what if the circular economy has not yet become mainstream in your country or environment? Fiona Charnley from Exeter Centre of Circular Economy – one of the leading academic institutes in circular economy – explains below how she has won over key stakeholders:

"One of the key things that I tried to get over those barriers was really explain the value of circular economy to different disciplines. So whether I was talking to engineering, water science or management, it was trying to resonate with different academics within those disciplines so that they had that overall understanding of where the value was."

You can watch Fiona's full interview: ['How do you convince your organisation to engage with the circular economy?'](#)

Challenge 3: How can I promote the novel curriculum within my organisation?

Traditionally, universities are structured in very disciplined and specific silos. When it comes to the development of a cross-disciplinary, pan-university course, it is difficult to break barriers between silos. A new kind of multidisciplinary cooperation has not traditionally been encouraged in schools.

The task sounds daunting – breaking the silos within universities might disrupt the existing system which has functioned for a long time. But it's achievable as demonstrated by many universities. More recent conversations with a number of universities have highlighted how many institutions have a single director or lead academic focusing on sustainability or circular economy and taking a whole campus approach to how the concepts are embedded across not only the curriculum but also the operations of the university.

For example, **Arizona State University**, home to the first comprehensive School of Sustainability in the US and twice recognised as the most innovative school in the nation by US News and World Report, approaches circular economy through a three-pronged strategy: in education, in practice, and through Research & Innovation Support Network (RISN), a collaborative global network of public and private partners.

“Through its charter, ASU is charged to assume ‘fundamental responsibility for the economic, cultural and overall health of the communities it serves.’ To meet this directive, adopting a Circular Economy approach to education, research and practice was not only natural but essential. We are fortunate to have project partners globally who have joined ASU to drive impactful change.”

(Rajesh Buch, Director, Sustainability Practice, International Development, Arizona State University)

Experimenting from a small scale

“It requires bringing an experimental mindset into universities to start with” as rightly stated by Learning Executive Lead, Jules Hayward. At the Foundation, we've developed a series of resources as laid out in this document and on our website which break down the circular economy and contextualises circular economy across a range of industries and practices.

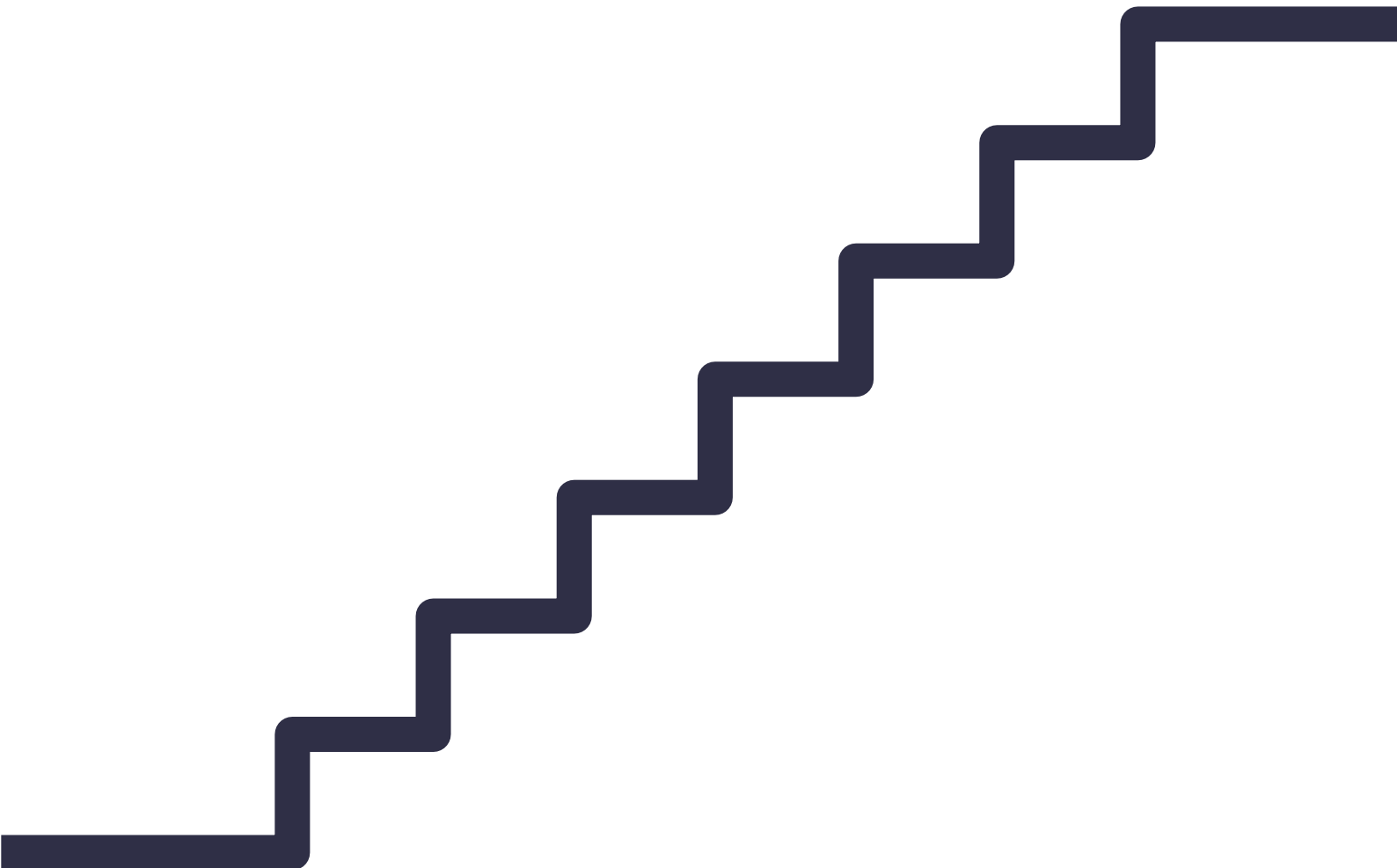
Campaign from the position of strength

UCL delivers a holistic circular economy offering through its interdisciplinary approach to circular economy and evidence-based solutions in educational programmes. With Institute for Sustainable Resources (ISR), Institute of Making, Centre for Resource Efficiency and the Environment (CREE) joint forces, the Circular Economy Lab from UCL is another exciting cross-faculty, cross-discipline initiative, aiming to develop the scientific and socio-economic understanding and technological basis for design and implementation of systems, processes, and policy that will support the transition to a circular economy. In recent years, UCL has continued to integrate circular economy into different areas, establishing Circular Cities Hub and Cities of Making centres.

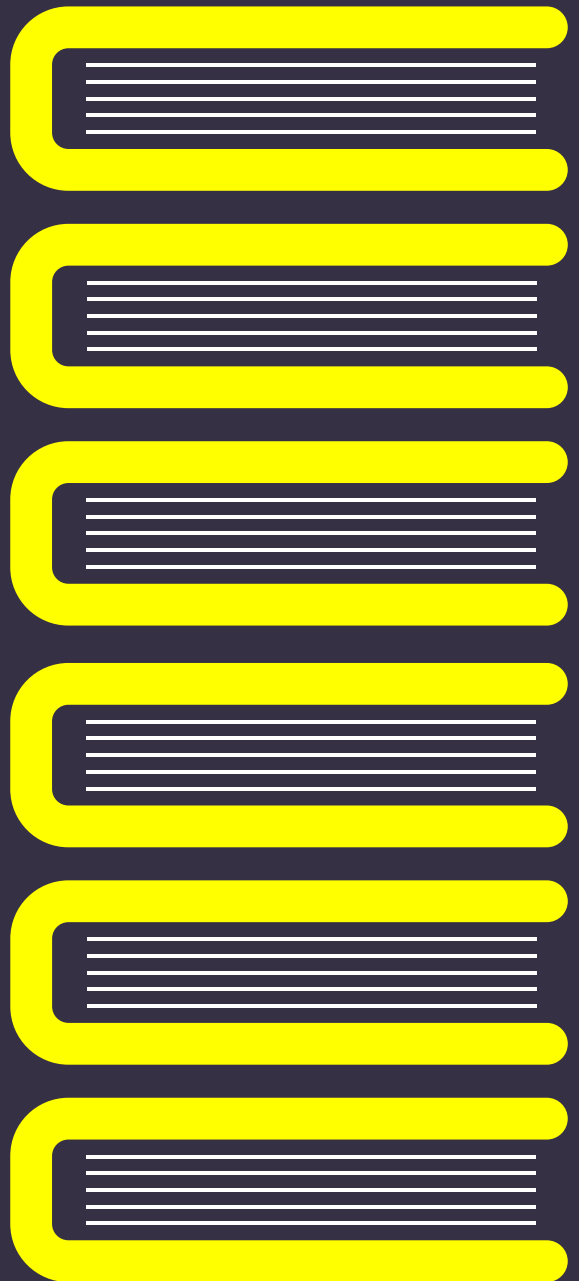
Besides the teaching and research, some frontrunners bring the circular economy principles into practice and engage not only the faculty, but also the campus management. At The University of Edinburgh, all coffee grounds from the university's cafés are reused as soil conditioner to improve the quality of the soil on the university estate. Around 24 tonnes of coffee ground waste was collected and recycled between when the project began in 2017 and the start of 2019. During 2020, embedding a circular economy approach to resources, the university launched a new campaign #ZeroWasteUoE with a bigger ambition to achieve a Zero Waste and disposable plastic-free university by 2030.

The University of California Berkeley (UC Berkeley) in the US demonstrates how embedding circular campus practices can also actively involve students, from water refill stations to move the campus towards its zero waste goals, to a student initiative which collects and redistributes supplies for free, called 'the Re-Used Stuff Emporium', diverting reusable materials from landfills. The Strawberry Creek educational programme is conducted with over 3,000 students annually to use the creek as an outdoor lab, in order to restore this natural habitat and its native species. UC Berkeley has also achieved LEED™ Gold for two new buildings, based on features including “a natural ventilation system, solar PV, water efficient landscaping, a stormwater collection system including a cistern and rain garden, over 100 bike racks, a student-run bike repair center, a new transit center, low flush toilets fed by rainwater, recycling and compost centers, and smart systems for HVAC, windows and lighting”. The Jacobs Institute for Design Innovation at UC Berkeley has been named by the American Institute of Architects as one of the nation’s top ten examples of sustainable architecture and ecological design (awarded the highest honour of LEED™ platinum). About 120,000 kWh of clean power each year is produced for the building from its rooftop solar arrays. Find out more.

While predominantly aimed at our business audience, the [Make a Circular Economy Pitch to Your Organisation](#) learning path on our Learning Hub gives some great insights into what has worked for others to gain support for implementing circular economy practices within their organisations.



Examples of the **circular economy** in curricula



In 2018, the Foundation's *A global snapshot of circular economy learning offerings in higher education* of circular economy learning offerings in higher education research paper found there were 138 higher education institutions with circular economy learning offerings (in English, Finnish, Dutch, and some Chinese). Of these, 61 mentioned circular economy explicitly in the course title, whilst others mentioned connected topic areas, such as 'Design and Systems Thinking' in the course descriptions. This 'snapshot' research was the first mapping exercise of its kind, aiming to provide learners and practitioners with a point-in-time snapshot of what is being taught, where, and how.

Since this research, interest and uptake in incorporating circular economy and related topic areas into courses has accelerated. The map below (fig 1.a) represents a snapshot of the number of universities/higher education institutions the Foundation was engaged with in North America in 2018 and how that network has grown, effectively doubling by 2019. (The universities/higher education institutions which are new are represented by the green pins, and the original relationships are displayed in blue).

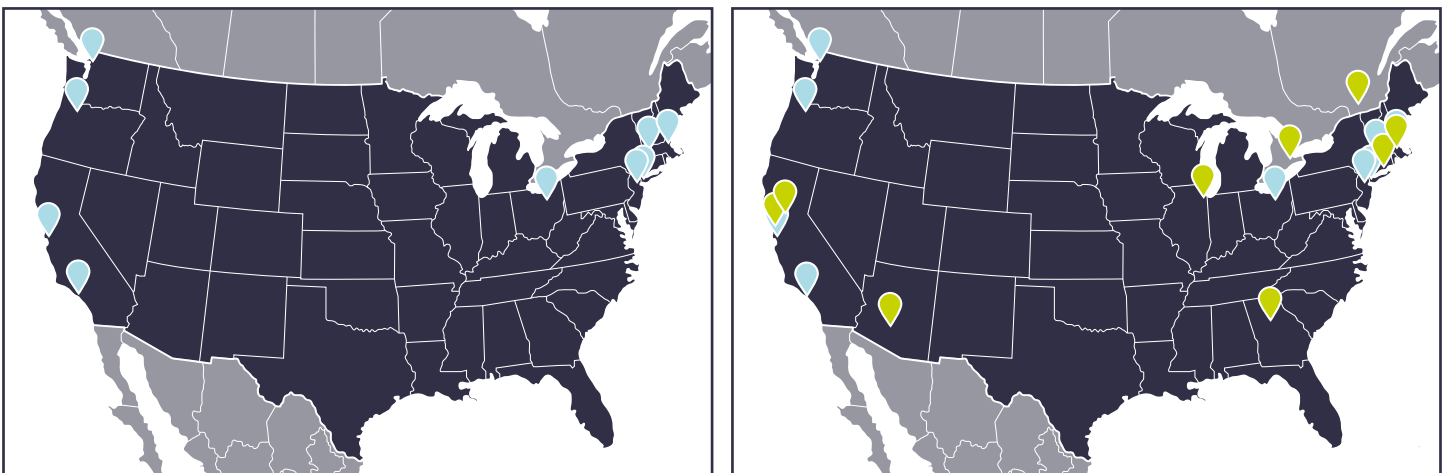


Fig 1.a - US university/higher education institution relationships in 2018 (left) to 2019 (right)

In addition to a growing university network, there is bottom-up demand growth too, as student curiosity for solutions to the problems of a linear economy has encouraged a push for circular economy teaching. To illustrate this, postgraduate and professional applications to the Foundation's 'From Linear to Circular' programmes have increased by a total of 32% from 2019 to 2020. On top of this, there has been significant demand for online content with over 8,000 participants in the 'From Linear to Circular' online programmes (spring 2020).

When adapting or building curricula to incorporate circular economy and related topic areas, there is no prescriptive 'one size fits all' approach, as each institution can adapt the volume and content of teaching modules to be most appropriate to its own students and environment. As previously stated, our view is that understanding the concept should appear across all areas of study and at all levels. How in-depth and nuanced this content is, will depend entirely on the course you are teaching.

In Finland, circular economy education has started to be included in all levels of education, from primary to higher education and the country is fast-becoming a world leader for circular economy experts. The International Baccalaureate currently has the circular economy in one school subject area, with a further three planned for upcoming academic years. The United World College syllabus now also includes the circular economy and so we are seeing an uptake of circular economy in multiple levels of education with more university students starting their academic journey with a basic knowledge of the principles already.

In this section, examples are provided from several universities who have developed different approaches to teaching circular economy. We have tried to include different length programmes covering a range of subject areas and programmes at both undergraduate and postgraduate level. The Foundation [profiles](#) a number of universities that have courses with circular economy content.

1

Circular Economy: An Introduction

Through the MOOC, learners are challenged to design a future that rethinks our current 'take-make-waste' economy to focus on circular, innovative products, and business models.

Institution: TU Delft, Netherlands

Delivery mechanism: Online/distance learning

Level: Beginner

Length of programme: 7 weeks (3-6hrs/week)

Course outline:

Episode 1: What is the circular economy? How can the circular economy provide solutions to the challenges our current, linear economy brings? Explores the roots of the circular economy with experts in the fields of industrial ecology, cradle-to-cradle and biomimicry.

Episode 2: Business value in a circular economy. Explores new opportunities for business via closed loop supply chains and reverse logistics, as well as value creation and new business models in a circular economy.

Episode 3: Longer lasting products. Product life extension through the eyes of designers and entrepreneurs and a 'repair café'.

Episode 4: Remanufacturing. Remanufacturing as an enabler for companies to recapture value on a product or component level. Explores the topic together with researchers and entrepreneurs.

Episode 5: Waste equals food. Taking inspiration from nature, when redesigning the way we deal with waste. Circular case study and identification of opportunities for change in participants' own areas.

Episode 6: Thinking in systems. The shift from linear to circular should not be underestimated. Discusses the extent and duration of the transition and asks, 'is the circular economy really sustainable?'

Episode 7: Giving back. Ending course webinar. Teachers available for a live session to discuss some of the most challenging issues and Q&As. Final exam.

2

Circular Economy

"Principles and concepts of circular economy that can support a more sustainable economic system. Includes consideration of circular design, materials management, business models, supply chains, policy, financing, metrics, and applications. May include field trips to explore companies with circular business practices."

Institution: Loyola University, Chicago, USA

Delivery mechanism: Face-to-face and online

Level: Graduate and undergraduate

Length of programme: Semester – weekly lectures

Course outline:

- Students learn to explain circular economy, including opportunities, challenges, critiques
- Students learn to identify applications of circularity in business models and value creation
- Students learn metrics and indicators for circular economies

3

A Circular Economy of Metals: Towards a Sustainable Societal Metabolism

This course focuses on options for closing the loop on metals to avoid the need to mine new ones. It is based on the series of reports on metals by the International Resource Panel, as well as the UN Sustainable Development Goals (SDGs).

Institution: Leiden University, Netherlands

Delivery mechanism: Online

Level: Beginner

Length of programme: 6 weeks

Course Outline:

Week 1 - Introduction & metals in society

Week 2 - Metals challenge

Week 3 - Dynamics of metal systems

Week 4 - Solutions to the metals challenge

Week 5 - Circular economy as an overarching solution

Week 6 - Look into the future

4

Finance for the Green Business and the Circular Economy

Students who attend this course develop in-depth knowledge on business model structure and financial analysis regarding deal typologies applied to the green business and the circular economy.

Institution: Bocconi University, Italy

Delivery mechanism: Face-to-face

Level: Undergraduate/Postgraduate master's elective

Course outline:

- Green business and circular economy: what they are and what they do
- Green business and circular business models: in what ways they differ from linear business models and how they work
- Investment opportunities for outside investors. The concept of stranded linear assets
- The changing profile of economics, financials, and sources of volatility in the green business and the circular economy
- Which are the financial actors and the deal typologies involved? Corporate lending, corporate finance, investment banking, and asset management (C&IB)
- How green and circular investments affect the main economics in the C&IB business models
- Operating risk measures. Discrete approach and stochastic approach application to sources of volatility related to green and circular items
- Debt capital in green and circular deals: analysis of the risks and potential returns associated with the project/asset, financial sustainability, and debt-holders' risk appetite (adequacy)
- Equity capital in green and circular deals: analysis of the risks and potential returns associated with the investment, equity risk, and return measures
- The future of green business and circular economy: a perspective

5

The Circular Economy Masterclass Introductory Course

Featuring active discussion forums with support from tutors and live webinar sessions with guest speakers and experts, the course is aimed at organisations and individuals who are familiar with the principles of circular economy, who are keen to extend their knowledge and put their ideas into action in order to create and deliver commercial benefits.

Institution: Exeter University, UK

Delivery mechanism: Online

Level: Professionals and organisations, familiarity with the circular economy principles

Length of programme: 6 weeks

Course outline:

Week 0 – Orientation week

Week 1 – Value wastage

Week 2 – Value creation

Week 3 – Value capture

Week 4 – Value distribution

Week 5 – Value measurement

Week 6 – Dealing with increasing complexity

6

McMaster Certificate in Leading Transition

This course teaches the foundational circular economy principles, helps identify circular economy practices that would fit individual participant's organisations, investigates practical case studies of successful transitions to different circular economy models, and practical circular economy tools that can be applied at different levels of organisational complexity and maturity.

Institution: McMaster University, Canada

Delivery mechanism: Face-to-face workshop

Level: Beginner (but participants should have a broad understanding of engineering or science principles at a college/university level)

Length of programme: 3 days

Course outline:

Module 1 – Understanding circular economy models; differentiating the benefits and challenges associated with specific models based on application

Module 2 – Case studies of current private and public sector approaches against existing models with discussion from an expert panel

Module 3 – Leadership in the circular economy – applying leadership and communication strategies in a transformative environment focused on circularity and products-as-a-service

Module 4 – Tools and techniques for circular economy implementation – how to identify the opportunities within an existing organisation or create new opportunities

Module 5 – Tools and practices available for quantifying circular economy impacts

7

Systems Thinking and System Dynamics

Institution: UCL, UK

Delivery mechanism: Face-to-face

Level: Postgraduate

Length of programme: Optional MSc module

Module outline:

- Teaches system dynamics modelling (a method for the analysis and design of complex systems)
- System dynamics to help understand problems characterised by complexity, policy resistance and/or multiple stakeholder views
- Design systems (interaction of socio-technical aspects in the built environment)
Applications, simulation analyses, and a management game
- Concrete cases (heating, ventilation and rebound, urban dynamics)
Project management and others



Beyond teaching and research



Throughout this document, reference is made to the circular economy being more than just a topic to teach or research within a university context, so it is right that this is explored further. The Foundation has identified five areas where the higher education sector has the power and influence to drive the transition to a circular economy. A challenge exists for academics to think about how they could embed the teaching within their own wider campus management and student activities. Ideally, what the students learn about the circular economy in the classroom should be reflected in other activity areas of the university/institution.

Teaching

Future leaders and young professionals gain circular economy insights, skills, and capabilities which they can take forward as change-makers within careers in business, design, policy, enterprise, and academia.

Example:

Virginia Tech's Centre for Leadership in Global Sustainability offers a circular economy elective course as part of the '[Online Master of Natural Resources in Global Sustainability](#)' master's degree in addition to other related options, such as 'Sustainability Systems' (systems thinking) and 'Transboundary Resource Management'.

(Also see [A global snapshot of circular economy learning offerings in higher education](#), 'Profiled Universities', and the section above)

Research

As an engine for innovation, applied research can provide the critical insights and knowledge exchange required to initiate industry and policy shifts. Research is a crucial aspect of developing the circular economy and one of the main methods by which universities can work directly with governments and businesses to address a particular challenge or generate expertise and knowledge. Embedding circular economy thinking in fundamental research is potentially very powerful. It also links in well to the ideas around understanding living systems and adapting those principles to wider contexts.

Example:

- **Linköping University, Sweden** – [Mistra REES](#) (Resource-Efficient and Effective Solutions) is an eight-year-long, research programme based on circular economy thinking.
- **Turku University, Finland** – circular business models research group
- **Imperial College London** researched and produced a report on the business case for adopting a circular economy in the UK, commissioned on behalf of Veolia. "The results demonstrate that using resources in a closed loop system has the potential to contribute GBP29 billion (1.8%) of GDP and create 175,000 new jobs in the UK."
- **Lund University, Sweden**, has joined forces with Virginia Tech to launch project 'CREASE' (Creating a Repair Society), a research collaboration to enable leadership strategies for circular economy, via repair, by amassing knowledge from around the world about the best policies and conditions for optimising repair systems. Project partners and advisers consist of the research universities as well as municipalities and municipal organisations, and repair business actors.
- **Loughborough University's** Centre for SMART (Sustainable Manufacturing and Recycling Technologies) is a research and development centre whose remit is to advance technologies related to sustainable manufacture and to promote effective end-of-life product retirement strategies in the wake of European legislation and corporate social responsibility.

Campus management:

University campuses can be ideal test-beds for larger scale circular projects because they often behave like ‘miniature cities’ in their own operations and function. They may have multiple campuses, buildings, transportation systems, and complex procurement and supply chains. Using campuses to showcase circular economy ‘in action’ also makes the case for wider scale initiatives to be replicated and scaled, whilst exposing more students to the concept and how the circular economy can be applied to existing business practices.

Example:

The University of Portsmouth is doing numerous things at a campus level to reduce waste and embed circular practices. Examples include: composting of all food waste at the university; the use of glass milk bottles for any catering event (these are then cleaned to be reused for the next event); and working with local suppliers to reduce the number of deliveries to campus.

At the MIT Office of Sustainability (MITOS), they are taking a strategic look at the substantial amounts of materials that flow through the institute to identify vital connections between the resources purchased and those discarded. Beginning in 2016, through a partnership with the MIT Environmental Solutions Initiative, MITOS teamed up with an MIT PhD student (and current MITOS student fellow), from the Institute for Data, Systems, and Society, as well as relevant operational departments to answer the question: How might we promote circular material flows where we leverage our purchasing power to support products, suppliers, and manufacturers who are using recycled materials as inputs and re-directing their outputs towards inputs for other processes?

Read the full case study on [our website](#)

Student-led innovation

Initiatives which drive circular solutions through student investment, application, and exploration of the topic are a key aspect of the research. Student interest in the topic of circular economy has been shown to be accelerating (see Section 1). This demand has helped to create a number of growing initiatives, both during the students’ engagement at university through (e.g.) student societies and councils and after they leave university

Example:

In the UK, the Student Office of Sustainability, part of the NUS (National Union of Students), uses Philips lighting ‘pay per lux’, or the ‘light as a service’ model.

Meanwhile, Roehampton University’s Students’ Union has developed, ‘Growhampton’ – an ‘edible campus’ made up of a number of growing areas spread throughout the university grounds, giving students the opportunity to learn about where food comes from and how to grow it. The award-winning, ‘Hive Café’, (built out of former shipping containers) is the social enterprise element of the programme, selling affordable and accessible organic, ethical, and local food. The Growhampton programme also has involvement in outreach work in the community, via delivering sessions about growing food and healthy eating in local schools.

In the US, PLAN (Post Landfill Action Network) engages and advises students to circularise waste streams at campus level through different mechanisms.

Influence and leadership:

It is important to recognise the influence universities have as local leaders and influencers of business and future workforce. Universities are hubs for change.

Example:

The REMADE Institute of Rochester Institute of Technology (RIT) received USD140 million from the US Department of Energy and US stakeholders for REMADE institute to find new and less expensive ways to reuse, recycle, and remanufacture metals, fibres, polymers, and electronics.

Loyola University Chicago's Retreat & Ecology Campus is working to educate the wider Loyola community and the campus' neighbours about the importance of developing a relationship with natural surroundings. Loyola offers ecological courses and internships based at the campus, and holds monthly volunteer 'Restoration Work Days' open to the public.

ASU RISN project: This is a four-year, USD2 million programme between Phoenix City Council and the Walton Sustainability Solutions Initiatives at the ASU Wrigley Institute, which works to establish, manage, and operate advances in integrated resource management through a global network of public and private partners using collaboration, research, innovation, and application of technologies to create economic value, driving a sustainable circular economy.

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About the Foundation

The Ellen MacArthur Foundation is a UK-based charity, committed to the creation of a circular economy that tackles some of the biggest challenges of our time, such as waste, pollution, and climate change. A circular economy designs out waste and pollution, keeps products and materials in use, and regenerates natural systems, creating benefits for society, the environment, and the economy. The Foundation collaborates with businesses; governments, institutions, and cities; designers; universities; and emerging innovators to drive collaboration, explore opportunities, and develop circular business initiatives.

Further information www.ellenmacarthurfoundation.org | @circulareconomy



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