CE100 CO.PROJECT RENEWABLES

RENEWABLE MATERIALS FOR A LOW-CARBON AND CIRCULAR FUTURE

CE100

COLLABORATIVE PROJECT

DEFINITIONS

RENEWABLE MATERIALS

Material that is composed of biomass and that can be continually replenished for example wood, crops, marine products, organic waste.

CIRCULAR ECONOMY

Based on the principle of designing out waste from products and services, a circular economy is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times. The most widely used definition, that of the Ellen MacArthur Foundation, distinguishes between technical and biological pathways. If you want to know more about the circular economy, please visit the Ellen MacArthur Foundation website.

BIO-ECONOMY

The bio-economy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce food, materials and energy.

REGENERATIVE AGRICULTURE

A regenerative agricultural system preserves the integrity of a farm's natural ecosystem, increasing its health, biodiversity, and resilience. In particular, no toxic substances are used, nutrient losses are minimised, and soil health is not only preserved but enhanced. Regenerative methods in agriculture can include, for example, organic farming, no-till, and restorative grazing. To generate maximum soil regeneration, and therefore land productivity and farm profitability, several of these methods are often combined.

FOREWORD

Achieving the 2030 UN Sustainable Development Goals and Paris Agreement climate targets will hinge upon the global transition to a low-carbon circular economy. Realising these goals requires action across the private sector, civil society and governments. Our organisations are committed to decrease climate change impacts and increase circularity. We minimise our greenhouse gas emissions, keep our products and materials in use and support recycling through innovation, collaboration and new thinking in our business models.

We see great potential for the increased uptake and recycling of renewable materials. In some cases, replacing finite and fossil-based materials with renewable materials can lead to substantial carbon footprint improvements for our products.

Full deployment of renewable materials can drive an innovation agenda and drive economic growth. In Europe alone, 400,000 new skilled jobs could be created in the bio-economy by 2020, and the global market for renewable plastics alone is forecast to grow 20% by 2022.

To achieve this potential an effort is needed to align business needs, research agendas, and policy making around common definitions and a common vision. To this end, the circular economy concept has had some success. However, the role renewable materials can play in the circular economy needs some clarification, including to what extent they can substitute for non-renewable materials.

This paper is designed to start a conversation. Our group of organisations seek to raise the questions that we encounter through efforts to implement circularity within our operations and with our supply chain partners. *In this paper we have set out the opportunities and challenges that face renewable materials today and our shared vision for the future.*

The private sector can drive the uptake, re-use and recycling of renewable materials. But dialogue is needed to align research agendas and develop policy frameworks. This communication is the result of our companies' collaboration within the Ellen MacArthur Foundation's CE100 network. By providing a pre-competitive space for organisations to learn, share and collaborate, forums such as the CE100 are essential to achieving our shared global goals.

- **RENEWABLE MATERIALS WILL PLAY A ROLE IN ACHIEVING A LOW-CARBON, CIRCULAR ECONOMY**
- **THE POTENTIAL FOR THESE MATERIALS TO CONTRIBUTE TO ACHIEVING A CIRCULAR ECONOMY IS NOT YET CLEARLY UNDERSTOOD**
- **MAXIMISING THE USE OF RENEWABLE MATERIALS COULD REDUCE GREENHOUSE GAS EMISSIONS WHILE INCREASING INNOVATION OPPORTUNITIES AND ECONOMIC GROWTH**
- **TO ACHIEVE THIS, BUSINESSES, RESEARCHERS, AND GOVERNMENTS NEED TO ALIGN AROUND A COMMON VISION**

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RENEWABLE MATERIALS FOR A LOW-CARBON AND CIRCULAR FUTURE

OUR VISION: A LOW CARBON CIRCULAR FUTURE WHERE RENEWABLE MATERIALS ARE FULLY DEPLOYED.

UTILISING RENEWABLE MATERIALS COULD DECARBONISE OUR ECONOMY AND, THROUGH RESPONSIBLE SOURCING, SECURE SUPPLY OF RAW MATERIALS – ESPECIALLY WHEN RECYCLED AND REUSED.

- Achieve UN Sustainability goal 12 and 13
- Circular and carbon neutral plants and other biomass are part of nature's regenerative cycles
- Keep fossil materials in the ground: Renewable materials replace fossil-based alternatives on a case-by-case basis

INVESTMENT IN RENEWABLE MATERIALS REPRESENTS AN INNOVATION AGENDA THAT CREATES ECONOMIC OPPORTUNITIES.

- **Innovation & deployment:** The renewable plastics market alone is forecast to grow 20% by 2022
- **Increased resilience of supply chains**
- **Job creation & economic growth:** By 2030, 700,000 new skilled jobs could be created in Europe by the bio-economy

THE REALITY: CURRENT PERCEPTION OF THE CIRCULAR ECONOMY CONCEPT UNDER-RATES THE CONTRIBUTION OF RENEWABLE MATERIALS.

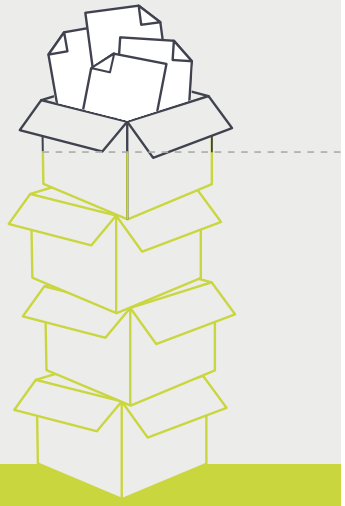
THE DIALOGUE AROUND RENEWABLE MATERIALS IN A CIRCULAR ECONOMY HAS FOCUSSED ON BIODEGRADABILITY.

In reality, renewable materials play a key role in reuse, remanufacturing, and recycling streams. By maximising the use of renewable materials, we can achieve a circular economy at lowest carbon footprint.

FOR EXAMPLE, IN EUROPE

72%

OF PAPER AND BOARD WAS RECYCLED IN 2016.



Lifecycle thinking must be the basis for assessing the social and environmental impacts of a product or material. There are already many innovative renewable solutions with proven benefits based on a life-cycle perspective, but for those materials the bottleneck remains deployment.

WHAT'S NEEDED: DIALOGUE, FURTHER RESEARCH, AND COLLABORATION.

- **Communication** to raise awareness that both recycled and renewable materials are pillars of a low-carbon circular economy
- **Research** to develop an evidence-base, enabling producers to make the right material choices e.g. the substitution of fossil-based materials on a case-by-case basis
- **Dialogue and collaboration** of private and public sectors to drive a research and innovation agenda around the deployment of renewable materials

RENEWABLE MATERIALS INCLUDE:

Wood | Crops | Organic waste

VISION FOR THE FUTURE

A LOW-CARBON AND CIRCULAR ECONOMY WHERE RENEWABLE MATERIALS ARE FULLY DEPLOYED

IN A LOW-CARBON AND CIRCULAR FUTURE...

A circular economy delivers the UN Sustainable Development Goals, particularly on Urgent Climate Action and Sustainable Consumption & Production.

Fossil fuels are kept in the ground to limit global temperature rises to less than 1.5 C and cap depletion of finite raw materials.

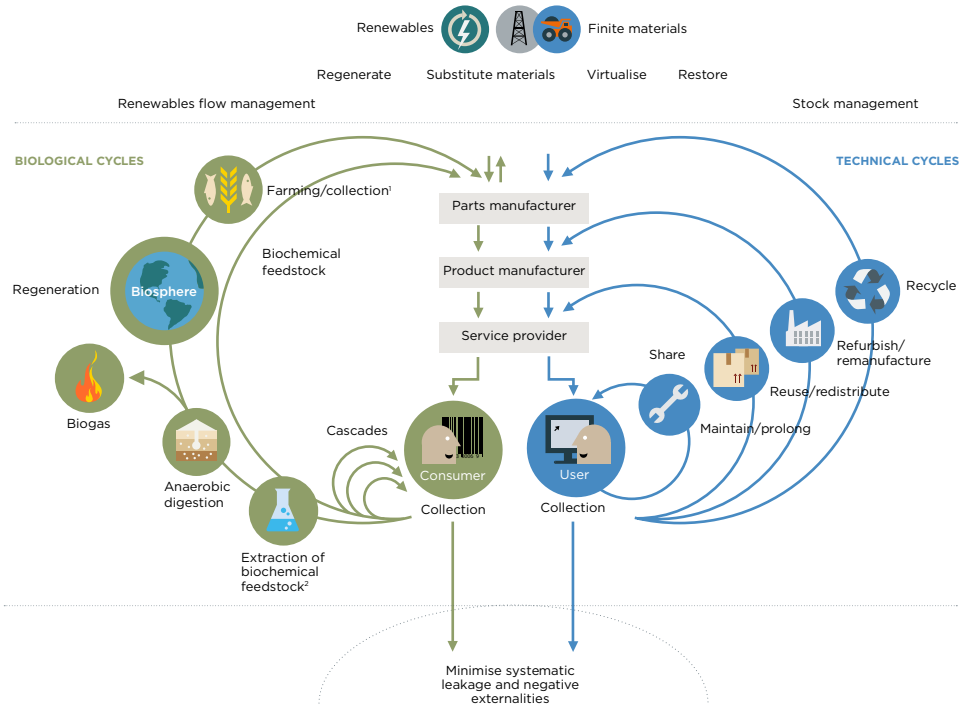
THE ROLE OF RENEWABLE MATERIALS IN ALL ASPECTS OF THE CIRCULAR ECONOMY MUST BE WELL UNDERSTOOD

In a circular economy, material pathways are determined by their destination or by 'the manner in which order is recreated'. Recreation through living systems give us the 'biosphere' and recreation through human effort gives us the 'technosphere'.

Renewable materials, by definition, originate from within the biosphere. Some of these materials may be converted into (or contribute to) products or components in a way which subsequently identifies them as part of the technosphere. This class of materials could be called bio-based technical materials and would carry the functional characteristics and opportunities afforded to technical products, components and materials.

ACCORDINGLY, ACHIEVING AN EFFECTIVE BIO-ECONOMY IS CRITICAL TO ACHIEVING AN EFFECTIVE CIRCULAR ECONOMY

Ellen MacArthur Foundation's Circular Economy System Diagram



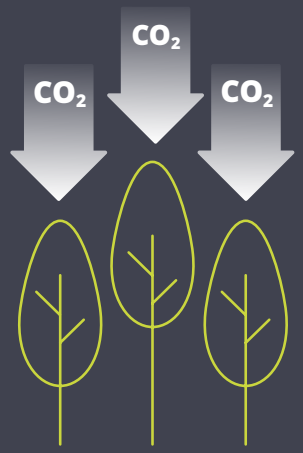
DEPLOYMENT OF RENEWABLE MATERIALS COULD DRIVE A LOW-CARBON ECONOMY

Replacing finite and fossil-based materials with responsibly managed renewable materials can decrease carbon emissions whilst reducing dependency on finite resources.

→ Using renewable materials as feedstock for products instead of fossils can reduce carbon emissions: forest and crops absorb CO_2 from the atmosphere whilst growing. This effect can be magnified when these materials are subsequently reused or recycled.

The UN has stated that 'growing more sustainable forest and the use of long-lasting forest products are currently the most effective forms of carbon capture'. European forests and the forest-based bio economy could capture 25% of current CO^2 emissions within the coming three decades.

→ Even a circular economy needs some input of raw materials to grow and maintain material loops. Renewable materials can secure raw material supply for the long-term as they are regenerative by nature: they derive from biomass which replenishes and regrows provided it is managed responsibly.



Royal DSM
Decovery®

Decovery® is a new plant-based resin technology for long lasting paints, coatings and inks that enables us to change our environment without impacting it. Decovery® consists of **30-50% renewable materials**, depending on the application, which do not compete with the food chain. These include sugars, starches, natural oils and materials from trees and agricultural waste. The Decovery® technology is already being used across wall paint, furniture and joinery. As well as applying the technology in wider markets and sectors, Royal DSM are working to increase the renewable material content to **100%**.

IKEA
ISTAD

ISTAD is Ikea's first ever large-scale bio-plastic product. It is an all-round plastic bag which is 85% made from a renewable sugarcane material.

Ikea plans to make 1.4 billion re-sealable ISTAD plastic bags, which is expected to **save 75,000 barrels of oil a year and significantly reduce carbon dioxide emissions.** ISTAD is recyclable in existing value chains alongside fossil based alternatives.

Tetra Pak
Tetra Rex® Bio-based

Tetra Rex® Bio-based is the world's first fully renewable beverage carton to be manufactured entirely from renewable materials. The paperboard comes from Forest Stewardship Council™ (FSC™) certified and controlled sources. The polyethylene used for the cap, neck and coating comes from renewable sugar cane, all traceable to their origins.

This fully renewable package **reduces GHG emissions per carton by over 50%** versus the equivalent standard package as shown in an LCA conducted for the Nordic markets, and is fully recyclable together with conventional beverage cartons.

DEPLOYMENT OF RENEWABLE MATERIALS DRIVES AN INNOVATION AGENDA TO BUILD SUPPLY CHAIN RESILIENCE AND SUPPORT ECONOMIC GROWTH

Renewable materials present significant market opportunities across the economy today and in the future, such as in the packaging, chemical, hygiene products and construction sectors. Further investment in new feedstocks and production methods could support the rapidly growing bio-industry.

INNOVATION

Public-private collaboration to increase the demand for renewable materials would send a signal to the market. This has the potential to (i) stimulate innovation to identify low carbon feedstocks that offer an alternative to fossil-based materials, and to (ii) unlock investment to upscale production.

The renewable plastics market alone is forecast to grow 20% by 2022 and to represent 40% share of the global plastic market by 2030.

INCREASED SUPPLY CHAIN RESILIENCE

Resource scarcity and consequent volatile pricing is a challenge for global supply chains. Switching to renewable materials reduces dependency on finite and fossil-based materials. In addition, responsible sourcing of renewable materials could ensure long-term availability of resources.

JOB CREATION & ECONOMIC GROWTH

In Europe alone, the bio-economy employs 18.6 million people and has €2.2 trillion of turnover – growing 7% since 2008 and equates to 9% of the total economy.

Through further investment in research, development of infrastructure and implementation of technologies, another 400,000 highly skilled jobs could be created by 2020, increasing to 700,000 by 2030 – up to 80% of which will be in rural areas.

In the US, renewable materials based products contributed $393 billion and 4.2 million jobs to America's economy in 2014.

THE REALITY

CURRENT PERCEPTION UNDER-RATES THE CONTRIBUTION OF RENEWABLE MATERIALS TO ACHIEVE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS AND ADDRESS CLIMATE CHANGE

1

TODAY'S INTERPRETATION OF THE CIRCULAR ECONOMY CONCEPT CAN UNDER-RATE THE CONTRIBUTION OF RENEWABLE MATERIALS

The Ellen MacArthur Foundation's often cited system diagram (commonly referred to as the 'butterfly diagram') distinguishes between the biosphere and technosphere. As a consequence, the dialogue around renewable materials in a circular economy has focussed on biodegradability and has to date engaged less with the technical characteristics of these materials.

In reality, renewable materials play a key role in reuse, remanufacturing, and recycling streams. For example, the use of wood in many manufacturing applications and after-use cascades, large volumes of paper and cardboard recycling, and the potential for the use of plant-based or greenhouse gas feedstocks for bioplastics entering recycling streams. Further effort is needed to articulate the nuances of the circular economy concept to encourage a more comprehensive understanding in key audiences.

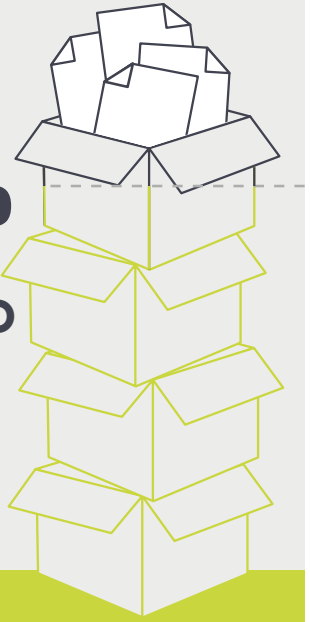
RECYCLED RENEWABLES ARE A REALITY

IN EUROPE

70%

OF PAPER AND BOARD

IS RECYCLED



Renewable materials, such as paper, contribute to the 'technical cycle' of the circular economy. At least 11% of the currently used, reused, composted or recycled materials are renewable.

TORK essity

Tork Paper Circle

THE FIRST RECYCLING SERVICE FOR PAPER HAND TOWELS

Essity collects used paper towels and recycles them into new tissue products. 2 million tons of hand towels are used globally to facilitate good hand hygiene. By collecting the hand towels in a clean and a separate fraction and by applying special treatment in the recycling process we are now able to close the loop for the products we put on the market.

An LCA* shows that the new recycling service from Tork reduces the carbon footprint by at least **-40%** compared to current waste handling options.

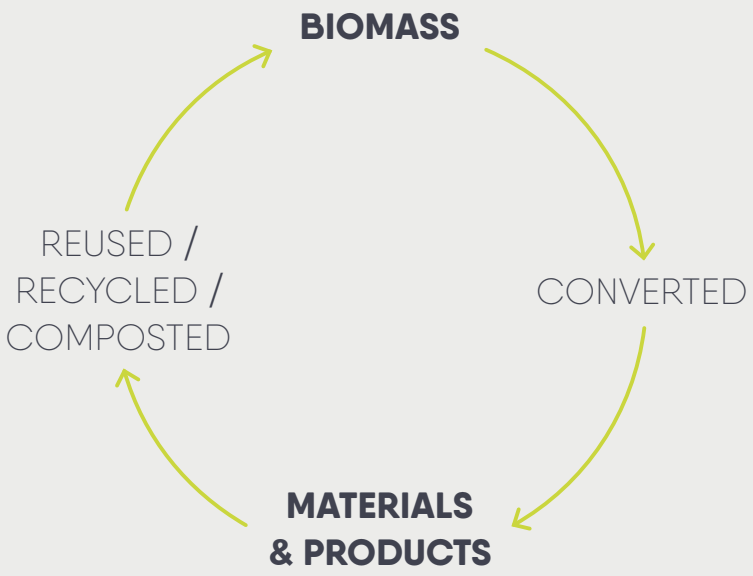
**Based on an LCA verified by Swedish Environmental Research Institute 2017, where the avoided processes have been taken into account.*

2 LIFECYCLE THINKING MUST BE THE BASIS FOR ASSESSING THE SOCIAL AND ENVIRONMENTAL IMPACTS OF A PRODUCT OR MATERIAL

Renewable materials are inherently regenerative: they derive from nature's regenerative systems and are today widely recycled or re-used.

Industrial linear production methods can be extractive and depletive, reducing soil quality and damaging local ecosystems. Mistakes have also been made in the past when well-intentioned initiatives led to competition with primary agriculture.

Responsible sourcing – as described on page 9 – regenerative agriculture practices, and a case-by-case approach to substitution based on an assessment of impacts during the entire life-cycle are critical to ensuring interventions improve full system effectiveness.



3 INNOVATION IN RENEWABLE MATERIALS FACES AN UP-HILL BATTLE

Today, suitably designed renewable materials can be effectively regenerated within the biosphere. However, in the technosphere, human ingenuity lags behind in creating a similarly effective restorative system for technical materials, including those which are renewable. Investment to increase the reuse and recyclability of renewable materials should be acknowledged and encouraged.

Public policies do not always provide enough certainty to unlock private investment in the deployment of renewable materials, and public funds are mainly limited to research and innovation. What is needed is for the production of renewable-based materials to reach volumes that unlock economies of scale. There are already many innovative solutions with proven benefits based on a life-cycle perspective, but for those materials the bottleneck remains deployment.

THE FUNDAMENTALS

THE CIRCULAR ECONOMY FRAMEWORK RECOGNISES THE TENSION BETWEEN EFFICIENCY AND EFFECTIVENESS.

SOME EFFICIENCIES MIGHT FOR INSTANCE HAVE UNINTENDED COSTS IN OTHER PARTS OF THE SYSTEM.

CAREFUL DESIGN IS THEREFORE NEEDED TO ENSURE THAT EACH INTERVENTION INCREASES OVERALL SYSTEM EFFECTIVENESS.

RESPONSIBLE SOURCING OF ALL MATERIALS IS THE FUNDAMENTAL STARTING POINT

Some primary materials are essential to a circular economy as it cannot function using only recycled materials. A circular economy therefore not only 'closes the loop', 'slows the flow' of resources and 'narrows the resources flow', it works from regenerating and restoring stocks to provide additional primary materials. This will provide the bedrock for sustainable consumption and production practices, since all materials in a circular economy should be 'nutrients' for either the technical or biological materials pathway and thus meet environmental criteria by default. Additionally, their sourcing would have to meet criteria for providing societal and environmental benefits.

> **A low-carbon and circular economy cannot be conceived without the responsible management of natural resources, respecting the regeneration levels of all resources and healthy ecosystems on land and in the sea.**

Main sources for biomass for technical use are forestry and agricultural biomass, although increasing interest is given to marine biomass and biomass from waste or side-streams. Like with other resources, renewable materials should be responsibly sourced and used as effectively as possible: Renewable products should be reused and recycled until they are safely returned to the biosphere.

REQUIREMENTS FOR RESPONSIBLE MANAGEMENT OF RENEWABLE MATERIALS

CAN YOU INTEGRATE 2ND GENERATION FEEDSTOCK?

NO

When using 1st generation feedstock, ensure it is from responsibly managed sources that use regenerative agricultural and forestry practices:

- Grown and harvested in a responsible manner that enhances biodiversity and ecosystem health
- Produced in socially acceptable conditions which positively impact local communities
- Secures regrowth by managing forestry and farmland as part of a positive cycle that builds soil health
- Fits within planetary and system boundaries (for example, producing feedstocks for renewable materials should not compromise food availability or run-down stocks of natural capital)

YES

Where possible: Integrate responsibly managed 2nd generation feedstock (by-products/ residues from forestry, agriculture, industry or waste streams).

Biomass as feedstock for materials is renewable but still ultimately limited in amount. Thus, it is important to direct the use of renewable materials to applications where they contribute the most to sustainability.

Life Cycle thinking is the basis for assessing the social and environmental impacts of a product or material. Assessing the impacts of carbon footprint together with impact of land use, agricultural processes and biomass production is important. One recognised tool is European Standard EN 16760:2015. It provides specific life cycle assessment (LCA) requirements and guidance for bio-based products, excluding food, feed and energy with the focus on how to handle the specificities of the bio-based part of the product.*

Existing responsible sourcing standards ensure a high degree of traceability and sustainability of the raw material and its production system, such as: the European Standard EN 16751:2016 providing sustainability criteria for bio-based products or recognised international standards such as:

FSC

RAINFOREST ALLIANCE CERTIFIED

SBP Sustainable Biomass Partnership

*It should be noted that, while LCA is a useful tool, it should be used with care and complemented by other forms of assessment since it does not take into account system level effects.

ROADMAP

COMMUNICATION, FURTHER RESEARCH, AND COLLABORATION NEEDED TO ENABLE THE EVIDENCE-LED DEPLOYMENT OF RENEWABLE MATERIALS

COMMUNICATION

Improve communication to address challenges with the existing perception of the role of renewable materials in a circular economy.

Awareness that both recycled and renewable materials are part of a circular economy will benefit both customers and commercial stakeholders:

- Ensure that guidance documents, for example "Design for Circularity", reflect the role and benefits of renewable materials in all loops and material streams.
- Highlight the environmental, social and economic opportunities of renewable materials compared to finite fossil-based materials on a case-by-case basis.
- Emphasize that responsible sourcing is fundamental for all materials.

RESEARCH

Engage in further research to develop a knowledge base that enables the evidence-led deployment of renewable materials that increase system effectiveness.

It is important to improve the knowledge of the properties and qualities of renewable materials and make it easy for manufacturers to select these materials.

- Standardised labelling can ensure common understanding by indicating the content and recyclability of renewable materials.
- Agreement towards harmonized requirements on sustainably managed biomass.

COLLABORATION

Stimulate public and private sector dialogue and collaboration to drive an innovation agenda that supports the identification and deployment of renewable materials.

Dialogue and collaboration across sectors and value chains, academia and governments, is vital to identify and deploy solutions that increase system effectiveness.

- Align around a common vision of the use of existing renewable materials and the need to stimulate innovation where alternatives to conventional finite and fossil-based materials are not yet available.
- Address the challenges of renewable materials through initiatives such as the development of criteria to address feedstock conflict. Assessing the carbon footprint together with impacts of land use, agricultural processes and production of renewable feedstock is important.
- Invest to identify and scale alternative feedstocks. Supply chains for fossil materials have been established and optimised over more than a century and have substantial government subsidy in many geographies. This makes it hard in the short-term to get innovative, renewable materials into a price competitive position.

CE100 CO.PROJECT RENEWABLES

RENEWABLE MATERIALS FOR A LOW-CARBON AND CIRCULAR FUTURE

This report has been produced by **Essity, IKEA, Royal DSM** and **Tetra Pak** in collaboration with the **Ellen MacArthur Foundation** and **SustainAbility**.

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SustainAbility Wolf&Player

ABOUT THE CE100

The Circular Economy 100 is a pre-competitive innovation programme of the Ellen MacArthur Foundation, established to enable organisations to develop new opportunities and realise their circular economy ambitions faster. It brings together corporates, governments and cities, academic institutions, emerging innovators and affiliates in a unique multi-stakeholder platform. Specially developed programme elements help members learn, build capacity, network and collaborate with key organisations around the circular economy.

ABOUT COLLABORATIVE PROJECTS (CO.PROJECTS)

Co.Projects are opportunities for formal pre-competitive collaboration between CE100 members. They are driven by members, for members, and their focus can range from research initiatives to pilots and toolkits. Co.Projects leverage the CE100 network with the aim of exploring opportunities and overcoming challenges commonly faced by organisations making the transition to a circular economy, which they may not be able to address in isolation.

ABOUT THE ELLEN MACARTHUR FOUNDATION

The Ellen MacArthur Foundation was created in 2010 to accelerate the transition to a circular economy. The Foundation works across five areas: insight and analysis, business and government, education and training, systemic initiatives and communication. In its business and government programme, the Foundation collaborates with its Global Partners (Danone, Google, H&M, Intesa Sanpaolo, Nike, Philips, Renault, Solvay, Unilever), Core Philanthropic Partners (SUN, MAVA, players of People's Postcode Lottery) and its CE100 network (businesses, universities, emerging innovators, governments, cities, affiliate organisations) to build capacity, explore collaboration opportunities and develop circular business initiatives.

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